Appendix I Hydrology Reports (Revised)

ATKINS

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Date: September 13, 2011

To: Terri Rahhal, City of San Bernardino Community Development Department

From: Julian Capata, Associate Manager

Subject: Palm/Industrial Distribution Center Updated Hydrology Technical Study and Water Quality Management Plan

Atkins technical staff has reviewed the updated Hydrology Technical Report and Water Quality Management Plan as recently submitted to the City. The updated report and plan demonstrate minor differences in the runoff calculations as reported in the Draft EIR circulated for the proposed project. However, it is our expert opinion that the minor differences do not change the significance findings as reported.

Julian Capata, Associate Manager
Atkins North America/Environmental West

Hydrology and Hydraulics Study (Revised)

PRELIMINARY HYDROLOGY CALCULATIONS

FOR

682K DISTRIBUTION FACILITY
PALM AVENUE AND INDUSTRIAL PARKWAY
SAN BERNARDINO COUNTY, CALIFORNIA
SCHEME 1D

PREPARED FOR

IDS REAL ESTATE GROUP/ HURD TRUST
515 S. FIGUEROA STREET, 16TH FLOOR
LOS ANGELES, CALIFORNIA 90071
P. (213) 362-9300
FAX. (213) 627-2138

PREPARED:

MARCH 10, 2011

JOB NO. 3032

PREPARED BY

THIENES ENGINEERING
14349 FIRESTONE BLVD.
LA MIRADA, CALIFORNIA 90638
P. (714) 521- 4811
FAX. (714) 521- 4173

PRELIMINARY HYDROLOGY CALCULATIONS

FOR

682 K DISTRIBUTION FACILITY
PALM AVENUE AND INDUSTRIAL PARKWAY

PREPARED BY BRIAN WEIL
UNDER THE SUPERVISION OF

REINHARD STENZEL DATE:
R.C.E. 56155
EXP. 12/31/12

Introduction

A preliminary hydrologic analysis for the IDS Real Estate Group – 682K Distribution Facility project has been completed. The project site is located west of Interstate 215, east of Industrial Parkway, and south of Palm Avenue in unincorporated San Bernardino County, California. The project site encompasses approximately 40 acres and designed to sheet flow southeasterly to Industrial Parkway. Improvements to the project site include a realignment of Industrial Parkway and Palm Avenue.

Discussion

The site is currently an undeveloped parcel of land. It is proposed that the site be developed as a business park with a large industrial warehouse building as well as associated parking areas and truck docks.

An onsite storm drain system is proposed to collect storm water runoff and convey flows in three detention basins situated in different locations of the site. The first basin (Basin "A") is located at the northerly portion of the project site and serves approximately 5.5 acres of the northerly portion of the site. These flows will be discharged through a parkway culvert to Industrial Parkway. The second basin (Basin "B") is located southwesterly of the proposed site and will collect flows from the westerly half of the site with an approximate area of 12.6 acres. The third basin (Basin "C") is located south easterly of the site and will collect flows from the easterly half and southerly portion of the site with an approximate area of 13.6 acres. Flow discharges from Basins "B" and "C" will drain to Industrial Parkway via a parkway culvert. The side slope and access road on the southerly portion of the site sheet flows to Industrial Parkway.

The three basins are used for both water quality purposes and to detain some of the 100-year peak flow rate. Offsite runoff from the Freeway will not drain to the onsite basins since this runoff does not need to be treated within the project site.

Under existing conditions, the site accepts drainage from Interstate 215 and areas between the Freeway and the site. Proposed conditions will continue to accept this runoff.

Hydrologic Analysis

The hydrologic analysis was completed in accordance with the San Bernardino County Hydrology Manual. Rational method analyses (by AES Software) were completed for the 100-year return event.

The site is situated within hydrologic soil types "A" and "D" as identified in the Hydrology Manual. A "Commercial" land use type has been assumed for the site and adjacent areas in the hydrologic analysis. Based on the isohyetal map in the Hydrology Manual, the 100-year 1-hour rainfall has been determined to be 1.40" and the slope of rainfall intensity – duration is 0.60.

A rational method hydrologic analysis was completed. The onsite hydrologic analysis was prepared to determine the 100-year peak flow rates generated by the site. Offsite runoff was incorporated into the rational method study.

Detention analysis was also calculated using AES software. The lower portion of the basin is used for water quality purposes. An outlet will be designed to discharge runoff once the water quality volume is achieved.

Please see Appendix "B" for hydrology calculations and Appendix "C" for detention analysis.

Runoff tributary to Industrial Parkway was previously determined in a study prepared by L.A. Wainscott & Associates, Inc. This study tabled a majority of the project site to Industrial Parkway with the remaining portion tabled to discharge near the Freeway. The overall peak flow rate tributary to Industrial Parkway in this study (adjacent to the southerly limits of the project site) is about 115 cfs. The study considered the site as commercial development. Please see Appendix "A" for portions of this study.

Summary of Results

The northerly portion of the site and offsite area (nodes 100-133 as shown on the hydrology map) ultimately discharge to Industrial Avenue. The 100-year peak flow rate (undetained) is approximately 41.8 cfs. The basin provides storage for about 9.0 cfs during the 100-year event. Overall runoff to the street at this location is about 32.8 cfs.

The westerly portion of the site (nodes 200-203) totals approximately 11.0 acres and produces a 100-year peak flow of 35.1 cfs. The easterly and southerly portion of the site (nodes 300-313) totals approximately 13.3 acres and produces a 100-year peak flow rate of 37.3 cfs. Total flow tributary to Basins "B" and "C" is approximately 69.2 cfs (undetained). Discharge from Basin "B" drains to Industrial Parkway via a parkway culvert. With detention, flow to Industrial parkway at this location is approximately 55.0 cfs.

Runoff from the easterly sideslope and portions of Interstate 215 (nodes 400-402) will continue to drain southeasterly along the Freeway. The 100-year peak flow rate is approximately 6.9 cfs.

A hydrologic model was established to determine all runoff from the site, Industrial Parkway and the proposed sideslopes adjacent to Industrial Parkway (nodes 500-503). The model incorporates street runoff and adds in the flows discharged from the detention basins. All flow is routed southerly in the street. The overall peak flow rate is approximately 106.0 cfs.

With detention, runoff from the project site discharging to Industrial Parkway is less than what was previously approved. Also, typical street sections for Industrial Parkway can convey the 100-year peak flow rate within the street right-of-way.

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CIVIL ENGINEERING • LAND SURVEYING
14349 FIRESTONE BOULEVARD
LA MIRADA, CALIFORNIA 90638
PH.(714)521-4811 FAX(714)521-4173

"VICINITY MAP"

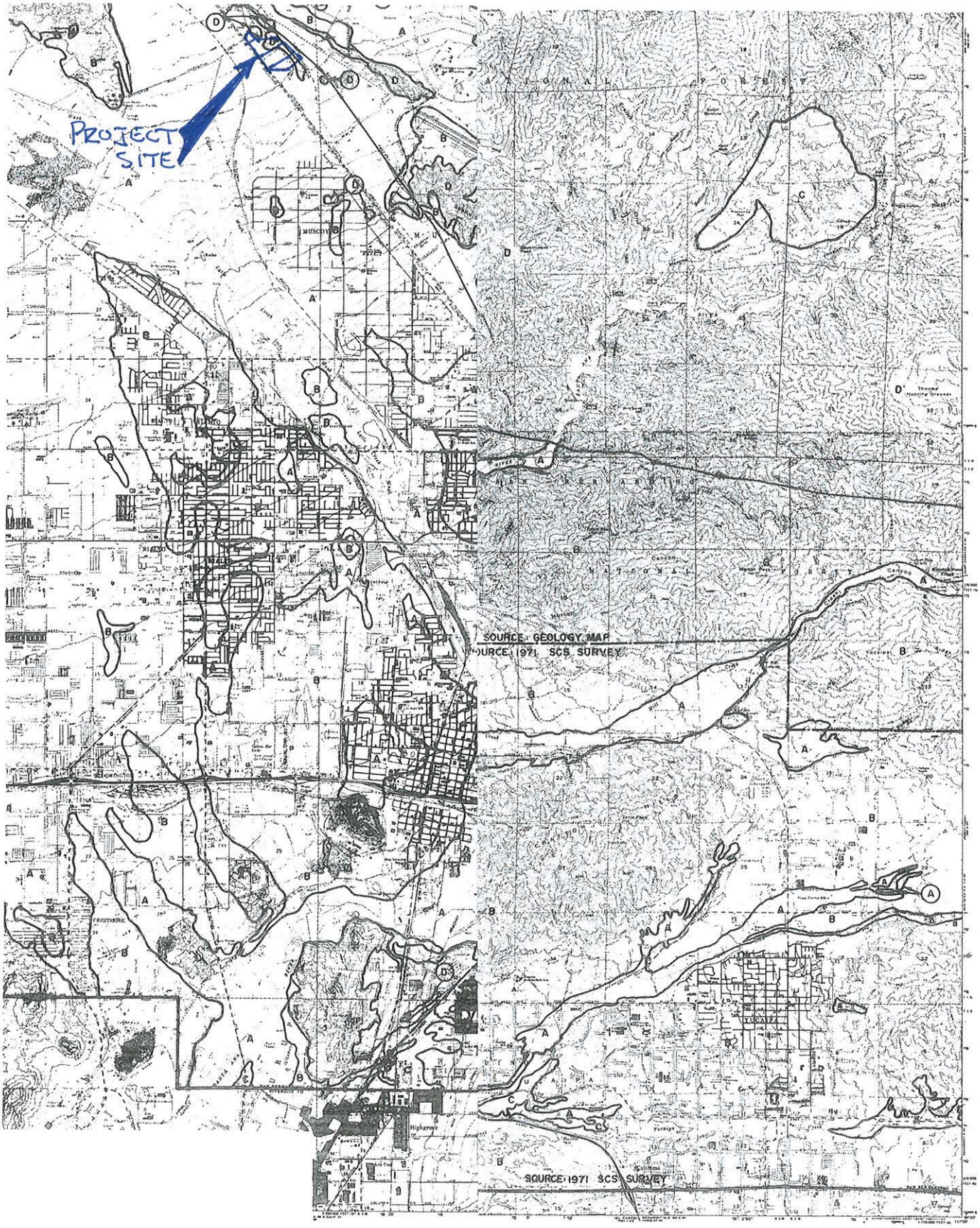
FOR

PALM AVENUE DISTRIBUTION CENTER

APPENDIX	DESCRIPTION
A	REFERENCE CALCULATIONS
B	HYDROLOGY CALCULATIONS
C	DETENTION ANALYSIS
D	HYDROLOGY MAP

APPENDIX A

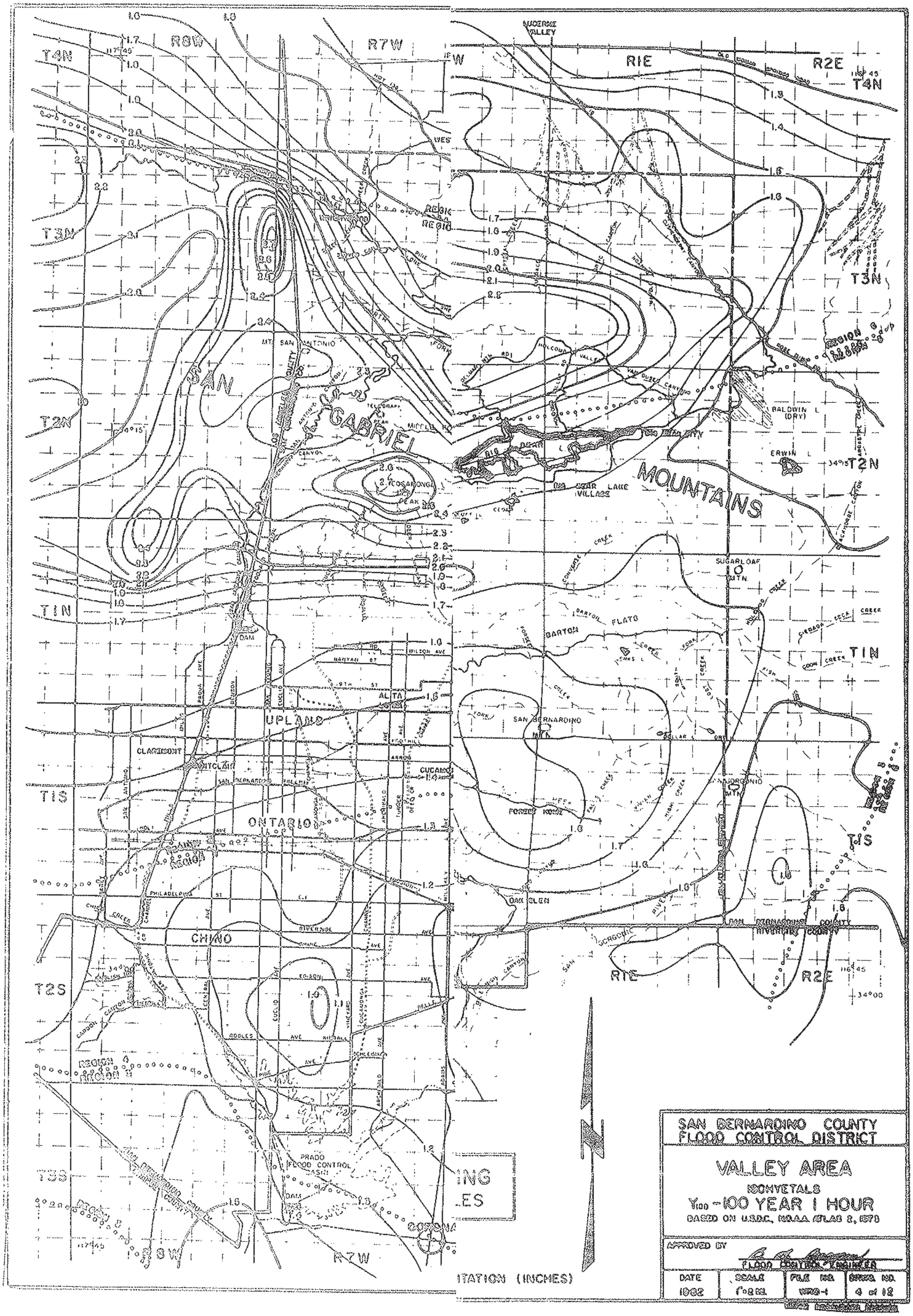
REFERENCE MATERIAL



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

HYDROLOGIC SOILS GROUP MAP
FOR
SOUTHWEST-D AREA

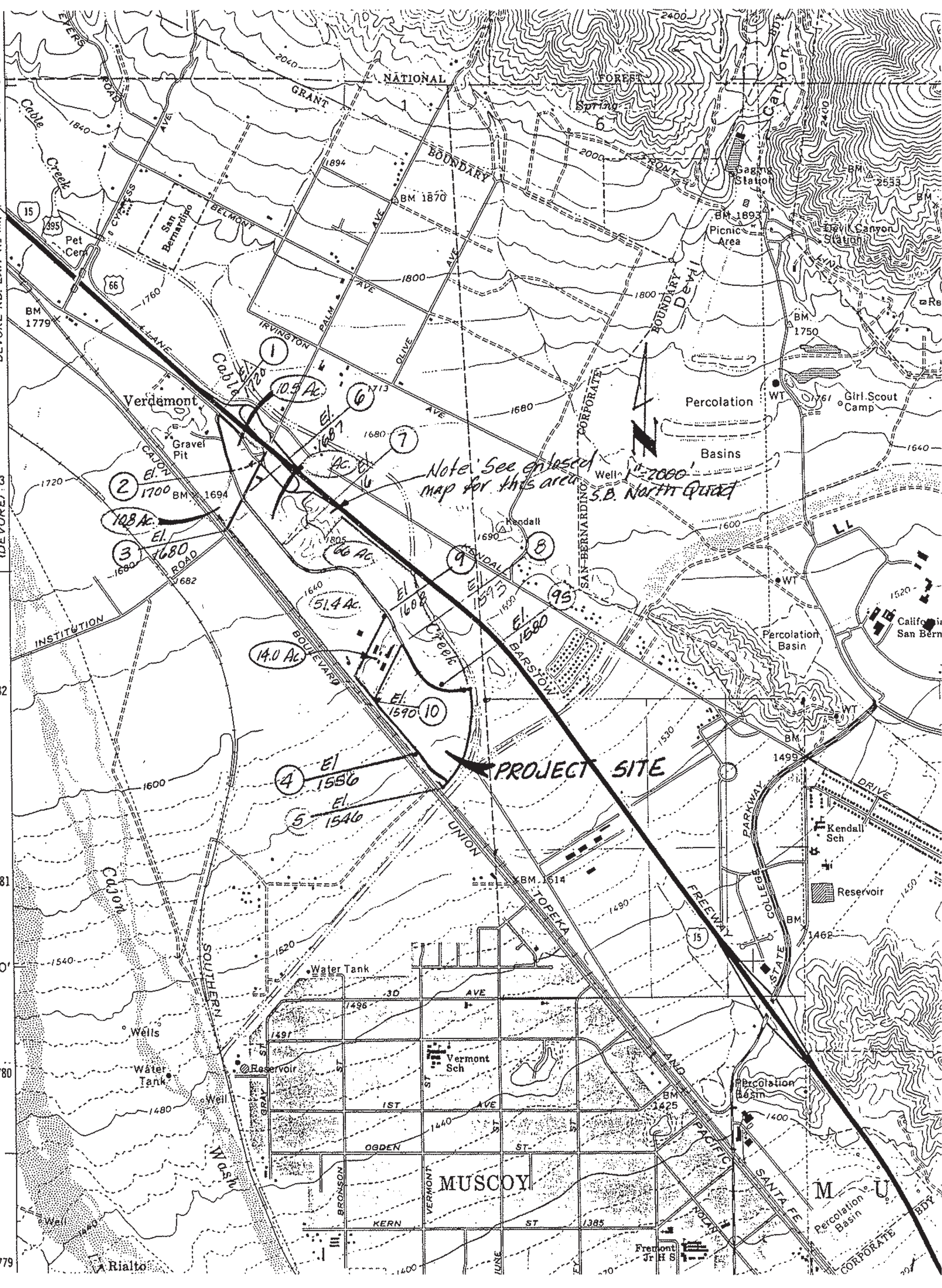
FIGURE C-16


SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT
VALLEY AREA
ISOHYETALS
Y100 - 100 YEAR 1 HOUR
BASED ON U.S.D.C., N.O.A.A. ATLAS 2, 1973
APPROVED BY
FLOOD CONTROL ENGINEER
DATE
1982
SCALE
FILE NO.
DWG. NO.
4 of 18
SAN GABRIEL MOUNTAINS
UPLAND
CLAREMONT
MONTCLAIR
ONTARIO
CHINO
ALTA
CUCAMONGA
SAN BERNARDINO MTN.
SAN GORGONIO MTN.
SUGARLOAF MTN.
BARTON FLATS
FOREST HOME
OAK GLEN
BALDWIN L. (DRY)
ERWIN L.
BIG BEAR LAKE VILLAGE
MT. SAN ANTONIO
CUCAMONGA PEAK
PRADO FLOOD CONTROL BASIN
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
T4N
T3N
T2N
T1N
T1S
T2S
T3S
R8W
R7W
R1E
R2E
ITATION (INCHES)

HYDROLOGY REPORT

L A WAINSCOTT & ASSOCIATES, INC.
LAND PLANNERS • CIVIL ENGINEERS • LAND SURVEYORS
22400 BARTON ROAD, SUITE 200, GRAND TERRACE, CA. 92324
TELEPHONE (714) 824-1779

W.O. 324.02


NATIONAL
FOREST
GRANT
BOUNDARY
FRONT
Spring
Canyon
Gaging Station
Picnic Area
Devil Canyon Station
Girl Scout Camp
Percolation
Basins
Percolation Basin
Kendall
Kendall Sch
Reservoir
Water Tank
Vermont Sch
Wells
Well
Fremont Jr H S
Rialto
MUSCOY
Verdemont
Gravel Pit
Pet Cem
Cable Creek
Cajon Wash
CYPRESS
AVE
BELMONT
San Bernardino
PALM
OLIVE
IRVINGTON
LANE
INSTITUTION
CAJON
ROAD
BOULEVARD
UNION
TOPEKA
SOUTHERN
PACIFIC
SANTA FE
AND
BARSTOW
FREEWAY
KENDALL
PARKWAY
STATE
COLLEGE
DRIVE
CORPORATE
SAN BERNARDINO
BOUNDARY
3D AVE
1ST AVE
OGDEN ST
KERN ST
GRAY ST
BRONSON
VERMONT
NOLAN
CORPORATE BDY
DEVORE RD. EXIT 1.9 MI.
(DEVORE)
BM 1870
BM 1893
BM 1779
BM 1694
BM 1750
BM 1499
BM 1514
BM 1425
BM 1462
15
395
66
Note: See enclosed map for this area 1"=2000' S.B. North Quad
PROJECT SITE
1 El 1720
2 El. 1700
3 El. 1680
4 El 1556
5 El. 1546
6 El. 1687
7 El
8
9 El 1608
95 El. 1595
El. 1580
10 El. 1590
10.5 Ac.
108 Ac.
66 Ac.
51.4 Ac.
14.0 Ac.
Ac.

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==========================================================================
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
                      SAN BERNARDINO COUNTY (SBC)
                        1983 HYDROLOGY MANUAL
==========================================================================

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

          (C) Copyright 1983 Advanced Engineering Software [AES]

                        Especially prepared for:

                    L A WAINSCOTT & ASSOCIATES, INC.

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

**********DESCRIPTION OF RESULTS**********************************************
* HYDROLOGY FOR SAN BERNARDINO STEEL IN NORTHWEST SAN BERNARDINO             *
* 100-YEAR STORM EVENT, ULTIMATE CONDITION                                  *
* FILE NAME: 149.20        W. O. NUMBER: 324.02                             *
*****************************************************************************

----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE =  .90
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.000
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.500
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =  100.00   1-HOUR INTENSITY(INCH/HOUR) = 1.5000
  SLOPE OF INTENSITY DURATION CURVE =  .6000

  SBC HYDROLOGY MANUAL "C"-VALUES USED

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

                    Advanced Engineering Software [AES]
                          SERIAL No. L1703
                    REV. 3.0      RELEASE DATE: 5/17/83

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**************************************************************************
  FLOW PROCESS FROM NODE     1.00 TO NODE     2.00 IS CODE =   2
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH =  1000.00
  UPSTREAM ELEVATION =   1720.00
  DOWNSTREAM ELEVATION =   1700.00
  ELEVATION DIFFERENCE =     20.00
  TC =  .303*[( 1000.00**3)/(    20.00)]**.2 =   10.505
   100.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.267
  SOIL CLASSIFICATION IS "A"
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8353
```

```
 SUBAREA RUNOFF(CFS) =     37.43
 TOTAL AREA(ACRES) =     10.50   TOTAL RUNOFF(CFS) =     37.43

****************************************************************************
 FLOW PROCESS FROM NODE     2.00 TO NODE     3.00 IS CODE =   6
----------------------------------------------------------------------------
 >>>>>COMPUTE STREETFLOW TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM ELEVATION =   1700.00   DOWNSTREAM ELEVATION =   1680.00
 STREET LENGTH(FEET) =  1000.00   CURB HEIGTH(INCHES) = 8.
 STREET HALFWIDTH(FEET) = 12.00   STREET CROSSFALL(DECIMAL) = .0200
 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
       **TRAVELTIME COMPUTED USING MEAN FLOW(CFS) =   54.50
           ***STREET FLOWING FULL***
       STREET FLOWDEPTH(FEET) =   .58
       HALFSTREET FLOODWIDTH(FEET) =   12.00
       AVERAGE FLOW VELOCITY(FEET/SEC.) =    7.07
       PRODUCT OF DEPTH&VELOCITY =    4.13
 STREETFLOW TRAVELTIME(MIN) =   2.36   TC(MIN) =  12.86

  100.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.779
 SOIL CLASSIFICATION IS "A"
 COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8334
 SUBAREA AREA(ACRES) =   10.80   SUBAREA RUNOFF(CFS) =   34.01
 SUMMED AREA(ACRES) =   21.30   TOTAL RUNOFF(CFS) =    71.44
 END OF SUBAREA STREETFLOW HYDRAULICS:
 DEPTH(FEET) =  .64   HALFSTREET FLOODWIDTH(FEET) = 12.00
 FLOW VELOCITY(FEET/SEC.) =  7.83   DEPTH*VELOCITY =   5.03

****************************************************************************
 FLOW PROCESS FROM NODE     3.00 TO NODE     4.00 IS CODE =   5
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL-CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION =   1680.00
 DOWNSTREAM NODE ELEVATION =   1556.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =  5400.00
 CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =   4.000
 MANNINGS FACTOR =  .030   MAXIMUM DEPTH(FEET) =   4.00
 CHANNEL FLOW THRU SUBAREA(CFS) =    71.44
 FLOW VELOCITY(FEET/SEC) =   5.91   FLOW DEPTH(FEET) =    .89
 TRAVEL TIME(MIN.) =  15.22   TC(MIN.) =  28.08

****************************************************************************
 FLOW PROCESS FROM NODE     4.00 TO NODE     4.00 IS CODE =   8
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.366
 SOIL CLASSIFICATION IS "A"
 COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8234
 SUBAREA AREA(ACRES) =   51.40   SUBAREA RUNOFF(CFS) =  100.12
 TOTAL AREA(ACRES) =   72.70   TOTAL RUNOFF(CFS) =  171.56
 TC(MIN) =  28.08

****************************************************************************
 FLOW PROCESS FROM NODE     9.00 TO NODE    10.00 IS CODE =   2
----------------------------------------------------------------------------
```

```
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
------------------------------------------------------------------------------
          ASSUMED INITIAL SUBAREA UNIFORM
          DEVELOPMENT IS COMMERCIAL
   TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
   INITIAL SUBAREA FLOW-LENGTH =  1550.00
   UPSTREAM ELEVATION =   1608.00
   DOWNSTREAM ELEVATION =   1590.00
   ELEVATION DIFFERENCE =     18.00
   TC =  .303*[( 1550.00**3)/(    18.00)]**.2 =   13.955
    100.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.599
   SOIL CLASSIFICATION IS "A"
   COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8325
   SUBAREA RUNOFF(CFS) =     41.94
   TOTAL AREA(ACRES) =     14.00   TOTAL RUNOFF(CFS) =     41.94

******************************************************************************
   FLOW PROCESS FROM NODE     6.00 TO NODE     7.00 IS CODE =   2
------------------------------------------------------------------------------
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
------------------------------------------------------------------------------
          ASSUMED INITIAL SUBAREA UNIFORM
          DEVELOPMENT IS COMMERCIAL
   TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
   INITIAL SUBAREA FLOW-LENGTH =  2200.00
   UPSTREAM ELEVATION =   1687.00
   DOWNSTREAM ELEVATION =   1658.00
   ELEVATION DIFFERENCE =     29.00
   TC =  .303*[( 2200.00**3)/(    29.00)]**.2 =   15.652
    100.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.359
   SOIL CLASSIFICATION IS "A"
   COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8313
   SUBAREA RUNOFF(CFS) =     93.55
   TOTAL AREA(ACRES) =     33.50   TOTAL RUNOFF(CFS) =     93.55

******************************************************************************
   FLOW PROCESS FROM NODE     7.00 TO NODE     8.00 IS CODE =   6
------------------------------------------------------------------------------
   >>>>>COMPUTE STREETFLOW TRAVELTIME THRU SUBAREA<<<<<
------------------------------------------------------------------------------
   UPSTREAM ELEVATION =   1658.00   DOWNSTREAM ELEVATION =   1593.00
   STREET LENGTH(FEET) =  2600.00   CURB HEIGTH(INCHES) = 8.
   STREET HALFWIDTH(FEET) = 32.00   STREET CROSSFALL(DECIMAL) = .0150
   SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
          **TRAVELTIME COMPUTED USING MEAN FLOW(CFS) =  119.44
              ***STREET FLOWING FULL***
          NOTE: STREETFLOW EXCEEDS TOP OF CURB.
          THE FOLLOWING STREETFLOW RESULTS ARE BASED ON THE ASSUMPTION
          THAT NEGLIBLE FLOW OCCURS OUTSIDE OF THE STREET CHANNEL.
          THAT IS, ALL FLOW ALONG THE PARKWAY, ETC., IS NEGLECTED.
          STREET FLOWDEPTH(FEET) =    .68
          HALFSTREET FLOODWIDTH(FEET) =   32.00
          AVERAGE FLOW VELOCITY(FEET/SEC.) =    6.77
          PRODUCT OF DEPTH&VELOCITY =    4.59
   STREETFLOW TRAVELTIME(MIN) =   6.40   TC(MIN) =  22.05

    100.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.735
   SOIL CLASSIFICATION IS "A"
   COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8270
   SUBAREA AREA(ACRES) =   22.70   SUBAREA RUNOFF(CFS) =   51.34
   SUMMED AREA(ACRES) =   56.20   TOTAL RUNOFF(CFS) =   144.89
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 END OF SUBAREA STREETFLOW HYDRAULICS:
 DEPTH(FEET) =  .72   HALFSTREET FLOODWIDTH(FEET) = 32.00
 FLOW VELOCITY(FEET/SEC.) =  7.20   DEPTH*VELOCITY =   5.16


****************************************************************************
 FLOW PROCESS FROM NODE     8.00 TO NODE     9.00 IS CODE =   6
----------------------------------------------------------------------------
 >>>>>COMPUTE STREETFLOW TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM ELEVATION =   1593.00   DOWNSTREAM ELEVATION =   1580.00
 STREET LENGTH(FEET) =  1300.00   CURB HEIGTH(INCHES) = 8.
 STREET HALFWIDTH(FEET) = 32.00   STREET CROSSFALL(DECIMAL) = .0150
 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
       **TRAVELTIME COMPUTED USING MEAN FLOW(CFS) =  176.46
          ***STREET FLOWING FULL***
       NOTE: STREETFLOW EXCEEDS TOP OF CURB.
       THE FOLLOWING STREETFLOW RESULTS ARE BASED ON THE ASSUMPTION
       THAT NEGLIBLE FLOW OCCURS OUTSIDE OF THE STREET CHANNEL.
       THAT IS, ALL FLOW ALONG THE PARKWAY, ETC., IS NEGLECTED.
       STREET FLOWDEPTH(FEET) =   .85
       HALFSTREET FLOODWIDTH(FEET) =   32.00
       AVERAGE FLOW VELOCITY(FEET/SEC.) =    6.11
       PRODUCT OF DEPTH&VELOCITY =    5.21
 STREETFLOW TRAVELTIME(MIN) =   3.55   TC(MIN) =  25.60

  100.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.501
 SOIL CLASSIFICATION IS "A"
 COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8248
 SUBAREA AREA(ACRES) =   30.60   SUBAREA RUNOFF(CFS) =   63.12
 SUMMED AREA(ACRES) =   86.80   TOTAL RUNOFF(CFS) =   208.01
 END OF SUBAREA STREETFLOW HYDRAULICS:
 DEPTH(FEET) =  .91   HALFSTREET FLOODWIDTH(FEET) = 32.00
 FLOW VELOCITY(FEET/SEC.) =  6.37   DEPTH*VELOCITY =   5.81


****************************************************************************
 FLOW PROCESS FROM NODE    10.00 TO NODE    11.00 IS CODE =   2
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
       ASSUMED INITIAL SUBAREA UNIFORM
       DEVELOPMENT IS COMMERCIAL
 TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
 INITIAL SUBAREA FLOW-LENGTH =  2400.00
 UPSTREAM ELEVATION =   1672.00
 DOWNSTREAM ELEVATION =   1630.00
 ELEVATION DIFFERENCE =     42.00
 TC =  .303*[( 2400.00**3)/(    42.00)]**.2 =   15.313
  100.00 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.404
 SOIL CLASSIFICATION IS "A"
 COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8315
 SUBAREA RUNOFF(CFS) =    62.26
 TOTAL AREA(ACRES) =    22.00   TOTAL RUNOFF(CFS) =    62.26
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

T46-E3

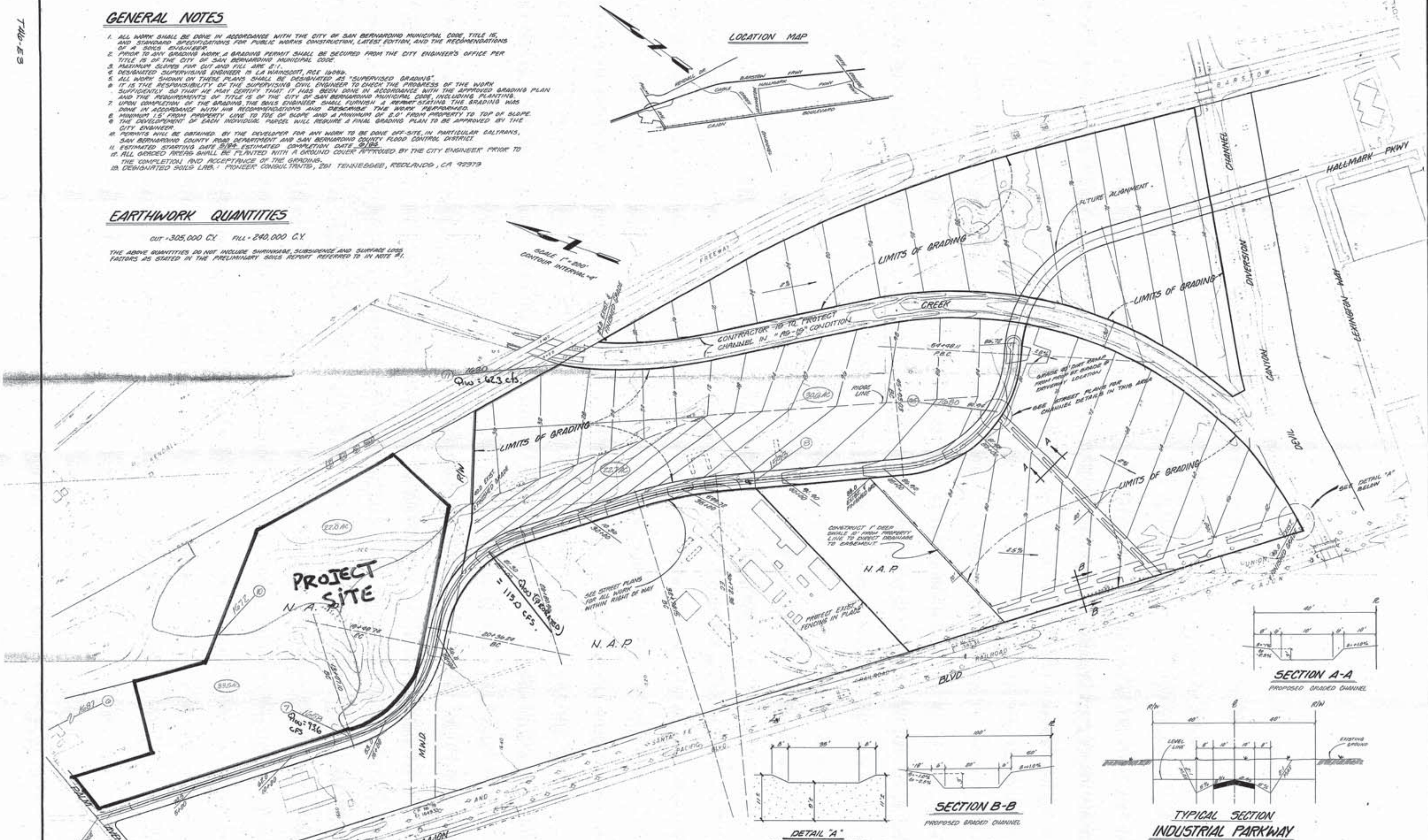
GENERAL NOTES

1. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE CITY OF SAN BERNARDINO MUNICIPAL CODE, TITLE 15, AND STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION, LATEST EDITION, AND THE RECOMENDATIONS OF A SOILS ENGINEER.
2. PRIOR TO ANY GRADING WORK, A GRADING PERMIT SHALL BE SECURED FROM THE CITY ENGINEER'S OFFICE PER TITLE 15 OF THE CITY OF SAN BERNARDINO MUNICIPAL CODE.
3. MAXIMUM SLOPES FOR CUT AND FILL ARE 2:1.
4. DESIGNATED SUPERVISING ENGINEER IS L.A. WAINSCOTT, RCE 16056.
5. ALL WORK SHOWN ON THESE PLANS SHALL BE DESIGNATED AS "SUPERVISED GRADING".
6. IT IS THE RESPONSIBILITY OF THE SUPERVISING CIVIL ENGINEER TO CHECK THE PROGRESS OF THE WORK SUFFICIENTLY SO THAT HE MAY CERTIFY THAT IT HAS BEEN DONE IN ACCORDANCE WITH THE APPROVED GRADING PLAN AND THE REQUIREMENTS OF TITLE 15 OF THE CITY OF SAN BERNARDINO MUNICIPAL CODE, INCLUDING PLANTING.
7. UPON COMPLETION OF THE GRADING, THE SOILS ENGINEER SHALL FURNISH A REPORT STATING THE GRADING WAS DONE IN ACCORDANCE WITH HIS RECOMMENDATIONS AND DESCRIBE THE WORK PERFORMED.
8. MINIMUM 1.5' FROM PROPERTY LINE TO TOE OF SLOPE AND A MINIMUM OF 2.0' FROM PROPERTY TO TOP OF SLOPE.
9. THE DEVELOPEMENT OF EACH INDIVIDUAL PARCEL WILL REQUIRE A FINAL GRADING PLAN TO BE APPROVED BY THE CITY ENGINEER.
10. PERMITS WILL BE OBTAINED BY THE DEVELOPER FOR ANY WORK TO BE DONE OFF-SITE, IN PARTICULAR CALTRANS, SAN BERNARDINO COUNTY ROAD DEPARTMENT AND SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT.
11. ESTIMATED STARTING DATE 5/84 ESTIMATED COMPLETION DATE 9/84
12. ALL GRADED AREAS SHALL BE PLANTED WITH A GROUND COVER APPROVED BY THE CITY ENGINEER PRIOR TO THE COMPLETION AND ACCEPTANCE OF THE GRADING.
13. DESIGNATED SOILS LAB.: PIONEER CONSULTANTS, 261 TENNESSEE, REDLANDS, CA 92373

EARTHWORK QUANTITIES

CUT = 305,000 C.Y. FILL = 240,000 C.Y.

THE ABOVE QUANTITIES DO NOT INCLUDE SHRINKAGE, SUBSIDENCE AND SURFACE LOSS FACTORS AS STATED IN THE PRELIMINARY SOILS REPORT REFERRED TO IN NOTE #1.



L A WAINSCOTT & ASSOCIATES, INC.
CIVIL ENGINEERS • LAND PLANNERS • LAND SURVEYORS

APPROVED BY L.A. Wainscott DATE 4-23-84

FOR JESSE HUBBS & SONS

MARK	REVISIONS	APPR.	DATE

DESIGNED BY BERNIE DRAWN BY CHRISTIE CHECKED BY EBS

BENCH MARK: USC & GS B.M. # D-40

APPROVED (GRADING ONLY) 5-10 1984
DIRECTOR OF PUBLIC WORKS/CITY ENGINEER
REGISTERED CIVIL ENGINEER NO.

DRAWING NO. 6529

DRAWN BY
CHECKED BY
RECOMENDED

DEPARTMENT OF PUBLIC WORKS
CITY OF SAN BERNARDINO
ROUGH CONTOUR GRADING PLANS

SHT. 1 OF 1
W.O. 149.20-C

T46-E3

APPENDIX B

HYDROLOGY CALCULATIONS

```
**************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
       (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
      (c) Copyright 1983-99 Advanced Engineering Software (aes)
          Ver. 8.0  Release Date: 01/01/99  License ID 1435

                        Analysis prepared by:

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 ************************** DESCRIPTION OF STUDY **************************
* PROPOSED DEVEOPMENT                                                     *
* AT INDUSTRIAL PARKWAY AND PALM                                          *
* NODES 100-133                                                           *
 **************************************************************************

  FILE NAME: C:\XDRIVE\3032\3032A.DAT
  TIME/DATE OF STUDY: 09:16 03/08/2011
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.4000

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*


**************************************************************************
  FLOW PROCESS FROM NODE     100.00 TO NODE     111.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   560.00
  ELEVATION DATA: UPSTREAM(FEET) =   1692.18  DOWNSTREAM(FEET) =   1681.19

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.387
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.559
  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        3.10      0.80        0.10    52    8.39
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.80
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA RUNOFF(CFS) =     12.50
  TOTAL AREA(ACRES) =      3.10   PEAK FLOW RATE(CFS) =     12.50

**************************************************************************
  FLOW PROCESS FROM NODE     111.00 TO NODE     111.00 IS CODE =   1
--------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
==========================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   8.39
  RAINFALL INTENSITY(INCH/HR) =   4.56
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.80
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =    3.10
  TOTAL STREAM AREA(ACRES) =    3.10
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     12.50

**************************************************************************
  FLOW PROCESS FROM NODE     110.00 TO NODE     111.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
```

```
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   420.00
 ELEVATION DATA: UPSTREAM(FEET) =   1697.70  DOWNSTREAM(FEET) =   1681.19

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.505
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.310
 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        1.10      0.80       0.10     52    6.51
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.80
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =      5.18
 TOTAL AREA(ACRES) =      1.10   PEAK FLOW RATE(CFS) =      5.18

****************************************************************************
 FLOW PROCESS FROM NODE    110.00 TO NODE    111.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN) =   6.51
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.310
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL GOOD COVER
 "GRASS"                     A        0.60      0.72       1.00     58
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.72
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.00
 SUBAREA AREA(ACRES) =     0.60      SUBAREA RUNOFF(CFS) =     2.48
 EFFECTIVE AREA(ACRES) =     1.70   AREA-AVERAGED Fm(INCH/HR) =  0.31
 AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.42
 TOTAL AREA(ACRES) =     1.70       PEAK FLOW RATE(CFS) =       7.65

****************************************************************************
 FLOW PROCESS FROM NODE    111.00 TO NODE    111.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   6.51
 RAINFALL INTENSITY(INCH/HR) =   5.31
 AREA-AVERAGED Fm(INCH/HR) =  0.31
 AREA-AVERAGED Fp(INCH/HR) =  0.74
 AREA-AVERAGED Ap =  0.42
 EFFECTIVE STREAM AREA(ACRES) =    1.70
 TOTAL STREAM AREA(ACRES) =    1.70
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      7.65

 ** CONFLUENCE DATA **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)        (ACRES)     NODE
     1     12.50   8.39    4.559  0.80( 0.08) 0.10      3.1      100.00
     2      7.65   6.51    5.310  0.74( 0.31) 0.42      1.7      110.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)        (ACRES)     NODE
     1     19.00   8.39    4.559  0.75( 0.16) 0.21      4.8      100.00
     2     18.97   6.51    5.310  0.75( 0.17) 0.23      4.1      110.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =     19.00    Tc(MIN.) =     8.39
 EFFECTIVE AREA(ACRES) =     4.80   AREA-AVERAGED Fm(INCH/HR) =  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.75  AREA-AVERAGED Ap =  0.21
 TOTAL AREA(ACRES) =      4.80
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    111.00 =   560.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    111.00 TO NODE    112.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
```

```
 ELEVATION DATA: UPSTREAM(FEET) =  1678.00  DOWNSTREAM(FEET) =  1676.90
 FLOW LENGTH(FEET) =    12.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  15.0 INCH PIPE IS  12.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  17.71
 ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     19.00
 PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =   8.40
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    112.00 =   572.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    111.00 TO NODE    112.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN) =   8.40
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.555
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL GOOD COVER
 "GRASS"                     A        0.70      0.72       1.00    58
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.72
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.00
 SUBAREA AREA(ACRES) =    0.70      SUBAREA RUNOFF(CFS) =    2.41
 EFFECTIVE AREA(ACRES) =    5.50   AREA-AVERAGED Fm(INCH/HR) =  0.23
 AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.31
 TOTAL AREA(ACRES) =    5.50       PEAK FLOW RATE(CFS) =      21.40

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)        (ACRES)     NODE
     1      21.40   8.40    4.555  0.74( 0.23) 0.31      5.5      100.00
     2      21.84   6.52    5.304  0.74( 0.25) 0.34      4.8      110.00
 NEW PEAK FLOW DATA ARE:
 PEAK FLOW RATE(CFS) =     21.84  Tc(MIN.) =   6.52
 AREA-AVERAGED Fm(INCH/HR) =  0.25  AREA-AVERAGED Fp(INCH/HR) =  0.74
 AREA-AVERAGED Ap =  0.34  EFFECTIVE AREA(ACRES) =      4.80

****************************************************************************
 FLOW PROCESS FROM NODE    112.00 TO NODE    123.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1675.00  DOWNSTREAM(FEET) =  1674.00
 FLOW LENGTH(FEET) =   190.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  27.0 INCH PIPE IS  22.1 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   6.28
 ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     21.84
 PIPE TRAVEL TIME(MIN.) =   0.50    Tc(MIN.) =   7.02
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    123.00 =   762.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    123.00 TO NODE    123.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =   7.02
 RAINFALL INTENSITY(INCH/HR) =   5.07
 AREA-AVERAGED Fm(INCH/HR) =  0.25
 AREA-AVERAGED Fp(INCH/HR) =  0.74
 AREA-AVERAGED Ap =  0.34
 EFFECTIVE STREAM AREA(ACRES) =    4.80
 TOTAL STREAM AREA(ACRES) =    5.50
 PEAK FLOW RATE(CFS) AT CONFLUENCE =     21.84

****************************************************************************
 FLOW PROCESS FROM NODE    120.00 TO NODE    121.00 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) =   1698.00  DOWNSTREAM(FEET) =   1683.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.419
```

```
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.925
 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.)
 NATURAL GOOD COVER
 "GRASS"                     A        1.50      0.72       1.00    58   16.67
 COMMERCIAL                  A        0.50      0.80       0.10    52    5.42
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.73
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.77
 SUBAREA RUNOFF(CFS) =      9.65
 TOTAL AREA(ACRES) =      2.00   PEAK FLOW RATE(CFS) =      9.65

****************************************************************************
 FLOW PROCESS FROM NODE    121.00 TO NODE    122.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1683.00  DOWNSTREAM(FEET) =  1682.00
 FLOW LENGTH(FEET) =    80.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   7.26
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      9.65
 PIPE TRAVEL TIME(MIN.) =   0.18    Tc(MIN.) =   5.60
 LONGEST FLOWPATH FROM NODE    120.00 TO NODE    122.00 =   380.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    121.00 TO NODE    122.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN) =   5.60
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.807
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL GOOD COVER
 "GRASS"                     A        1.20      0.72       1.00    58
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.72
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.00
 SUBAREA AREA(ACRES) =    1.20      SUBAREA RUNOFF(CFS) =    5.49
 EFFECTIVE AREA(ACRES) =     3.20   AREA-AVERAGED Fm(INCH/HR) =  0.62
 AREA-AVERAGED Fp(INCH/HR) =  0.73  AREA-AVERAGED Ap =  0.86
 TOTAL AREA(ACRES) =     3.20       PEAK FLOW RATE(CFS) =      14.93

****************************************************************************
 FLOW PROCESS FROM NODE    122.00 TO NODE    123.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1680.00  DOWNSTREAM(FEET) =  1674.00
 FLOW LENGTH(FEET) =   335.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   9.36
 ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     14.93
 PIPE TRAVEL TIME(MIN.) =   0.60    Tc(MIN.) =   6.20
 LONGEST FLOWPATH FROM NODE    120.00 TO NODE    123.00 =   715.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    123.00 TO NODE    123.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   6.20
 RAINFALL INTENSITY(INCH/HR) =   5.47
 AREA-AVERAGED Fm(INCH/HR) =  0.62
 AREA-AVERAGED Fp(INCH/HR) =  0.73
 AREA-AVERAGED Ap =  0.86
 EFFECTIVE STREAM AREA(ACRES) =    3.20
 TOTAL STREAM AREA(ACRES) =    3.20
 PEAK FLOW RATE(CFS) AT CONFLUENCE =     14.93

 ** CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
```

```
 NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)        (ACRES)     NODE
    1      21.40   8.90     4.399  0.74( 0.23) 0.31      5.5      100.00
    1      21.84   7.02     5.072  0.74( 0.25) 0.34      4.8      110.00
    2      14.93   6.20     5.465  0.73( 0.62) 0.86      3.2      120.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)        (ACRES)     NODE
    1      35.55   7.02     5.072  0.73( 0.40) 0.55      8.0      110.00
    2      33.04   8.90     4.399  0.73( 0.38) 0.51      8.7      100.00
    3      35.79   6.20     5.465  0.73( 0.41) 0.57      7.4      120.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =     35.79    Tc(MIN.) =     6.20
 EFFECTIVE AREA(ACRES) =     7.44   AREA-AVERAGED Fm(INCH/HR) =  0.41
 AREA-AVERAGED Fp(INCH/HR) =  0.73  AREA-AVERAGED Ap =  0.57
 TOTAL AREA(ACRES) =      8.70
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    123.00 =   762.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    123.00 TO NODE    132.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1674.00  DOWNSTREAM(FEET) =  1673.00
 FLOW LENGTH(FEET) =    83.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  30.0 INCH PIPE IS  20.6 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   9.96
 ESTIMATED PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     35.79
 PIPE TRAVEL TIME(MIN.) =   0.14    Tc(MIN.) =   6.34
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    132.00 =   845.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    132.00 TO NODE    132.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =   6.34
 RAINFALL INTENSITY(INCH/HR) =   5.39
 AREA-AVERAGED Fm(INCH/HR) =  0.41
 AREA-AVERAGED Fp(INCH/HR) =  0.73
 AREA-AVERAGED Ap =  0.57
 EFFECTIVE STREAM AREA(ACRES) =    7.44
 TOTAL STREAM AREA(ACRES) =    8.70
 PEAK FLOW RATE(CFS) AT CONFLUENCE =     35.79

****************************************************************************
 FLOW PROCESS FROM NODE    130.00 TO NODE    131.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   252.00
 ELEVATION DATA: UPSTREAM(FEET) =   1688.90  DOWNSTREAM(FEET) =   1682.40

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.769
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.706
 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        0.80      0.80       0.10     52    5.77
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.80
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =      4.05
 TOTAL AREA(ACRES) =      0.80   PEAK FLOW RATE(CFS) =      4.05

****************************************************************************
 FLOW PROCESS FROM NODE    131.00 TO NODE    132.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
```

```
 ELEVATION DATA: UPSTREAM(FEET) =  1676.70  DOWNSTREAM(FEET) =  1673.00
 FLOW LENGTH(FEET) =    93.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.6 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   9.17
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      4.05
 PIPE TRAVEL TIME(MIN.) =   0.17    Tc(MIN.) =   5.94
 LONGEST FLOWPATH FROM NODE    130.00 TO NODE    132.00 =   345.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    132.00 TO NODE    132.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   5.94
 RAINFALL INTENSITY(INCH/HR) =   5.61
 AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.80
 AREA-AVERAGED Ap =  0.10
 EFFECTIVE STREAM AREA(ACRES) =    0.80
 TOTAL STREAM AREA(ACRES) =    0.80
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      4.05

 ** CONFLUENCE DATA **
  STREAM      Q     Tc   Intensity   Fp(Fm)     Ap   Ae     HEADWATER
  NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)        (ACRES)    NODE
     1     35.55   7.16    5.013  0.73( 0.40) 0.55     8.0     110.00
     1     33.04   9.05    4.356  0.73( 0.38) 0.51     8.7     100.00
     1     35.79   6.34    5.393  0.73( 0.41) 0.57     7.4     120.00
     2      4.05   5.94    5.608  0.80( 0.08) 0.10     0.8     130.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q     Tc   Intensity   Fp(Fm)     Ap   Ae     HEADWATER
  NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)        (ACRES)    NODE
     1     39.68   6.34    5.393  0.73( 0.38) 0.52     8.2     120.00
     2     39.17   7.16    5.013  0.73( 0.37) 0.51     8.8     110.00
     3     36.18   9.05    4.356  0.73( 0.35) 0.48     9.5     100.00
     4     39.03   5.94    5.608  0.73( 0.38) 0.52     7.8     130.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =     39.68    Tc(MIN.) =     6.34
 EFFECTIVE AREA(ACRES) =     8.24   AREA-AVERAGED Fm(INCH/HR) =  0.38
 AREA-AVERAGED Fp(INCH/HR) =  0.73  AREA-AVERAGED Ap =  0.52
 TOTAL AREA(ACRES) =      9.50
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    132.00 =   845.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    132.00 TO NODE    133.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1672.03  DOWNSTREAM(FEET) =  1670.90
 FLOW LENGTH(FEET) =   195.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  36.0 INCH PIPE IS  24.4 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   7.78
 ESTIMATED PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     39.68
 PIPE TRAVEL TIME(MIN.) =   0.42    Tc(MIN.) =   6.76
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    133.00 =  1040.00 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =      9.50  TC(MIN.) =      6.76
 EFFECTIVE AREA(ACRES) =      8.24  AREA-AVERAGED Fm(INCH/HR)=  0.38
 AREA-AVERAGED Fp(INCH/HR) =  0.73  AREA-AVERAGED Ap =  0.52
 PEAK FLOW RATE(CFS)    =     39.68

 ** PEAK FLOW RATE TABLE **
  STREAM      Q     Tc   Intensity   Fp(Fm)     Ap   Ae     HEADWATER
  NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)        (ACRES)    NODE
     1     39.03   6.37    5.377  0.73( 0.38) 0.52     7.8     130.00
     2     39.68   6.76    5.191  0.73( 0.38) 0.52     8.2     120.00
     3     39.17   7.59    4.840  0.73( 0.37) 0.51     8.8     110.00
     4     36.18   9.48    4.235  0.73( 0.35) 0.48     9.5     100.00
```

END OF RATIONAL METHOD ANALYSIS

1

```
**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
         (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
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                        Analysis prepared by:

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 ************************** DESCRIPTION OF STUDY **************************
* PROPOSED DEVELOPMENT                                                    *
* AT INDUSTRIAL PARKWAY AND PALM                                          *
* NODES 200-315                                                           *
 **************************************************************************

  FILE NAME: C:\XDRIVE\3032\3032B.DAT
  TIME/DATE OF STUDY: 13:51 03/09/2011
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.4000

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*


**************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   457.00
  ELEVATION DATA: UPSTREAM(FEET) =   1693.90  DOWNSTREAM(FEET) =   1685.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.744
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.782
  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        3.10      0.80       0.10    52    7.74
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.80
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA RUNOFF(CFS) =     13.12
  TOTAL AREA(ACRES) =      3.10   PEAK FLOW RATE(CFS) =     13.12

**************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  61
--------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STANDARD CURB SECTION USED)<<<<<
==========================================================================
  UPSTREAM ELEVATION(FEET) = 1685.00  DOWNSTREAM ELEVATION(FEET) = 1683.50
  STREET LENGTH(FEET) =   305.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 80.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  40.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0148

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      19.28
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
         NOTE: STREET FLOW EXCEEDS TOP OF CURB.
         THE FOLLOWING STREET FLOW RESULTS ARE BASED ON THE ASSUMPTION
```

```
        THAT NEGLIBLE FLOW OCCURS OUTSIDE OF THE STREET CHANNEL.
        THAT IS, ALL FLOW ALONG THE PARKWAY, ETC., IS NEGLECTED.
    STREET FLOW DEPTH(FEET) =  0.67
    HALFSTREET FLOOD WIDTH(FEET) =   25.65
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.85
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.91
  STREET FLOW TRAVEL TIME(MIN.) =   1.78   Tc(MIN.) =   9.53
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.223
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  A        3.30      0.80        0.10    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.80
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA AREA(ACRES) =    3.30      SUBAREA RUNOFF(CFS) =   12.31
  EFFECTIVE AREA(ACRES) =    6.40    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.80  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =    6.40        PEAK FLOW RATE(CFS) =      23.86

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.72   HALFSTREET FLOOD WIDTH(FEET) =  27.86
  FLOW VELOCITY(FEET/SEC.) =  3.00   DEPTH*VELOCITY(FT*FT/SEC.) =   2.15
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =   762.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  61
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STANDARD CURB SECTION USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1683.50  DOWNSTREAM ELEVATION(FEET) = 1682.20
  STREET LENGTH(FEET) =   220.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 80.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  40.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0148

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      32.61
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
        NOTE: STREET FLOW EXCEEDS TOP OF CURB.
        THE FOLLOWING STREET FLOW RESULTS ARE BASED ON THE ASSUMPTION
        THAT NEGLIBLE FLOW OCCURS OUTSIDE OF THE STREET CHANNEL.
        THAT IS, ALL FLOW ALONG THE PARKWAY, ETC., IS NEGLECTED.
    STREET FLOW DEPTH(FEET) =  0.76
    HALFSTREET FLOOD WIDTH(FEET) =   30.30
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.48
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.66
  STREET FLOW TRAVEL TIME(MIN.) =   1.05   Tc(MIN.) =  10.58
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.965
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  A        5.00      0.80        0.10    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.80
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA AREA(ACRES) =    5.00      SUBAREA RUNOFF(CFS) =   17.49
  EFFECTIVE AREA(ACRES) =   11.40    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.80  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =   11.40        PEAK FLOW RATE(CFS) =      39.87

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.81   HALFSTREET FLOOD WIDTH(FEET) =  32.74
  FLOW VELOCITY(FEET/SEC.) =  3.66   DEPTH*VELOCITY(FT*FT/SEC.) =   2.97
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L =  220.0 FT WITH ELEVATION-DROP =   1.3 FT, IS   21.9 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE    203.00
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    203.00 =   982.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    314.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1678.00  DOWNSTREAM(FEET) =  1658.25
  FLOW LENGTH(FEET) =    25.00   MANNING'S N =  0.013
```

```
 DEPTH OF FLOW IN  15.0 INCH PIPE IS    9.4 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  49.52
 ESTIMATED PIPE DIAMETER(INCH) =  15.00     NUMBER OF PIPES =    1
 PIPE-FLOW(CFS) =      39.87
 PIPE TRAVEL TIME(MIN.) =    0.01     Tc(MIN.) =  10.59
 LONGEST FLOWPATH FROM NODE     200.00 TO NODE     314.00 =  1007.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     314.00 TO NODE     314.00 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE     300.00 TO NODE     301.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   530.00
 ELEVATION DATA: UPSTREAM(FEET) =   1688.40  DOWNSTREAM(FEET) =   1685.50

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.592
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.963
 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                  D        3.40      0.18       0.10     91   10.59
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.18
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =     12.07
 TOTAL AREA(ACRES) =      3.40   PEAK FLOW RATE(CFS) =     12.07

****************************************************************************
 FLOW PROCESS FROM NODE     301.00 TO NODE     302.00 IS CODE =  61
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STANDARD CURB SECTION USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) = 1685.50  DOWNSTREAM ELEVATION(FEET) = 1684.00
 STREET LENGTH(FEET) =   305.00   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 80.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  40.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0148

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      16.91
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.65
   HALFSTREET FLOOD WIDTH(FEET) =   24.36
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.76
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.78
 STREET FLOW TRAVEL TIME(MIN.) =   1.84   Tc(MIN.) =  12.43
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.600
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        3.00      0.18       0.10     91
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.18
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA AREA(ACRES) =     3.00      SUBAREA RUNOFF(CFS) =     9.67
 EFFECTIVE AREA(ACRES) =    6.40     AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.18  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     6.40        PEAK FLOW RATE(CFS) =      20.63

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.68   HALFSTREET FLOOD WIDTH(FEET) =  26.34
 FLOW VELOCITY(FEET/SEC.) =  2.90   DEPTH*VELOCITY(FT*FT/SEC.) =   1.98
 LONGEST FLOWPATH FROM NODE     300.00 TO NODE     302.00 =   835.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     302.00 TO NODE     303.00 IS CODE =  61
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STANDARD CURB SECTION USED)<<<<<
```

```
==========================================================================
  UPSTREAM ELEVATION(FEET) = 1684.00  DOWNSTREAM ELEVATION(FEET) = 1682.40
  STREET LENGTH(FEET) =   315.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 80.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  40.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0148

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      25.11
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
         NOTE: STREET FLOW EXCEEDS TOP OF CURB.
         THE FOLLOWING STREET FLOW RESULTS ARE BASED ON THE ASSUMPTION
         THAT NEGLIBLE FLOW OCCURS OUTSIDE OF THE STREET CHANNEL.
         THAT IS, ALL FLOW ALONG THE PARKWAY, ETC., IS NEGLECTED.
    STREET FLOW DEPTH(FEET) =  0.72
    HALFSTREET FLOOD WIDTH(FEET) =   28.24
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.07
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.22
  STREET FLOW TRAVEL TIME(MIN.) =   1.71   Tc(MIN.) =  14.14
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.332
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        3.00      0.18       0.10     91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.18
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA AREA(ACRES) =    3.00      SUBAREA RUNOFF(CFS) =    8.95
  EFFECTIVE AREA(ACRES) =    9.40    AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.18  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =    9.40        PEAK FLOW RATE(CFS) =      28.04

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.75   HALFSTREET FLOOD WIDTH(FEET) =  29.46
  FLOW VELOCITY(FEET/SEC.) =  3.16   DEPTH*VELOCITY(FT*FT/SEC.) =   2.36
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    303.00 =  1150.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    303.00 TO NODE    304.00 IS CODE =  61
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STANDARD CURB SECTION USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1682.40  DOWNSTREAM ELEVATION(FEET) = 1680.51
  STREET LENGTH(FEET) =   255.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 80.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  40.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0148

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      31.89
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
         NOTE: STREET FLOW EXCEEDS TOP OF CURB.
         THE FOLLOWING STREET FLOW RESULTS ARE BASED ON THE ASSUMPTION
         THAT NEGLIBLE FLOW OCCURS OUTSIDE OF THE STREET CHANNEL.
         THAT IS, ALL FLOW ALONG THE PARKWAY, ETC., IS NEGLECTED.
    STREET FLOW DEPTH(FEET) =  0.73
    HALFSTREET FLOOD WIDTH(FEET) =   28.77
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.76
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.76
  STREET FLOW TRAVEL TIME(MIN.) =   1.13   Tc(MIN.) =  15.27
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.182
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        2.70      0.18       0.10     91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.18
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA AREA(ACRES) =    2.70      SUBAREA RUNOFF(CFS) =    7.69
  EFFECTIVE AREA(ACRES) =   12.10    AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.18  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =   12.10        PEAK FLOW RATE(CFS) =      34.46
```

```
 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.75  HALFSTREET FLOOD WIDTH(FEET) =  29.61
 FLOW VELOCITY(FEET/SEC.) =  3.85  DEPTH*VELOCITY(FT*FT/SEC.) =  2.89
 LONGEST FLOWPATH FROM NODE    300.00 TO NODE    304.00 =  1405.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    304.00 TO NODE    305.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1675.00  DOWNSTREAM(FEET) =  1660.43
 FLOW LENGTH(FEET) =  150.00  MANNING'S N =  0.013
 DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.1 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  21.75
 ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =  1
 PIPE-FLOW(CFS) =     34.46
 PIPE TRAVEL TIME(MIN.) =  0.11    Tc(MIN.) =  15.38
 LONGEST FLOWPATH FROM NODE    300.00 TO NODE    305.00 =  1555.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    305.00 TO NODE    313.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1660.43  DOWNSTREAM(FEET) =  1660.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =  155.00  CHANNEL SLOPE =  0.0028
 CHANNEL BASE(FEET) =  20.00  "Z" FACTOR =  3.000
 MANNING'S FACTOR = 0.030  MAXIMUM DEPTH(FEET) =  3.00
 CHANNEL FLOW THRU SUBAREA(CFS) =     34.46
 FLOW VELOCITY(FEET/SEC) =  2.03  FLOW DEPTH(FEET) =  0.76
 TRAVEL TIME(MIN.) =  1.27  Tc(MIN.) =  16.65
 LONGEST FLOWPATH FROM NODE    300.00 TO NODE    313.00 =  1710.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    313.00 TO NODE    313.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN) =  16.65
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.021
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL GOOD COVER
 "GRASS"                     A        1.00      0.72       1.00    58
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.72
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.00
 SUBAREA AREA(ACRES) =    1.00      SUBAREA RUNOFF(CFS) =    2.07
 EFFECTIVE AREA(ACRES) =    13.10   AREA-AVERAGED Fm(INCH/HR) =  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.43  AREA-AVERAGED Ap =  0.17
 TOTAL AREA(ACRES) =    13.10       PEAK FLOW RATE(CFS) =      34.77

****************************************************************************
 FLOW PROCESS FROM NODE    313.00 TO NODE    313.00 IS CODE =  1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  16.65
 RAINFALL INTENSITY(INCH/HR) =  3.02
 AREA-AVERAGED Fm(INCH/HR) =  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.43
 AREA-AVERAGED Ap =  0.17
 EFFECTIVE STREAM AREA(ACRES) =  13.10
 TOTAL STREAM AREA(ACRES) =  13.10
 PEAK FLOW RATE(CFS) AT CONFLUENCE =     34.77

****************************************************************************
 FLOW PROCESS FROM NODE    310.00 TO NODE    311.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =  400.00
 ELEVATION DATA: UPSTREAM(FEET) =  1685.40  DOWNSTREAM(FEET) =  1682.89

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
```

```
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =     9.208
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.310
 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        0.50      0.80       0.10     52    9.21
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.80
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA RUNOFF(CFS) =       1.90
 TOTAL AREA(ACRES) =       0.50   PEAK FLOW RATE(CFS) =       1.90

****************************************************************************
 FLOW PROCESS FROM NODE     311.00 TO NODE     312.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1677.60  DOWNSTREAM(FEET) =  1660.50
 FLOW LENGTH(FEET) =   180.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   3.4 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  10.28
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       1.90
 PIPE TRAVEL TIME(MIN.) =   0.29    Tc(MIN.) =   9.50
 LONGEST FLOWPATH FROM NODE     310.00 TO NODE     312.00 =   580.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     313.00 TO NODE     313.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   9.50
 RAINFALL INTENSITY(INCH/HR) =   4.23
 AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.80
 AREA-AVERAGED Ap =  0.10
 EFFECTIVE STREAM AREA(ACRES) =    0.50
 TOTAL STREAM AREA(ACRES) =    0.50
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.90

 ** CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)     NODE
     1      34.77   16.65     3.021   0.43( 0.07) 0.17     13.1      300.00
     2       1.90    9.50     4.230   0.80( 0.08) 0.10      0.5      310.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)     NODE
     1      36.12   16.65     3.021   0.43( 0.07) 0.17     13.6      300.00
     2      29.87    9.50     4.230   0.44( 0.07) 0.16      8.0      310.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =     36.12    Tc(MIN.) =    16.65
 EFFECTIVE AREA(ACRES) =    13.60   AREA-AVERAGED Fm(INCH/HR) =  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.43  AREA-AVERAGED Ap =  0.17
 TOTAL AREA(ACRES) =     13.60
 LONGEST FLOWPATH FROM NODE     300.00 TO NODE     313.00 =  1710.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     313.00 TO NODE     314.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1660.00  DOWNSTREAM(FEET) =  1658.25
 FLOW LENGTH(FEET) =   790.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  39.0 INCH PIPE IS  30.5 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.20
 ESTIMATED PIPE DIAMETER(INCH) =  39.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     36.12
 PIPE TRAVEL TIME(MIN.) =   2.53    Tc(MIN.) =  19.19
 LONGEST FLOWPATH FROM NODE     300.00 TO NODE     314.00 =  2500.00 FEET.
```

```
****************************************************************************
 FLOW PROCESS FROM NODE     314.00 TO NODE     314.00 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1      29.87  12.17    3.646  0.44( 0.07) 0.16      8.0      310.00
     2      36.12  19.19    2.775  0.43( 0.07) 0.17     13.6      300.00
 LONGEST FLOWPATH FROM NODE     300.00 TO NODE     314.00 =  2500.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1      39.87  10.59    3.963  0.80( 0.08) 0.10     11.4      200.00
 LONGEST FLOWPATH FROM NODE       0.00 TO NODE     314.00 =     0.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1      66.49  12.17    3.646  0.61( 0.08) 0.13     19.4      310.00
     2      63.78  19.19    2.775  0.56( 0.08) 0.14     25.0      300.00
     3      68.17  10.59    3.963  0.62( 0.08) 0.12     18.3      200.00
   TOTAL AREA(ACRES) =      25.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       68.17  Tc(MIN.) =   10.590
 EFFECTIVE AREA(ACRES) =     18.34  AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.62  AREA-AVERAGED Ap =  0.12
 TOTAL AREA(ACRES) =     25.00
 LONGEST FLOWPATH FROM NODE     300.00 TO NODE     314.00 =  2500.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     314.00 TO NODE     314.00 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE     314.00 TO NODE     315.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1658.25  DOWNSTREAM(FEET) =  1658.00
 FLOW LENGTH(FEET) =    85.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  48.0 INCH PIPE IS  35.5 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   6.84
 ESTIMATED PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     68.17
 PIPE TRAVEL TIME(MIN.) =   0.21    Tc(MIN.) =  10.80
 LONGEST FLOWPATH FROM NODE     300.00 TO NODE     315.00 =  2585.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     315.00 TO NODE     316.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1658.00  DOWNSTREAM(FEET) =  1657.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =  160.00   CHANNEL SLOPE =  0.0063
 CHANNEL BASE(FEET) =  20.00   "Z" FACTOR =  3.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =  3.00
 CHANNEL FLOW THRU SUBAREA(CFS) =     68.17
 FLOW VELOCITY(FEET/SEC) =  3.36   FLOW DEPTH(FEET) =  0.90
 TRAVEL TIME(MIN.) =  0.79   Tc(MIN.) =  11.59
 LONGEST FLOWPATH FROM NODE     300.00 TO NODE     316.00 =  2745.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     315.00 TO NODE     316.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN) =  11.59
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.754
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
```

```
     LAND USE              GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL GOOD COVER
  "GRASS"                    A        1.20       0.72       1.00    58
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.72
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.00
  SUBAREA AREA(ACRES) =     1.20      SUBAREA RUNOFF(CFS) =     3.27
  EFFECTIVE AREA(ACRES) =    19.54    AREA-AVERAGED Fm(INCH/HR) =  0.12
  AREA-AVERAGED Fp(INCH/HR) =  0.65  AREA-AVERAGED Ap =  0.18
  TOTAL AREA(ACRES) =    26.20       PEAK FLOW RATE(CFS) =       68.17
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)      =      26.20  TC(MIN.) =      11.59
  EFFECTIVE AREA(ACRES) =      19.54  AREA-AVERAGED Fm(INCH/HR)=  0.12
  AREA-AVERAGED Fp(INCH/HR) =  0.65  AREA-AVERAGED Ap =  0.18
  PEAK FLOW RATE(CFS)    =      68.17

  ** PEAK FLOW RATE TABLE **
   STREAM      Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
   NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)     NODE
      1      68.17  11.59     3.754  0.65( 0.12) 0.18     19.5      200.00
      2      66.49  13.18     3.476  0.64( 0.11) 0.18     20.6      310.00
      3      63.78  20.22     2.689  0.60( 0.11) 0.18     26.2      300.00
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS

1
```

```
**************************************************************************
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                        Analysis prepared by:

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 ************************** DESCRIPTION OF STUDY *************************
* PROPOSED DEVELOPMENT                                                   *
* AT INDUSTRIAL AND PALM AVENUE                                          *
* NODE 400-402                                                           *
 **************************************************************************

  FILE NAME: C:\XDRIVE\3032\3032C.DAT
  TIME/DATE OF STUDY: 14:06 03/09/2011
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.4000

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*


**************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   743.00
  ELEVATION DATA: UPSTREAM(FEET) =   1698.00  DOWNSTREAM(FEET) =   1661.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   18.153
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.869
  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.)
  NATURAL FAIR COVER
  "GRASS"                     A        3.20      0.55       1.00    70   18.15
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.55
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.00
  SUBAREA RUNOFF(CFS) =      6.68
  TOTAL AREA(ACRES) =      3.20   PEAK FLOW RATE(CFS) =      6.68

**************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    402.00 IS CODE =  51
--------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1661.50  DOWNSTREAM(FEET) =   1648.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   761.00   CHANNEL SLOPE =  0.0177
  CHANNEL BASE(FEET) =  100.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   6.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      6.68
  FLOW VELOCITY(FEET/SEC) =   1.04   FLOW DEPTH(FEET) =   0.06
  TRAVEL TIME(MIN.) =  12.15   Tc(MIN.) =  30.31
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    402.00 =  1504.00 FEET.

**************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    402.00 IS CODE =  81
--------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==========================================================================
```

```
 MAINLINE Tc(MIN) =  30.31
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.109
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL FAIR COVER
 "GRASS"                     A        3.00      0.55       1.00    70
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.55
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.00
 SUBAREA AREA(ACRES) =     3.00      SUBAREA RUNOFF(CFS) =     4.21
 EFFECTIVE AREA(ACRES) =     6.20   AREA-AVERAGED Fm(INCH/HR) =  0.55
 AREA-AVERAGED Fp(INCH/HR) =  0.55  AREA-AVERAGED Ap =  1.00
 TOTAL AREA(ACRES) =     6.20       PEAK FLOW RATE(CFS) =        8.70
================================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =       6.20  TC(MIN.) =      30.31
 EFFECTIVE AREA(ACRES) =       6.20  AREA-AVERAGED Fm(INCH/HR)=  0.55
 AREA-AVERAGED Fp(INCH/HR) =  0.55  AREA-AVERAGED Ap =  1.00
 PEAK FLOW RATE(CFS)    =       8.70
================================================================================
================================================================================
 END OF RATIONAL METHOD ANALYSIS

1
```

```
**************************************************************************
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                        Analysis prepared by:

                          THIENES ENGINEERING
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                          LA MIRADA CA 90638
                    PH: (714) 521-4811 FAX: (714) 521-4173

 ************************** DESCRIPTION OF STUDY **************************
* PROPOSED DEVELOPMENT                                                    *
* AT INDUSTRIAL AND PALM AVENUE                                           *
* TOTAL RUNOFF TO INDUSTRIAL PARKWAY INCLUDING DETENTION                  *
 **************************************************************************

  FILE NAME: C:\XDRIVE\3032\3032ALL.DAT
  TIME/DATE OF STUDY: 08:52 03/24/2011
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.4000

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*


**************************************************************************
  FLOW PROCESS FROM NODE     500.00 TO NODE     501.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   625.00
  ELEVATION DATA: UPSTREAM(FEET) =   1697.50  DOWNSTREAM(FEET) =   1671.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.512
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.870
  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        1.60      0.80        0.10    52    7.51
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.80
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA RUNOFF(CFS) =      6.90
  TOTAL AREA(ACRES) =      1.60   PEAK FLOW RATE(CFS) =      6.90

**************************************************************************
  FLOW PROCESS FROM NODE     501.00 TO NODE     501.00 IS CODE =   1
--------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
==========================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   7.51
  RAINFALL INTENSITY(INCH/HR) =   4.87
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.80
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =    1.60
  TOTAL STREAM AREA(ACRES) =    1.60
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      6.90

**************************************************************************
  FLOW PROCESS FROM NODE     133.00 TO NODE     133.00 IS CODE =   7
--------------------------------------------------------------------------
  >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
==========================================================================
```

```
 USER-SPECIFIED VALUES ARE AS FOLLOWS:
 TC(MIN.) =   6.80   RAINFALL INTENSITY(INCH/HR) =  5.17
 EFFECTIVE AREA(ACRES) =     7.40
 TOTAL AREA(ACRES) =     7.40         PEAK FLOW RATE(CFS) =     30.70
 AREA-AVERAGED Fm(INCH/HR) =   0.38  AREA-AVERAGED Fp(INCH/HR) =   0.73
 AREA-AVERAGED Ap =  0.52
 NOTE: EFFECTIVE AREA IS USED AS THE TOTAL CONTRIBUTING AREA FOR ALL
       CONFLUENCE ANALYSES.

****************************************************************************
 FLOW PROCESS FROM NODE    501.00 TO NODE    501.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   6.80
 RAINFALL INTENSITY(INCH/HR) =   5.17
 AREA-AVERAGED Fm(INCH/HR) =  0.38
 AREA-AVERAGED Fp(INCH/HR) =  0.73
 AREA-AVERAGED Ap =  0.52
 EFFECTIVE STREAM AREA(ACRES) =    7.40
 TOTAL STREAM AREA(ACRES) =    7.40
 PEAK FLOW RATE(CFS) AT CONFLUENCE =     30.70

 ** CONFLUENCE DATA **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS) (MIN.) (INCH/HR) (INCH/HR)        (ACRES)     NODE
     1       6.90   7.51    4.870  0.80( 0.08) 0.10      1.6      500.00
     2      30.70   6.80    5.170  0.73( 0.38) 0.52      7.4      133.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS) (MIN.) (INCH/HR) (INCH/HR)        (ACRES)     NODE
     1      35.68   7.51    4.870  0.73( 0.33) 0.45      9.0      500.00
     2      37.34   6.80    5.170  0.73( 0.33) 0.45      8.8      133.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =     37.34    Tc(MIN.) =     6.80
 EFFECTIVE AREA(ACRES) =     8.85   AREA-AVERAGED Fm(INCH/HR) =  0.33
 AREA-AVERAGED Fp(INCH/HR) =  0.73  AREA-AVERAGED Ap =  0.45
 TOTAL AREA(ACRES) =      9.00
 LONGEST FLOWPATH FROM NODE    500.00 TO NODE    501.00 =   625.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    501.00 TO NODE    502.00 IS CODE =  61
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STANDARD CURB SECTION USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) = 1671.00  DOWNSTREAM ELEVATION(FEET) = 1653.00
 STREET LENGTH(FEET) =   970.00   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 30.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  25.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0148
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      42.18
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.57
   HALFSTREET FLOOD WIDTH(FEET) =   20.48
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.81
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.73
 STREET FLOW TRAVEL TIME(MIN.) =   3.36   Tc(MIN.) =  10.16
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.063
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 A        2.70      0.80       0.10    52
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.80
```

```
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA AREA(ACRES) =     2.70      SUBAREA RUNOFF(CFS) =     9.68
 EFFECTIVE AREA(ACRES) =   11.55     AREA-AVERAGED Fm(INCH/HR) =  0.27
 AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.37
 TOTAL AREA(ACRES) =   11.70         PEAK FLOW RATE(CFS) =      39.41

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.56   HALFSTREET FLOOD WIDTH(FEET) =  19.99
 FLOW VELOCITY(FEET/SEC.) =  4.71   DEPTH*VELOCITY(FT*FT/SEC.) =   2.63
 LONGEST FLOWPATH FROM NODE    500.00 TO NODE    502.00 =  1595.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    502.00 TO NODE    502.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  10.16
 RAINFALL INTENSITY(INCH/HR) =   4.06
 AREA-AVERAGED Fm(INCH/HR) =  0.27
 AREA-AVERAGED Fp(INCH/HR) =  0.74
 AREA-AVERAGED Ap =  0.37
 EFFECTIVE STREAM AREA(ACRES) =   11.55
 TOTAL STREAM AREA(ACRES) =   11.70
 PEAK FLOW RATE(CFS) AT CONFLUENCE =     39.41

****************************************************************************
 FLOW PROCESS FROM NODE    315.00 TO NODE    315.00 IS CODE =   7
----------------------------------------------------------------------------
 >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
 USER-SPECIFIED VALUES ARE AS FOLLOWS:
 TC(MIN.) =  11.60   RAINFALL INTENSITY(INCH/HR) =  3.75
 EFFECTIVE AREA(ACRES) =    21.10
 TOTAL AREA(ACRES) =    21.10         PEAK FLOW RATE(CFS) =     55.00
 AREA-AVERAGED Fm(INCH/HR) =   0.12  AREA-AVERAGED Fp(INCH/HR) =   0.65
 AREA-AVERAGED Ap =  0.18
 NOTE: EFFECTIVE AREA IS USED AS THE TOTAL CONTRIBUTING AREA FOR ALL
       CONFLUENCE ANALYSES.

****************************************************************************
 FLOW PROCESS FROM NODE    315.00 TO NODE    315.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =  11.60
 RAINFALL INTENSITY(INCH/HR) =   3.75
 AREA-AVERAGED Fm(INCH/HR) =  0.12
 AREA-AVERAGED Fp(INCH/HR) =  0.65
 AREA-AVERAGED Ap =  0.18
 EFFECTIVE STREAM AREA(ACRES) =   21.10
 TOTAL STREAM AREA(ACRES) =   21.10
 PEAK FLOW RATE(CFS) AT CONFLUENCE =     55.00

 ** CONFLUENCE DATA **
  STREAM     Q     Tc   Intensity   Fp(Fm)     Ap   Ae     HEADWATER
  NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)       (ACRES)    NODE
     1     38.18  10.90    3.895  0.74( 0.27) 0.37    11.7     500.00
     1     39.41  10.16    4.063  0.74( 0.27) 0.37    11.5     133.00
     2     55.00  11.60    3.753  0.65( 0.12) 0.18    21.1     315.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM     Q     Tc   Intensity   Fp(Fm)     Ap   Ae     HEADWATER
  NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)       (ACRES)    NODE
     1     91.70  10.16    4.063  0.70( 0.18) 0.25    30.0     133.00
     2     91.89  10.90    3.895  0.70( 0.17) 0.25    31.5     500.00
     3     91.68  11.60    3.753  0.70( 0.17) 0.25    32.8     315.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =     91.89    Tc(MIN.) =    10.90
 EFFECTIVE AREA(ACRES) =    31.53   AREA-AVERAGED Fm(INCH/HR) =  0.17
 AREA-AVERAGED Fp(INCH/HR) =  0.70  AREA-AVERAGED Ap =  0.25
 TOTAL AREA(ACRES) =     32.80
```

```
 LONGEST FLOWPATH FROM NODE    500.00 TO NODE    315.00 =  1595.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    502.00 TO NODE    503.00 IS CODE =  61
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STANDARD CURB SECTION USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) = 1653.00  DOWNSTREAM ELEVATION(FEET) = 1625.00
 STREET LENGTH(FEET) =   970.00   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 30.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  25.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0148
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      98.16
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.68
   HALFSTREET FLOOD WIDTH(FEET) =   26.86
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    6.98
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    4.76
 STREET FLOW TRAVEL TIME(MIN.) =   2.32   Tc(MIN.) =  13.22
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.470
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  A        2.00      0.80       0.10    52
 NATURAL GOOD COVER
 "GRASS"                     A        2.60      0.72       1.00    58
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.73
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.61
 SUBAREA AREA(ACRES) =    4.60      SUBAREA RUNOFF(CFS) =   12.53
 EFFECTIVE AREA(ACRES) =   36.13    AREA-AVERAGED Fm(INCH/HR) =  0.21
 AREA-AVERAGED Fp(INCH/HR) =  0.71  AREA-AVERAGED Ap =  0.29
 TOTAL AREA(ACRES) =   37.40        PEAK FLOW RATE(CFS) =     106.07

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.70   HALFSTREET FLOOD WIDTH(FEET) =  28.43
 FLOW VELOCITY(FEET/SEC.) =  7.11   DEPTH*VELOCITY(FT*FT/SEC.) =   4.95

 ** PEAK FLOW RATE TABLE **
  STREAM     Q     Tc   Intensity   Fp(Fm)     Ap   Ae     HEADWATER
  NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)       (ACRES)    NODE
     1    105.36  12.47    3.593  0.71( 0.21) 0.30    34.6     133.00
     2    106.07  13.22    3.470  0.71( 0.21) 0.29    36.1     500.00
     3    106.30  13.93    3.363  0.70( 0.20) 0.29    37.4     315.00
 NEW PEAK FLOW DATA ARE:
 PEAK FLOW RATE(CFS) =    106.30  Tc(MIN.) =  13.93
 AREA-AVERAGED Fm(INCH/HR) =  0.20  AREA-AVERAGED Fp(INCH/HR) =  0.70
 AREA-AVERAGED Ap =  0.29  EFFECTIVE AREA(ACRES) =     37.40
 LONGEST FLOWPATH FROM NODE    500.00 TO NODE    503.00 =  2565.00 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =     37.40  TC(MIN.) =     13.93
 EFFECTIVE AREA(ACRES) =     37.40  AREA-AVERAGED Fm(INCH/HR)=  0.20
 AREA-AVERAGED Fp(INCH/HR) =  0.70  AREA-AVERAGED Ap =  0.29
 PEAK FLOW RATE(CFS)    =    106.30

 ** PEAK FLOW RATE TABLE **
  STREAM     Q     Tc   Intensity   Fp(Fm)     Ap   Ae     HEADWATER
  NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)       (ACRES)    NODE
     1    105.36  12.47    3.593  0.71( 0.21) 0.30    34.6     133.00
     2    106.07  13.22    3.470  0.71( 0.21) 0.29    36.1     500.00
     3    106.30  13.93    3.363  0.70( 0.20) 0.29    37.4     315.00
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

APPENDIX C

DETENTION ANALYSIS

Volume of detention basin "a"

Elevation	Depth (feet)	Area (sq. ft.)	Volume (c.f.)	Σ Volume (c.f.)	Σ Volume (ac-ft)	Discharge (cfs)
1675.00	0.00	0				
			2350	2350	0.05	0
1676.00	1.00	4700				
			5350	7700	0.18	0
1677.00	2.00	6000				
			6750	14450	0.33	0
1678.00	3.00	7500				
			8300	22750	0.52	0
1679.00	4.00	9100				
			10000	32750	0.75	15.1
1680.00	5.00	10900				
			11850	44600	1.02	21.4
1681.00	6.00	12800				

WATER QUALITY VOLUME

$Q_{OUT} = .6(3.14)\sqrt{64.4 \times h.}$

h = 1 @ ELEV. 1680 Q = 15.1 cfs

h = 2 @ ELEV. 1681 Q = 21.4 cfs.

24" RISER

$A = 3.14\,\phi$

****

NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
AND LOW LOSS FRACTION ESTIMATIONS

Ver. 8.0 Release Date: 01/01/99 License ID 1435

Analysis prepared by:

THIENES ENGINEERING
16800 VALLEY VIEW AVENUE
LA MIRADA CA 90638
PH: (714) 521-4811 FAX: (714) 521-4173

*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
AND LOW LOSS FRACTION ESTIMATIONS FOR AMC III:

TOTAL 24-HOUR DURATION RAINFALL DEPTH = 9.50 (inches)

SOIL-COVER TYPE	AREA (Acres)	PERCENT OF PERVIOUS AREA	SCS CURVE NUMBER	LOSS RATE Fp(in./hr.)	YIELD
1	5.50	10.00	52.(32.)	0.742	0.914

TOTAL AREA (Acres) = 5.50

AREA-AVERAGED LOSS RATE, $\bar{F}m$ (in./hr.) = 0.074

AREA-AVERAGED LOW LOSS FRACTION, $\bar{Y}$ = 0.086

1

```
**************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL

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            Ver. 8.0  Release Date: 01/01/99  License ID 1435

                          Analysis prepared by:

                            THIENES ENGINEERING
                          16800 VALLEY VIEW AVENUE
                            LA MIRADA CA 90638
                      PH: (714) 521-4811 FAX: (714) 521-4173


   RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
   TOTAL CATCHMENT AREA(ACRES) =    5.50
   SOIL-LOSS RATE, Fm,(INCH/HR) =  0.074
   LOW LOSS FRACTION = 0.086
   TIME OF CONCENTRATION(MIN.) =  6.50
   RATIONAL METHOD PEAK FLOW RATE (DEFINED BY USER)
   IS USED FOR SMALL AREA PEAK Q
   USER SPECIFIED RAINFALL VALUES ARE USED
   RETURN FREQUENCY(YEARS) = 100
      5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.51
     30-MINUTE POINT RAINFALL VALUE(INCHES) =  1.05
      1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.40
      3-HOUR   POINT RAINFALL VALUE(INCHES) =  2.70
      6-HOUR   POINT RAINFALL VALUE(INCHES) =  4.00
     24-HOUR   POINT RAINFALL VALUE(INCHES) =  9.50

--------------------------------------------------------------------------

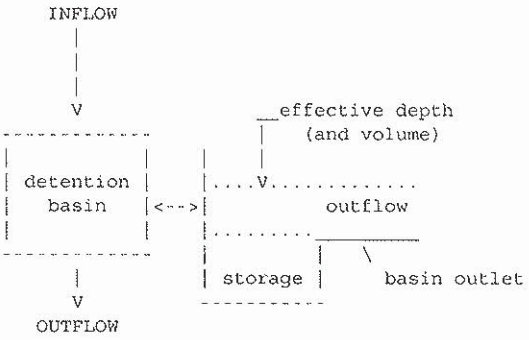
   TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     3.55
   TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.80

**************************************************************************
  TIME      VOLUME       Q    0.        7.5       15.0       22.5       30.0
 (HOURS)     (AF)      (CFS)
--------------------------------------------------------------------------
 12.10      1.3771      1.81  . Q       .          .          .          .
 12.21      1.3930      1.74  . Q       .          .          .          .
 12.32      1.4086      1.75  . Q       .          .          .          .
 12.43      1.4244      1.78  . Q       .          .          .          .
 12.53      1.4404      1.80  . Q       .          .          .          .
 12.64      1.4567      1.83  . Q       .          .          .          .
 12.75      1.4731      1.84  . Q       .          .          .          .
 12.86      1.4898      1.88  . Q       .          .          .          .
 12.97      1.5067      1.90  . Q       .          .          .          .
 13.07      1.5239      1.94  . Q       .          .          .          .
 13.18      1.5413      1.96  . Q       .          .          .          .
 13.29      1.5590      2.00  . Q       .          .          .          .
 13.40      1.5771      2.02  . Q       .          .          .          .
 13.51      1.5954      2.07  . Q       .          .          .          .
 13.62      1.6141      2.10  . Q       .          .          .          .
 13.73      1.6331      2.15  . Q       .          .          .          .
 13.83      1.6526      2.18  . Q       .          .          .          .
 13.94      1.6724      2.25  . Q       .          .          .          .
 14.05      1.6926      2.28  .  Q       .          .          .          .
 14.16      1.7140      2.48  .  Q       .          .          .          .
 14.27      1.7363      2.52  .  Q       .          .          .          .
 14.38      1.7592      2.60  .  Q       .          .          .          .
 14.48      1.7827      2.65  .  Q       .          .          .          .
 14.59      1.8068      2.75  .  Q       .          .          .          .
 14.70      1.8317      2.80  .  Q       .          .          .          .
 14.81      1.8574      2.93  .  Q       .          .          .          .
 14.92      1.8839      3.00  .  Q       .          .          .          .
 15.02      1.9114      3.16  .   Q      .          .          .          .
 15.13      1.9401      3.25  .   Q      .          .          .          .
 15.24      1.9702      3.47  .   Q      .          .          .          .
 15.35      2.0018      3.60  .   Q      .          .          .          .
 15.46      2.0303      2.76  .  Q       .          .          .          .
 15.57      2.0559      2.97  .  Q       .          .          .          .
 15.68      2.0852      3.56  .   Q      .          .          .          .
 15.78      2.1188      3.94  .    Q     .          .          .          .
 15.89      2.1620      5.71  .      Q   .          .          .          .
 16.00      2.2233      7.98  .        Q .          .          .          .
 16.11      2.3620     23.00  .          .          .          Q          .
 16.22      2.4855      4.59  .     Q    .          .          .          .
```

16.33	2.5205	3.23	.	Q	.	.	.	.
16.43	2.5506	3.48	.	Q	.	.	.	.
16.54	2.5811	3.35	.	Q	.	.	.	.
16.65	2.6099	3.07	.	Q	.	.	.	.
16.76	2.6365	2.86	.	Q	.	.	.	.
16.87	2.6614	2.70	.	Q	.	.	.	.
16.98	2.6849	2.56	.	Q	.	.	.	.
17.08	2.7071	2.40	.	Q	.	.	.	.
17.19	2.7278	2.21	.	Q	.	.	.	.
17.30	2.7472	2.13	.	Q	.	.	.	.
17.41	2.7659	2.05	.	Q	.	.	.	.
17.52	2.7839	1.98	.	Q	.	.	.	.
17.63	2.8014	1.92	.	Q	.	.	.	.
17.73	2.8183	1.86	.	Q	.	.	.	.
17.84	2.8347	1.81	.	Q	.	.	.	.
17.95	2.8507	1.77	.	Q	.	.	.	.

FLOW-THROUGH DETENTION BASIN MODEL

SPECIFIED BASIN CONDITIONS ARE AS FOLLOWS:
CONSTANT HYDROGRAPH TIME UNIT(MINUTES) = 6.500
DEAD STORAGE(AF) = 0.00
SPECIFIED DEAD STORAGE(AF) FILLED = 0.00
ASSUMED INITIAL DEPTH(FEET) IN STORAGE BASIN = 0.00



DEPTH-VS.-STORAGE AND DEPTH-VS.-DISCHARGE INFORMATION:
TOTAL NUMBER OF BASIN DEPTH INFORMATION ENTRIES = 7

*BASIN-DEPTH (FEET)	STORAGE (ACRE-FEET)	OUTFLOW (CFS)	**	**BASIN-DEPTH (FEET)	STORAGE (ACRE-FEET)	OUTFLOW (CFS)	*
* 0.000	0.000	0.000	**	1.000	0.050	0.010	*
* 2.000	0.180	0.020	**	3.000	0.330	0.020	*
* 4.000	0.520	0.020	**	5.000	0.750	15.100	*
* 6.000	1.020	21.400	**				

BASIN STORAGE, OUTFLOW AND DEPTH ROUTING VALUES:

INTERVAL NUMBER	DEPTH (FEET)	{S-O*DT/2} (ACRE-FEET)	{S+O*DT/2} (ACRE-FEET)
1	0.00	0.00000	0.00000
2	1.00	0.04996	0.05004
3	2.00	0.17991	0.18009
4	3.00	0.32991	0.33009
5	4.00	0.51991	0.52009
6	5.00	0.68240	0.81760
7	6.00	0.92420	1.11580

WHERE S=STORAGE(AF);O=OUTFLOW(AF/MIN.);DT=UNIT INTERVAL(MIN.)

DETENTION BASIN ROUTING RESULTS:
NOTE: COMPUTED BASIN DEPTH, OUTFLOW, AND STORAGE QUANTITIES OCCUR AT THE GIVEN TIME. BASIN INFLOW VALUES REPRESENT THE AVERAGE INFLOW DURING THE RECENT HYDROGRAPH UNIT INTERVAL.

TIME (HRS)	DEAD-STORAGE FILLED(AF)	INFLOW (CFS)	EFFECTIVE DEPTH(FT)	OUTFLOW (CFS)	EFFECTIVE VOLUME(AF)
12.100	0.000	1.81	4.12	1.84	0.548
12.208	0.000	1.74	4.12	1.81	0.547
12.317	0.000	1.75	4.12	1.78	0.547
12.425	0.000	1.78	4.12	1.77	0.547
12.533	0.000	1.80	4.12	1.78	0.547

12.642	0.000	1.83	4.12	1.79	0.547
12.750	0.000	1.84	4.12	1.81	0.547
12.858	0.000	1.88	4.12	1.84	0.548
12.967	0.000	1.90	4.12	1.86	0.548
13.075	0.000	1.94	4.12	1.89	0.549
13.183	0.000	1.96	4.13	1.91	0.549
13.292	0.000	2.00	4.13	1.94	0.550
13.400	0.000	2.02	4.13	1.98	0.550
13.508	0.000	2.07	4.13	2.01	0.551
13.617	0.000	2.10	4.14	2.04	0.551
13.725	0.000	2.15	4.14	2.08	0.552
13.833	0.000	2.18	4.14	2.12	0.552
13.942	0.000	2.25	4.14	2.16	0.553
14.050	0.000	2.28	4.15	2.21	0.554
14.158	0.000	2.48	4.15	2.29	0.555
14.267	0.000	2.52	4.16	2.38	0.557
14.375	0.000	2.60	4.16	2.46	0.558
14.483	0.000	2.65	4.17	2.54	0.559
14.592	0.000	2.75	4.17	2.61	0.560
14.700	0.000	2.80	4.18	2.68	0.561
14.808	0.000	2.93	4.19	2.77	0.563
14.917	0.000	3.00	4.19	2.86	0.564
15.025	0.000	3.16	4.20	2.96	0.566
15.133	0.000	3.25	4.21	3.07	0.567
15.242	0.000	3.47	4.22	3.20	0.570
15.350	0.000	3.60	4.23	3.35	0.572
15.458	0.000	2.76	4.21	3.27	0.567
15.567	0.000	2.97	4.20	3.09	0.566
15.675	0.000	3.56	4.22	3.17	0.570
15.783	0.000	3.94	4.24	3.43	0.574
15.892	0.000	5.71	4.30	4.07	0.589
16.000	0.000	7.98	4.40	5.33	0.613
16.108	0.000	23.00	4.91	9.94	0.730
16.217	0.000	4.59	4.64	11.69	0.666
16.325	0.000	3.23	4.44	8.16	0.622
16.433	0.000	3.48	4.35	5.98	0.600
16.542	0.000	3.35	4.29	4.82	0.587
16.650	0.000	3.07	4.25	4.09	0.578
16.758	0.000	2.86	4.22	3.58	0.571
16.867	0.000	2.70	4.20	3.22	0.566
16.975	0.000	2.56	4.19	2.95	0.563
17.083	0.000	2.40	4.17	2.74	0.560
17.192	0.000	2.21	4.16	2.54	0.557
17.300	0.000	2.13	4.15	2.37	0.555
17.408	0.000	2.05	4.14	2.24	0.553
17.517	0.000	1.98	4.14	2.14	0.552
17.625	0.000	1.92	4.13	2.05	0.550
17.733	0.000	1.86	4.13	1.98	0.549
17.842	0.000	1.81	4.12	1.91	0.548
17.950	0.000	1.77	4.12	1.86	0.548

Volume of detention basin "b"

Elevation	Depth (feet)	Area (sq. ft.)	Volume (c.f.)	Σ Volume (c.f.)	Σ Volume (ac-ft)	Discharge (cfs)
1658.00	0.00	5000				
			6250	6250	0.14	0
1659.00	1.00	7500				
			8550	14800	0.34	0
1660.00	2.00	9600				
			10800	25600	0.59	0
1661.00	3.00	12000				
			13200	38800	0.89	0
1662.00	4.00	14400				
			15700	54500	1.25	0
1663.00	5.00	17000				
			18500	73000	1.68	0
1664.00	6.00	20000				
			21500	94500	2.17	61
1665.00	7.00	23000				

WATER QUALITY VOLUME

$Q_{OUT} = .6(12.56)\sqrt{64A(1)} = 60.5$

48" RISER

AREA = 12.56

Volume of detention basin "c"

Elevation	Depth (feet)	Area (sq. ft.)	Volume (c.f.)	Σ Volume (c.f.)	Σ Volume (ac-ft)	Discharge (cfs)
1660.00	0.00	4500				
			5575	5575	0.13	0
1661.00	1.00	6650				
			7425	13000	0.30	0
1662.00	2.00	8200				
			8950	21950	0.50	0
1663.00	3.00	9700				
			10650	32600	0.75	0
1664.00	4.00	11600				
			12550	45150	1.04	0
1665.00	5.00	13500				
			14400	59550	1.37	0
1666.00	6.00	15300				
			16400	75950	1.74	46
1667.00	7.00	17500				

WATER QUALITY VOLUME

$Q_{OUT} = .6(9.61)\sqrt{64.4(1)} = 46.3$

****

NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
AND LOW LOSS FRACTION ESTIMATIONS

Ver. 8.0 Release Date: 01/01/99 License ID 1435

Analysis prepared by:

THIENES ENGINEERING
16800 VALLEY VIEW AVENUE
LA MIRADA CA 90638
PH: (714) 521-4811 FAX: (714) 521-4173

*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
AND LOW LOSS FRACTION ESTIMATIONS FOR AMC III:

TOTAL 24-HOUR DURATION RAINFALL DEPTH = 9.50 (inches)

SOIL-COVER TYPE	AREA (Acres)	PERCENT OF PERVIOUS AREA	SCS CURVE NUMBER	LOSS RATE Fp(in./hr.)	YIELD
1	10.00	10.00	52.(32.)	0.742	0.914

TOTAL AREA (Acres) = 10.00

AREA-AVERAGED LOSS RATE, $\bar{Fm}$ (in./hr.) = 0.074

AREA-AVERAGED LOW LOSS FRACTION, $\bar{Y}$ = 0.086

1

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**************************************************************************

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                          Analysis prepared by:

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 ************************** DESCRIPTION OF STUDY **************************
* INDUSTRIAL PARKWAY AT PALM                                              *
* DETENTION BASINS "B" AND "C"                                            *
* 100-YEAR                                                                *
 **************************************************************************

  FILE NAME: C:\XDRIVE\3032\BASINB.DAT
  TIME/DATE OF STUDY: 10:39 03/09/2011


**************************************************************************
  FLOW PROCESS FROM NODE    312.00 TO NODE    312.00 IS CODE =   1
--------------------------------------------------------------------------
  >>>>>SUBAREA RUNOFF (UNIT-HYDROGRAPH ANALYSIS)<<<<<
==========================================================================

      (UNIT-HYDROGRAPH ADDED TO STREAM #1)

         WATERSHED AREA =       13.600 ACRES
         BASEFLOW =    0.000 CFS/SQUARE-MILE
         *USER ENTERED "LAG" TIME =     0.220 HOURS
          CAUTION: LAG TIME IS LESS THAN 0.50 HOURS.
          THE 5-MINUTE PERIOD UH MODEL (USED IN THIS COMPUTER PROGRAM)
          MAY BE TOO LARGE FOR PEAK FLOW ESTIMATES.
         VALLEY(DEVELOPED) S-GRAPH SELECTED
         MAXIMUM WATERSHED LOSS RATE(INCH/HOUR) =  0.074
         LOW LOSS FRACTION = 0.086
         *HYDROGRAPH MODEL #1 SPECIFIED*

         SPECIFIED PEAK  5-MINUTES RAINFALL(INCH)=  0.51
         SPECIFIED PEAK 30-MINUTES RAINFALL(INCH)=  1.05
         SPECIFIED PEAK  1-HOUR RAINFALL(INCH) =  1.40
         SPECIFIED PEAK  3-HOUR RAINFALL(INCH) =  2.70
         SPECIFIED PEAK  6-HOUR RAINFALL(INCH) =  4.00
         SPECIFIED PEAK 24-HOUR RAINFALL(INCH) =  9.50

         PRECIPITATION DEPTH-AREA REDUCTION FACTORS:
           5-MINUTE FACTOR = 0.999
          30-MINUTE FACTOR = 0.999
           1-HOUR FACTOR = 0.999
           3-HOUR FACTOR = 1.000
           6-HOUR FACTOR = 1.000
          24-HOUR FACTOR = 1.000

         UNIT HYDROGRAPH TIME UNIT =    5.000 MINUTES
         UNIT INTERVAL PERCENTAGE OF LAG-TIME =  37.879


         RUNOFF HYDROGRAPH LISTING LIMITS:
         MODEL TIME(HOURS) FOR BEGINNING OF RESULTS =  14.00
         MODEL TIME(HOURS) FOR END OF RESULTS =  18.00


==========================================================================
                      UNIT HYDROGRAPH DETERMINATION

--------------------------------------------------------------------------
    INTERVAL          "S" GRAPH          UNIT HYDROGRAPH
     NUMBER          MEAN VALUES          ORDINATES(CFS)
--------------------------------------------------------------------------
        1                2.653                4.363
        2               17.527               24.464
        3               44.644               44.601
        4               73.375               47.255
        5               88.902               25.537
```

6	95.634	11.072
7	98.163	4.161
8	98.920	1.245
9	99.471	0.905
10	99.788	0.522
11	99.947	0.261
12	100.000	0.087

TOTAL SOIL-LOSS VOLUME(ACRE-FEET) = 0.8656
TOTAL STORM RUNOFF VOLUME(ACRE-FEET) = 9.8957

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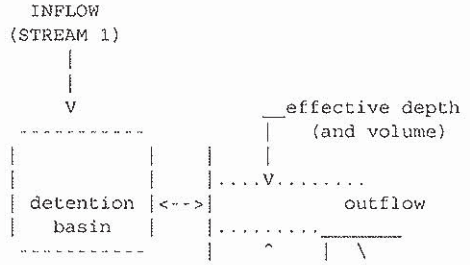
2 4 - H O U R S T O R M
R U N O F F H Y D R O G R A P H

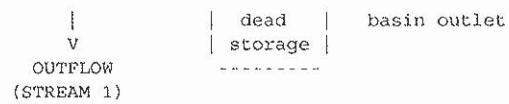
HYDROGRAPH IN FIVE-MINUTE UNIT INTERVALS(CFS)
(Note: Time indicated is at END of Each Unit Intervals)

TIME(HRS)	VOLUME(AF)	Q(CFS)	0. 10.0 20.0 30.0 40.0
14.000	4.5655	6.02	. Q . V . . .
14.083	4.6077	6.13	. Q . V . . .
14.167	4.6510	6.28	. Q . V . . .
14.250	4.6956	6.48	. Q . V . . .
14.333	4.7418	6.70	. Q . V. . . .
14.417	4.7891	6.87	. Q . V. . . .
14.500	4.8375	7.03	. Q . V. . . .
14.583	4.8869	7.17	. Q . V. . . .
14.667	4.9373	7.32	. Q . V. . . .
14.750	4.9887	7.48	. Q . V . . .
14.833	5.0414	7.65	. Q . V . . .
14.917	5.0953	7.83	. Q . V . . .
15.000	5.1507	8.03	. Q . V . . .
15.083	5.2075	8.25	. Q . .V . . .
15.167	5.2659	8.49	. Q . .V . . .
15.250	5.3263	8.76	. Q . .V . . .
15.333	5.3887	9.06	. Q. .V . . .
15.417	5.4528	9.31	. Q. . V . . .
15.500	5.5164	9.23	. Q. . V . . .
15.583	5.5771	8.82	. Q . . V . . .
15.667	5.6354	8.46	. Q . . V . . .
15.750	5.6949	8.64	. Q . . V . . .
15.833	5.7590	9.31	. Q. . V . . .
15.917	5.8311	10.47	. Q . V . . .
16.000	5.9179	12.60	. . Q . V . . .
16.083	6.0389	17.56	. . Q . V . . .
16.167	6.2336	28.27	. . . V Q . . .
16.250	6.4860	36.65	. . . V . Q .
16.333	6.7300	35.44	. . . V . Q .
16.417	6.8950	23.95	. . . Q V . . .
16.500	7.0043	15.87	. Q . V . . .
16.583	7.0864	11.92	. .Q . V . . .
16.667	7.1573	10.29	. Q . V . . .
16.750	7.2239	9.67	. Q. . V. . .
16.833	7.2859	9.00	. Q. . V. . .
16.917	7.3438	8.41	. Q . V. . .
17.000	7.3982	7.90	. Q . V. . .
17.083	7.4499	7.50	. Q . V . . .
17.167	7.4990	7.14	. Q . V . . .
17.250	7.5457	6.78	. Q . V . . .
17.333	7.5900	6.44	. Q . V . . .
17.417	7.6325	6.17	. Q . V . . .
17.500	7.6735	5.95	. Q . .V . . .
17.583	7.7133	5.77	. Q . .V . . .
17.667	7.7519	5.61	. Q . .V . . .
17.750	7.7895	5.46	. Q . .V . . .
17.833	7.8263	5.33	. Q . .V . . .
17.917	7.8621	5.21	. Q . .V . . .
18.000	7.8972	5.10	. Q . .V . . .

****
FLOW PROCESS FROM NODE 312.00 TO NODE 312.00 IS CODE = 3.1

>>>>>FLOW-THROUGH DETENTION BASIN ROUTING MODEL APPLIED TO STREAM #1<<<<<





ROUTE RUNOFF HYDROGRAPH FROM STREAM NUMBER 1
THROUGH A FLOW-THROUGH DETENTION BASIN
SPECIFIED BASIN CONDITIONS ARE AS FOLLOWS:
DEAD STORAGE(AF) = 0.000
SPECIFIED DEAD STORAGE(AF) FILLED = 0.000
SPECIFIED EFFECTIVE VOLUME(AF) FILLED ABOVE OUTLET = 0.000
DETENTION BASIN CONSTANT LOSS RATE(CFS) = 0.00

BASIN DEPTH VERSUS OUTFLOW AND STORAGE INFORMATION:

INTERVAL NUMBER	DEPTH (FT)	OUTFLOW (CFS)	STORAGE (AF)
1	0.00	0.00	0.000
2	1.00	0.10	0.130
3	2.00	0.15	0.300
4	3.00	0.20	0.500
5	4.00	0.25	0.750
6	5.00	0.27	1.040
7	6.00	0.28	1.370
8	7.00	46.00	1.740

MODIFIED-PULS BASIN ROUTING MODEL RESULTS(5-MINUTE COMPUTATION INTERVALS):
(Note: Computed EFFECTIVE DEPTH and VOLUME are estimated at the clock time;
MEAN OUTFLOW is the average value during the unit interval.)

CLOCK TIME (HRS)	DEAD-STORAGE FILLED(AF)	INFLOW (CFS)	LOSS (CFS)	EFFECTIVE DEPTH(FT)	MEAN OUTFLOW (CFS)	EFFECTIVE VOLUME(AF)
14.083	0.000	6.13	0.00	6.13	6.0	1.417
14.167	0.000	6.28	0.00	6.13	6.1	1.418
14.250	0.000	6.48	0.00	6.13	6.3	1.419
14.333	0.000	6.70	0.00	6.14	6.5	1.421
14.417	0.000	6.87	0.00	6.14	6.7	1.422
14.500	0.000	7.03	0.00	6.15	6.8	1.424
14.583	0.000	7.17	0.00	6.15	7.0	1.425
14.667	0.000	7.32	0.00	6.15	7.1	1.426
14.750	0.000	7.48	0.00	6.16	7.3	1.427
14.833	0.000	7.65	0.00	6.16	7.5	1.429
14.917	0.000	7.83	0.00	6.16	7.6	1.430
15.000	0.000	8.03	0.00	6.17	7.8	1.432
15.083	0.000	8.25	0.00	6.17	8.0	1.433
15.167	0.000	8.49	0.00	6.18	8.2	1.435
15.250	0.000	8.76	0.00	6.18	8.5	1.437
15.333	0.000	9.06	0.00	6.19	8.7	1.440
15.417	0.000	9.31	0.00	6.19	9.0	1.442
15.500	0.000	9.23	0.00	6.19	9.2	1.442
15.583	0.000	8.82	0.00	6.19	9.1	1.440
15.667	0.000	8.46	0.00	6.18	8.8	1.438
15.750	0.000	8.64	0.00	6.18	8.7	1.438
15.833	0.000	9.31	0.00	6.19	8.8	1.441
15.917	0.000	10.47	0.00	6.21	9.5	1.448
16.000	0.000	12.60	0.00	6.25	10.7	1.461
16.083	0.000	17.56	0.00	6.32	13.3	1.490
16.167	0.000	28.27	0.00	6.50	19.0	1.554
16.250	0.000	36.65	0.00	6.67	27.1	1.620
16.333	0.000	35.44	0.00	6.73	32.4	1.641
16.417	0.000	23.95	0.00	6.60	30.8	1.593
16.500	0.000	15.87	0.00	6.45	24.3	1.535
16.583	0.000	11.92	0.00	6.33	18.1	1.493
16.667	0.000	10.29	0.00	6.26	13.9	1.468
16.750	0.000	9.67	0.00	6.23	11.6	1.455
16.833	0.000	9.00	0.00	6.21	10.2	1.446
16.917	0.000	8.41	0.00	6.19	9.3	1.440
17.000	0.000	7.90	0.00	6.18	8.6	1.435
17.083	0.000	7.50	0.00	6.17	8.1	1.431
17.167	0.000	7.14	0.00	6.16	7.6	1.428
17.250	0.000	6.78	0.00	6.15	7.2	1.425
17.333	0.000	6.44	0.00	6.14	6.9	1.422
17.417	0.000	6.17	0.00	6.13	6.5	1.419

17.500	0.000	5.95	0.00	6.13	6.2	1.417
17.583	0.000	5.77	0.00	6.12	6.0	1.416
17.667	0.000	5.61	0.00	6.12	5.8	1.414
17.750	0.000	5.46	0.00	6.12	5.7	1.413
17.833	0.000	5.33	0.00	6.11	5.5	1.412
17.917	0.000	5.21	0.00	6.11	5.4	1.411
18.000	0.000	5.10	0.00	6.11	5.2	1.410

PROCESS SUMMARY OF STORAGE:
INFLOW VOLUME = 9.896 AF
BASIN STORAGE = 0.000 AF (WITH 0.000 AF INITIALLY FILLED)
OUTFLOW VOLUME = 9.896 AF
LOSS VOLUME = 0.000 AF

FLOW PROCESS FROM NODE 312.00 TO NODE 205.00 IS CODE = 4

>>>>>MODEL PIPEFLOW ROUTING OF STREAM #1<<<<<

MODEL PIPEFLOW ROUTING OF STREAM 1 WHERE
STORAGE EFFECTS ARE NEGLECTED WITHIN THE PIPE, FLOW
VELOCITIES ARE ESTIMATED BY ASSUMING STEADY FLOW FOR
EACH UNIT INTERVAL(NORMAL DEPTH, Dn), AND FLOWS IN EXCESS
OF (.82)(DIAMETER) ARE PONDED AT THE UPSTREAM INLET:
UNIT INTERVAL FLOW VELOCITY COMPUTED USING Dn UP TO
(0.938)(DIAMETER):

PIPELENGTH(FT) = 880.00 MANNINGS FACTOR = 0.013
UPSTREAM ELEVATION(FT) = 1660.00
DOWNSTREAM ELEVATION(FT) = 1658.00
PIPE DIAMETER(FT) = 4.00

NORMAL DEPTH VELOCITY PIPE ROUTING RESULTS:

TIME (HRS)	INFLOW (CFS)	VELOCITY (FPS)	OUTFLOW (CFS)	UPSTREAM PONDING(AF)
12.000	5.03	3.11	5.00	0.000
12.083	5.06	3.12	5.04	0.000
12.167	5.07	3.12	5.06	0.000
12.250	5.04	3.12	5.06	0.000
12.333	4.97	3.10	5.02	0.000
12.417	4.91	3.09	4.95	0.000
12.500	4.88	3.09	4.90	0.000
12.583	4.88	3.09	4.88	0.000
12.667	4.90	3.09	4.89	0.000
12.750	4.94	3.10	4.92	0.000
12.833	4.98	3.11	4.95	0.000
12.917	5.03	3.12	5.00	0.000
13.000	5.08	3.12	5.05	0.000
13.083	5.14	3.13	5.10	0.000
13.167	5.20	3.14	5.16	0.000
13.250	5.26	3.15	5.22	0.000
13.333	5.32	3.17	5.28	0.000
13.417	5.38	3.18	5.34	0.000
13.500	5.45	3.19	5.40	0.000
13.583	5.52	3.20	5.47	0.000
13.667	5.59	3.21	5.54	0.000
13.750	5.66	3.23	5.62	0.000
13.833	5.74	3.24	5.69	0.000
13.917	5.83	3.25	5.78	0.000
14.000	5.91	3.27	5.86	0.000
14.083	6.01	3.29	5.95	0.000
14.167	6.12	3.31	6.05	0.000
14.250	6.28	3.33	6.19	0.000
14.333	6.47	3.37	6.36	0.000
14.417	6.66	3.40	6.55	0.000
14.500	6.83	3.43	6.73	0.000
14.583	6.99	3.45	6.89	0.000
14.667	7.14	3.47	7.05	0.000
14.750	7.29	3.49	7.20	0.000
14.833	7.45	3.52	7.36	0.000
14.917	7.62	3.54	7.52	0.000
15.000	7.81	3.56	7.70	0.000
15.083	8.01	3.59	7.89	0.000

15.167	8.22	3.62	8.10	0.000
15.250	8.46	3.65	8.33	0.000
15.333	8.73	3.69	8.58	0.000
15.417	9.00	3.72	8.86	0.000
15.500	9.16	3.75	9.08	0.000
15.583	9.08	3.74	9.12	0.000
15.667	8.82	3.70	8.96	0.000
15.750	8.66	3.68	8.74	0.000
15.833	8.85	3.70	8.75	0.000
15.917	9.47	3.79	9.15	0.000
16.000	10.70	3.94	10.07	0.000
16.083	13.32	4.21	12.01	0.000
16.167	19.05	4.68	16.39	0.000
16.250	27.05	5.13	23.53	0.000
16.333	32.42	5.36	30.15	0.000
16.417	30.79	5.29	31.44	0.000
16.500	24.30	4.99	27.10	0.000
16.583	18.09	4.61	20.86	0.000
16.667	13.92	4.27	15.87	0.000
16.750	11.57	4.03	12.71	0.000
16.833	10.24	3.89	10.94	0.000
16.917	9.32	3.77	9.78	0.000
17.000	8.63	3.67	9.00	0.000
17.083	8.07	3.60	8.38	0.000
17.167	7.62	3.54	7.88	0.000
17.250	7.23	3.48	7.46	0.000
17.333	6.86	3.43	7.08	0.000
17.417	6.53	3.38	6.71	0.000
17.500	6.25	3.33	6.41	0.000
17.583	6.02	3.29	6.16	0.000
17.667	5.82	3.25	5.94	0.000
17.750	5.65	3.22	5.76	0.000
17.833	5.50	3.20	5.60	0.000
17.917	5.36	3.17	5.45	0.000
18.000	5.24	3.15	5.32	0.000

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****************************************************************************
  FLOW PROCESS FROM NODE   205.00 TO NODE   205.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>SUBAREA RUNOFF (UNIT-HYDROGRAPH ANALYSIS)<<<<<
============================================================================

      (UNIT-HYDROGRAPH ADDED TO STREAM #1)

         WATERSHED AREA =      12.600 ACRES
         BASEFLOW =    0.000 CFS/SQUARE-MILE
         *USER ENTERED "LAG" TIME =     0.150 HOURS
          CAUTION: LAG TIME IS LESS THAN 0.50 HOURS.
          THE 5-MINUTE PERIOD UH MODEL (USED IN THIS COMPUTER PROGRAM)
          MAY BE TOO LARGE FOR PEAK FLOW ESTIMATES.
         VALLEY(DEVELOPED) S-GRAPH SELECTED
         MAXIMUM WATERSHED LOSS RATE(INCH/HOUR) =  0.074
         LOW LOSS FRACTION = 0.086
         *HYDROGRAPH MODEL #1 SPECIFIED*

         SPECIFIED PEAK  5-MINUTES RAINFALL(INCH)=  0.51
         SPECIFIED PEAK 30-MINUTES RAINFALL(INCH)=  1.05
         SPECIFIED PEAK  1-HOUR RAINFALL(INCH) =  1.40
         SPECIFIED PEAK  3-HOUR RAINFALL(INCH) =  2.70
         SPECIFIED PEAK  6-HOUR RAINFALL(INCH) =  4.00
         SPECIFIED PEAK 24-HOUR RAINFALL(INCH) =  9.50

         PRECIPITATION DEPTH-AREA REDUCTION FACTORS:
           5-MINUTE FACTOR = 0.999
          30-MINUTE FACTOR = 0.999
           1-HOUR FACTOR = 0.999
           3-HOUR FACTOR = 1.000
           6-HOUR FACTOR = 1.000
          24-HOUR FACTOR = 1.000

         UNIT HYDROGRAPH TIME UNIT =    5.000 MINUTES
         UNIT INTERVAL PERCENTAGE OF LAG-TIME =  55.556


         RUNOFF HYDROGRAPH LISTING LIMITS:
         MODEL TIME(HOURS) FOR BEGINNING OF RESULTS =  12.00
         MODEL TIME(HOURS) FOR END OF RESULTS =  18.00
```

UNIT HYDROGRAPH DETERMINATION

INTERVAL NUMBER	"S" GRAPH MEAN VALUES	UNIT HYDROGRAPH ORDINATES(CFS)
1	5.492	8.368
2	36.014	46.510
3	76.167	61.185
4	93.537	26.470
5	98.194	7.095
6	99.268	1.638
7	99.707	0.669
8	99.927	0.334
9	100.000	0.111

TOTAL SOIL-LOSS VOLUME(ACRE-FEET) = 0.8019
TOTAL STORM RUNOFF VOLUME(ACRE-FEET) = 9.1681

2 4 - H O U R S T O R M
R U N O F F H Y D R O G R A P H

HYDROGRAPH IN FIVE-MINUTE UNIT INTERVALS(CFS)
(Note: Time indicated is at END of Each Unit Intervals)

TIME(HRS)	VOLUME(AF)	Q(CFS)	0.	12.5	25.0	37.5	50.0
12.000	3.4496	4.73	Q	V			
12.083	3.4822	4.74	Q	V			
12.167	3.5142	4.64	Q	V			
12.250	3.5452	4.50	Q	V			
12.333	3.5760	4.47	Q	V			
12.417	3.6069	4.49	Q	V			
12.500	3.6381	4.53	Q	V			
12.583	3.6695	4.57	Q	V			
12.667	3.7013	4.61	Q	V			
12.750	3.7334	4.66	Q	V			
12.833	3.7659	4.71	Q	V			
12.917	3.7987	4.76	Q	V			
13.000	3.8318	4.81	Q	V			
13.083	3.8654	4.87	Q	V			
13.167	3.8993	4.93	Q	V			
13.250	3.9337	4.99	Q	V			
13.333	3.9684	5.05	Q	V			
13.417	4.0036	5.11	Q	V			
13.500	4.0393	5.18	Q	V			
13.583	4.0754	5.25	Q	V			
13.667	4.1121	5.32	Q	V			
13.750	4.1493	5.40	Q	V			
13.833	4.1870	5.48	Q	V			
13.917	4.2254	5.57	Q	V			
14.000	4.2643	5.65	Q	V			
14.083	4.3040	5.77	Q	V			
14.167	4.3451	5.96	Q	V			
14.250	4.3878	6.20	Q	V			
14.333	4.4317	6.37	Q	V			
14.417	4.4764	6.50	Q	V			
14.500	4.5221	6.63	Q	V			
14.583	4.5686	6.76	Q	V			
14.667	4.6162	6.91	Q	V			
14.750	4.6648	7.06	Q	V			
14.833	4.7146	7.23	Q	V			
14.917	4.7656	7.41	Q	V			
15.000	4.8181	7.61	Q	V			
15.083	4.8720	7.83	Q	V			
15.167	4.9276	8.07	Q	V			
15.250	4.9850	8.34	Q	V			
15.333	5.0446	8.65	Q	V			
15.417	5.1055	8.84	Q	V			
15.500	5.1630	8.34	Q	V			
15.583	5.2155	7.64	Q	V			
15.667	5.2687	7.73	Q	V			
15.750	5.3262	8.35	Q	V			
15.833	5.3903	9.30	Q	V			
15.917	5.4647	10.80	Q	V			
16.000	5.5591	13.71	Q	V			
16.083	5.7052	21.21	Q	V			
16.167	5.9641	37.59		V	Q		
16.250	6.2449	40.78		V	Q		
16.333	6.4080	23.68	Q	V			
16.417	6.4983	13.12	Q	V			
16.500	6.5659	9.80	Q	V			
16.583	6.6299	9.31	Q	V			
16.667	6.6906	8.81	Q	V			
16.750	6.7471	8.21	Q	V			
16.833	6.8001	7.69	Q	V			
16.917	6.8503	7.30	Q	V			
17.000	6.8983	6.97	Q	V			
17.083	6.9442	6.66	Q	V			
17.167	6.9877	6.31	Q	V			
17.250	7.0287	5.96	Q	V			
17.333	7.0680	5.71	Q	V			
17.417	7.1060	5.51	Q	V			
17.500	7.1429	5.35	Q	V			
17.583	7.1787	5.20	Q	V			

17.667	7.2136	5.07	.	Q	.	.	.V	.	
17.750	7.2477	4.95	.	Q	.	.	.V	.	
17.833	7.2809	4.83	.	Q	.	.	.V	.	
17.917	7.3135	4.73	.	Q	.	.	.V	.	
18.000	7.3454	4.63	.	Q	.	.	. V	.	

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FLOW PROCESS FROM NODE 205.00 TO NODE 205.00 IS CODE = 11

>>>>>VIEW STREAM NUMBER 1 HYDROGRAPH<<<<<

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STREAM HYDROGRAPH IN FIVE-MINUTE UNIT INTERVALS(CFS)

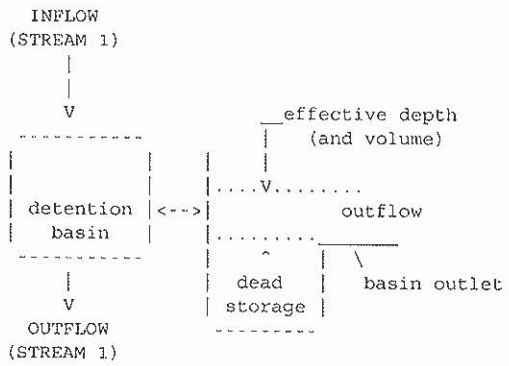
(Note: Time indicated is at END of Each Unit Intervals)

TIME(HRS)	VOLUME(AF)	Q(CFS)	0.	17.5	35.0	52.5	70.0
12.000	5.7005	9.73	.	Q .V	.	.	.
12.083	5.7679	9.78	.	Q . V	.	.	.
12.167	5.8347	9.71	.	Q . V	.	.	.
12.250	5.9006	9.57	.	Q . V	.	.	.
12.333	5.9659	9.49	.	Q . V	.	.	.
12.417	6.0309	9.44	.	Q . V	.	.	.
12.500	6.0959	9.43	.	Q . V	.	.	.
12.583	6.1609	9.45	.	Q . V	.	.	.
12.667	6.2264	9.50	.	Q . V	.	.	.
12.750	6.2923	9.58	.	Q . V	.	.	.
12.833	6.3589	9.67	.	Q . V	.	.	.
12.917	6.4261	9.76	.	Q . V	.	.	.
13.000	6.4941	9.86	.	Q . V	.	.	.
13.083	6.5627	9.97	.	Q . V	.	.	.
13.167	6.6322	10.08	.	Q . V	.	.	.
13.250	6.7025	10.20	.	Q . V	.	.	.
13.333	6.7736	10.32	.	Q . V	.	.	.
13.417	6.8455	10.45	.	Q . V	.	.	.
13.500	6.9184	10.58	.	Q . V	.	.	.
13.583	6.9923	10.72	.	Q . V	.	.	.
13.667	7.0671	10.87	.	Q . V	.	.	.
13.750	7.1430	11.02	.	Q . V	.	.	.
13.833	7.2199	11.17	.	Q . V	.	.	.
13.917	7.2980	11.34	.	Q . V	.	.	.
14.000	7.3773	11.51	.	Q . V	.	.	.
14.083	7.4580	11.72	.	Q . V	.	.	.
14.167	7.5408	12.02	.	Q . V	.	.	.
14.250	7.6261	12.39	.	Q . V	.	.	.
14.333	7.7138	12.72	.	Q . V	.	.	.
14.417	7.8036	13.05	.	Q . V	.	.	.
14.500	7.8956	13.36	.	Q . V	.	.	.
14.583	7.9897	13.66	.	Q . V	.	.	.
14.667	8.0858	13.95	.	Q . V	.	.	.
14.750	8.1840	14.26	.	Q . V	.	.	.
14.833	8.2845	14.59	.	Q . V	.	.	.
14.917	8.3873	14.93	.	Q . V	.	.	.
15.000	8.4928	15.31	.	Q . V	.	.	.
15.083	8.6010	15.72	.	Q . V	.	.	.
15.167	8.7124	16.17	.	Q. V	.	.	.
15.250	8.8273	16.67	.	Q. V	.	.	.
15.333	8.9460	17.24	.	Q. V	.	.	.
15.417	9.0678	17.70	.	Q V.	.	.	.
15.500	9.1878	17.42	.	Q. V.	.	.	.
15.583	9.3032	16.76	.	Q. V.	.	.	.
15.667	9.4181	16.68	.	Q. V.	.	.	.
15.750	9.5358	17.09	.	Q. V	.	.	.
15.833	9.6601	18.05	.	Q V	.	.	.
15.917	9.7975	19.94	.	.Q V	.	.	.
16.000	9.9613	23.79	.	. Q V	.	.	.
16.083	10.1900	33.21	.	. Q .V	.	.	.
16.167	10.5618	53.98	.	. . V	Q	.	.
16.250	11.0047	64.31	.	. . V	.	Q	.
16.333	11.3754	53.83	.	. . V	Q	.	.
16.417	11.6822	44.56	.	. . VQ	.	.	.
16.500	11.9364	36.90	.	. .Q V	.	.	.
16.583	12.1442	30.17	.	. Q . V	.	.	.
16.667	12.3141	24.68	.	. Q . V	.	.	.
16.750	12.4582	20.92	.	.Q . V	.	.	.
16.833	12.5865	18.63	.	Q . V	.	.	.
16.917	12.7041	17.08	.	Q. . V	.	.	.
17.000	12.8140	15.96	.	Q. . V	.	.	.
17.083	12.9176	15.04	.	Q . . V	.	.	.

17.167	13.0154	14.20	.		Q	.	.	V	.	.
17.250	13.1079	13.42	.		Q	.	.	V	.	.
17.333	13.1959	12.79	.		Q	.	.	V	.	.
17.417	13.2802	12.23	.		Q	.	.	V	.	.
17.500	13.3612	11.76	.		Q	.	.	V	.	.
17.583	13.4394	11.36	.		Q	.	.	V	.	.
17.667	13.5152	11.01	.		Q	.	.	V	.	.
17.750	13.5889	10.70	.		Q	.	.	V	.	.
17.833	13.6608	10.43	.		Q	.	.	V	.	.
17.917	13.7309	10.18	.		Q	.	.	V	.	.
18.000	13.7994	9.95	.		Q	.	.	V	.	.

****
FLOW PROCESS FROM NODE 205.00 TO NODE 205.00 IS CODE = 3.1

>>>>>FLOW-THROUGH DETENTION BASIN ROUTING MODEL APPLIED TO STREAM #1<<<<<
==========



ROUTE RUNOFF HYDROGRAPH FROM STREAM NUMBER 1
THROUGH A FLOW-THROUGH DETENTION BASIN
SPECIFIED BASIN CONDITIONS ARE AS FOLLOWS:
DEAD STORAGE(AF) = 0.000
SPECIFIED DEAD STORAGE(AF) FILLED = 0.000
SPECIFIED EFFECTIVE VOLUME(AF) FILLED ABOVE OUTLET = 0.000
DETENTION BASIN CONSTANT LOSS RATE(CFS) = 0.00

BASIN DEPTH VERSUS OUTFLOW AND STORAGE INFORMATION:

INTERVAL NUMBER	DEPTH (FT)	OUTFLOW (CFS)	STORAGE (AF)
1	0.00	0.00	0.000
2	1.00	0.02	0.140
3	2.00	0.03	0.340
4	3.00	0.05	0.590
5	4.00	0.10	0.890
6	5.00	0.12	1.250
7	6.00	0.15	1.680
8	7.00	61.00	2.170

==========
MODIFIED-PULS BASIN ROUTING MODEL RESULTS(5-MINUTE COMPUTATION INTERVALS):
(Note: Computed EFFECTIVE DEPTH and VOLUME are estimated at the clock time;
MEAN OUTFLOW is the average value during the unit interval.)

CLOCK TIME (HRS)	DEAD-STORAGE FILLED(AF)	INFLOW (CFS)	LOSS (CFS)	EFFECTIVE DEPTH(FT)	MEAN OUTFLOW (CFS)	EFFECTIVE VOLUME(AF)
12.083	0.000	9.78	0.00	6.16	9.7	1.757
12.167	0.000	9.71	0.00	6.16	9.7	1.757
12.250	0.000	9.57	0.00	6.16	9.7	1.756
12.333	0.000	9.49	0.00	6.15	9.6	1.756
12.417	0.000	9.44	0.00	6.15	9.5	1.755
12.500	0.000	9.43	0.00	6.15	9.5	1.755
12.583	0.000	9.45	0.00	6.15	9.4	1.755
12.667	0.000	9.50	0.00	6.15	9.5	1.755
12.750	0.000	9.58	0.00	6.15	9.5	1.756
12.833	0.000	9.67	0.00	6.16	9.6	1.756
12.917	0.000	9.76	0.00	6.16	9.7	1.757

13.000	0.000	9.86	0.00	6.16	9.8	1.758
13.083	0.000	9.97	0.00	6.16	9.9	1.759
13.167	0.000	10.08	0.00	6.16	10.0	1.759
13.250	0.000	10.20	0.00	6.16	10.1	1.760
13.333	0.000	10.32	0.00	6.17	10.2	1.761
13.417	0.000	10.45	0.00	6.17	10.3	1.762
13.500	0.000	10.58	0.00	6.17	10.4	1.763
13.583	0.000	10.72	0.00	6.17	10.6	1.764
13.667	0.000	10.87	0.00	6.17	10.7	1.766
13.750	0.000	11.02	0.00	6.18	10.8	1.767
13.833	0.000	11.17	0.00	6.18	11.0	1.768
13.917	0.000	11.34	0.00	6.18	11.2	1.769
14.000	0.000	11.51	0.00	6.18	11.3	1.771
14.083	0.000	11.72	0.00	6.19	11.5	1.772
14.167	0.000	12.02	0.00	6.19	11.7	1.774
14.250	0.000	12.39	0.00	6.20	12.0	1.777
14.333	0.000	12.72	0.00	6.20	12.3	1.779
14.417	0.000	13.05	0.00	6.21	12.7	1.782
14.500	0.000	13.36	0.00	6.21	13.0	1.785
14.583	0.000	13.66	0.00	6.22	13.3	1.787
14.667	0.000	13.95	0.00	6.22	13.6	1.790
14.750	0.000	14.26	0.00	6.23	13.9	1.792
14.833	0.000	14.59	0.00	6.23	14.2	1.795
14.917	0.000	14.93	0.00	6.24	14.5	1.797
15.000	0.000	15.31	0.00	6.25	14.9	1.800
15.083	0.000	15.72	0.00	6.25	15.3	1.803
15.167	0.000	16.17	0.00	6.26	15.7	1.807
15.250	0.000	16.67	0.00	6.27	16.1	1.811
15.333	0.000	17.24	0.00	6.28	16.6	1.815
15.417	0.000	17.70	0.00	6.28	17.1	1.819
15.500	0.000	17.42	0.00	6.28	17.4	1.819
15.583	0.000	16.76	0.00	6.28	17.2	1.816
15.667	0.000	16.68	0.00	6.27	16.9	1.814
15.750	0.000	17.09	0.00	6.28	16.9	1.816
15.833	0.000	18.05	0.00	6.29	17.3	1.821
15.917	0.000	19.94	0.00	6.31	18.3	1.832
16.000	0.000	23.79	0.00	6.36	20.4	1.855
16.083	0.000	33.21	0.00	6.47	25.3	1.910
16.167	0.000	53.98	0.00	6.72	36.2	2.032
16.250	0.000	64.31	0.00	6.92	50.0	2.131
16.333	0.000	53.83	0.00	6.90	55.4	2.120
16.417	0.000	44.56	0.00	6.80	51.7	2.070
16.500	0.000	36.90	0.00	6.68	45.1	2.014
16.583	0.000	30.17	0.00	6.57	38.2	1.959
16.667	0.000	24.68	0.00	6.47	31.7	1.910
16.750	0.000	20.92	0.00	6.39	26.4	1.872
16.833	0.000	18.63	0.00	6.34	22.4	1.846
16.917	0.000	17.08	0.00	6.30	19.7	1.828
17.000	0.000	15.96	0.00	6.28	17.8	1.816
17.083	0.000	15.04	0.00	6.26	16.4	1.806
17.167	0.000	14.20	0.00	6.24	15.3	1.798
17.250	0.000	13.42	0.00	6.23	14.4	1.792
17.333	0.000	12.79	0.00	6.22	13.6	1.786
17.417	0.000	12.23	0.00	6.21	13.0	1.781
17.500	0.000	11.76	0.00	6.20	12.4	1.776
17.583	0.000	11.36	0.00	6.19	11.9	1.773
17.667	0.000	11.01	0.00	6.18	11.5	1.770
17.750	0.000	10.70	0.00	6.18	11.1	1.767
17.833	0.000	10.43	0.00	6.17	10.8	1.764
17.917	0.000	10.18	0.00	6.17	10.5	1.762
18.000	0.000	9.95	0.00	6.16	10.2	1.760

PROCESS SUMMARY OF STORAGE:

INFLOW VOLUME = 19.064 AF

BASIN STORAGE = 0.001 AF (WITH 0.000 AF INITIALLY FILLED)

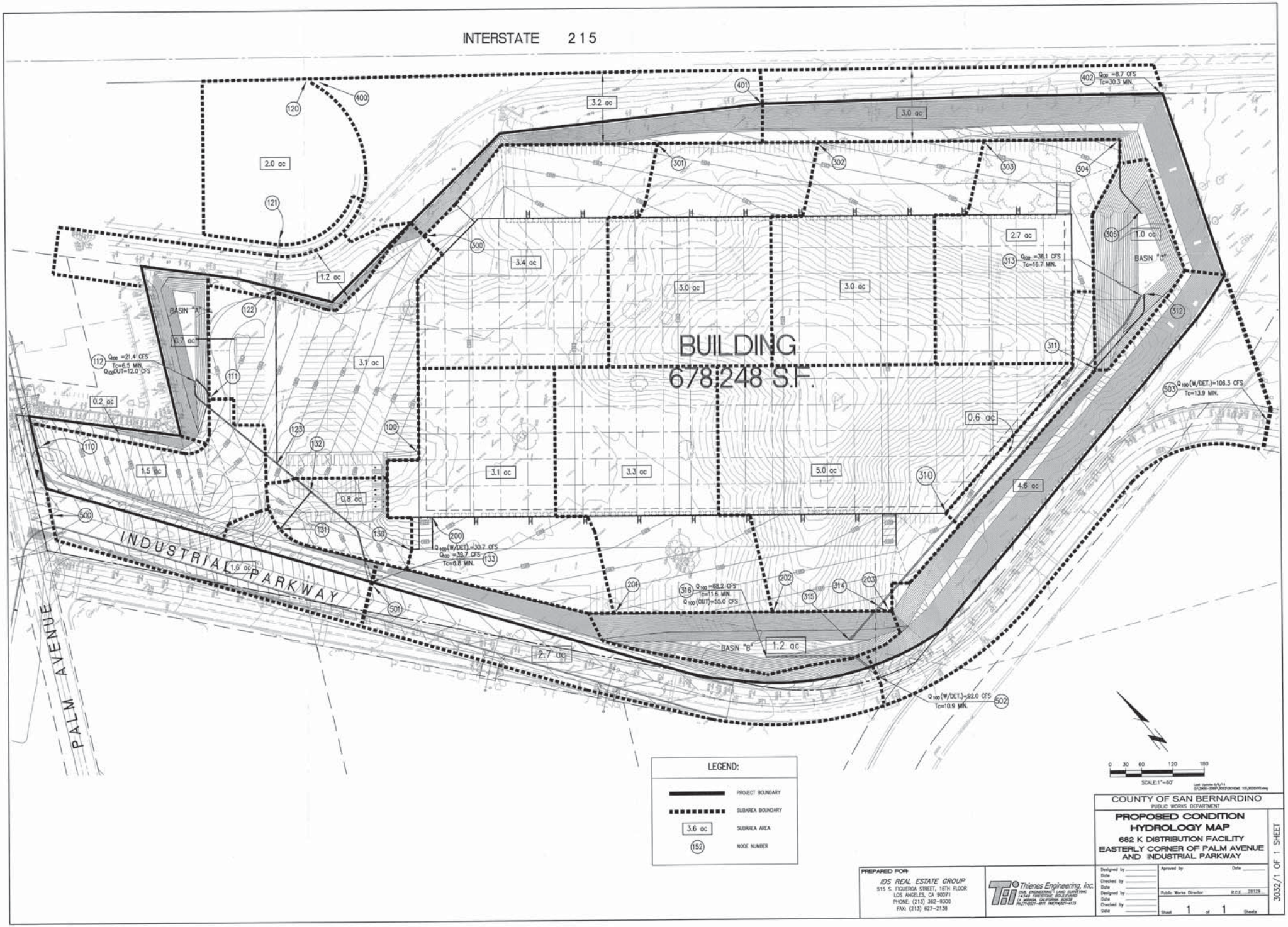
OUTFLOW VOLUME = 19.063 AF

LOSS VOLUME = 0.000 AF

END OF FLOODSCx ROUTING ANALYSIS

APPENDIX D

HYDROLOGY MAP


INTERSTATE 215
BUILDING
678,248 S.F.
BASIN "A"
BASIN "B"
BASIN "C"
PALM AVENUE
INDUSTRIAL PARKWAY
LEGEND:
PROJECT BOUNDARY
SUBAREA BOUNDARY
SUBAREA AREA
NODE NUMBER
SCALE:1"=60'
COUNTY OF SAN BERNARDINO
PUBLIC WORKS DEPARTMENT
PROPOSED CONDITION
HYDROLOGY MAP
682 K DISTRIBUTION FACILITY
EASTERLY CORNER OF PALM AVENUE
AND INDUSTRIAL PARKWAY
3032/1 OF 1 SHEET
PREPARED FOR:
IDS REAL ESTATE GROUP
515 S. FIGUEROA STREET, 16TH FLOOR
LOS ANGELES, CA 90071
PHONE: (213) 362-9300
FAX: (213) 627-2138
Thienes Engineering, Inc.
CIVIL ENGINEERING * LAND SURVEYING
14349 FIRESTONE BOULEVARD
LA MIRADA, CALIFORNIA 90638
(714)521-4811 (WITH(627-4113
Designed by
Date
Checked by
Date
Designed by
Date
Checked by
Date
Aproved by
Date
Public Works Director
R.C.E. 28128
Sheet 1 of 1 Sheets

Water Quality Management Plan (Revised)

WATER QUALITY MANAGEMENT PLAN (WQMP)

FOR

PALM AVENUE DISTRIBUTION CENTER
E.C. OF PALM AVENUE AND INDUSTRIAL PARKWAY
SAN BERNARDINO COUNTY, CALIFORNIA 92407
"SCHEME 1D"

PREPARED FOR

IDS REAL ESTATE GROUP-L.A.
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MARCH 7, 2011

JOB NO. 3032

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WATER QUALITY MANAGEMENT PLAN
(WQMP)

FOR

PALM AVENUE DISTRIBUTION CENTER

PREPARED BY SHELLY MCMASTERS
UNDER THE SUPERVISION OF

REINHARD STENZEL DATE:
R.C.E. 56155
EXP. 12/31/12

Attachment A "WQMP"
for
"Palm Avenue Distribution Center"

San Bernardino County Stormwater Program

WATER QUALITY MANAGEMENT PLAN TEMPLATE

WATER QUALITY MANAGEMENT PLAN (WQMP)

For compliance with Santa Ana Regional Water Quality Control Board

Order Number R8-2002-0012 (NPDES Permit No. CAS618036)

for

PALM AVENUE DISTRIBUTION CENTER
E.C. OF PALM AVENUE AND INDUSTRIAL PARKWAY
SAN BERNARDINO COUNTY, CALIFORNIA 92407

Prepared for:
IDS REAL ESTATE GROUP-L.A.
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P. (213) 362-9300
FAX. (213) 627-2138
CONTACT: PATRICK SPILLANE

WQMP Preparation Date
MARCH 7, 2011

WATER QUALITY MANAGEMENT PLAN (WQMP)

PROJECT SITE INFORMATION

Name of Project: Palm Avenue Distribution Center

Project Location: E.C. of Palm Ave. & Industrial Pkwy., San Bernardino County, Ca. 92407

Size of Significant Re-Development on an Already Developed Site (in feet^2): N/A

Size of New Development (in feet^2): 1,677,060 square feet

Number of Home Subdivisions: N/A

SIC Codes: 1541 General Contractors-Industrial Buildings and Warehouses

Erosive Site Conditions?: N/A

Natural Slope More Than 25%?: Yes

WATER QUALITY MANAGEMENT PLAN (WQMP)

Check the appropriate project category below:

Check below	**Project Categories**
	1. All significant re-development projects. Significant re-development is defined as the addition or creation of 5,000 or more square feet of impervious surface on an already developed site. This includes, but is not limited to, additional buildings and/or structures, extension of existing footprint of a building, construction of parking lots, etc. Where redevelopment results in an increase of less than fifty percent of the impervious surfaces of a previously existing development, and the existing development was not subject to SUSMPs, the design standards apply only to the addition, and not the entire development. When the redevelopment results in an increase of more than fifty percent of the impervious surfaces, then a WQMP is required for the entire development (new and existing).
	2. Home subdivisions of 10 units or more. This includes single family residences, multi-family residence, condominiums, apartments, etc.
X	3. Industrial/commercial developments of 100,000 square feet or more. Commercial developments include non-residential developments such as hospitals, educational institutions, recreational facilities, mini-malls, hotels, office buildings, warehouses, and light industrial facilities.
	4. Automotive repair shops (with SIC codes 5013, 5014, 5541, 7532- 7534, 7536-7539).
	5. Restaurants where the land area of development is 5,000 square feet or more.
	6. Hillside developments of 10,000 square feet or more which are located on areas with known erosive soil conditions or where the natural slope is twenty-five percent or more.
	7. Developments of 2,500 square feet of impervious surface or more adjacent to (within 200 feet) or discharging directly into environmentally sensitive areas such as areas designated in the Ocean Plan as areas of special biological significance or waterbodies listed on the CWA Section 303(d) list of impaired waters.
X	8. Parking lots of 5,000 square feet or more exposed to storm water. Parking lot is defined as land area or facility for the temporary storage of motor vehicles.
	The project does not fall into any of the categories described above. (If the project requires a precise plan of development [e.g. all commercial or industrial projects, residential projects of less than 10 dwelling units, and all other land development projects with potential for significant adverse water quality impacts] or subdivision of land, it is defined as a Non-Category Project.)

Section 1
Introduction And Project Description

1.1 Project Information

- IDS Real Estate Group-L.A.
- 515 S. Figueroa St. Los Angeles, Ca. 90071
- P. (213) 362-9300

Project Site Location

- E.C. of Palm Ave. & Industrial Pkwy. San Bernardino County, Ca. 92407

1.2 Permits

- A.P.N. # 0266-041-62

1.3 Project Description

The proposed industrial site encompasses approximately 38.5 acres in San Bernardino County, Ca.
Please see vicinity map and site plan in attachment "F" for details.
Proposed improvements to the site consist of the construction of one industrial type building approximately 626,198 square feet. Proposed truck docks will be on the northerly and southerly sides of the building and the trash compactors will be located in the truck docks. Proposed landscaping will be located throughout the site. The remainder of the site will be paved for vehicle and truck parking. Proposed infiltration basins will be located on the westerly, southerly and easterly sides of the site.

1.4 Site Description

The project site is currently an undeveloped dirt lot and generally drains from the north to the south.

In the developed condition, the entire site will discharge into these three infiltration basins. Please see Attachment "F" for locations of the BMP's.

The stormwater runoff will discharge into the Lytle Creek via Cajon Wash. The Cajon Wash is not an impaired water body, the Lytle Creek is impaired for Pathogens. Ultimately the runoff will discharge into the Santa Ana River (Reach 3) which is impaired for Bacteria Indicators/Pathogens.

Section 2
Pollutants of concern and hydrologic conditions of concern

2.1 Pollutants of Concern (NOT REQUIRED FOR NON-CATEGORY PROJECTS)

Use Table 2-1 in the WQMP Guidance to identify the potential pollutants expected to be generated by the development. List all expected pollutants of concern for the project site as directed below:

- Parking Lots (>5,000 ft^2)
  Bacteria/Virus- Potential
  Heavy Metals- Expected
  Nutrients- Potential
  Pesticides- Potential
  Organic Compounds- Expected
  Sediments- Potential
  Trash and Debris- Expected
  Oxygen Demanding Substances- Potential
  Oil and Grease- Expected

- Identify pollutants of concern in the receiving waters as follows:

- 1. The project site's runoff will surface drain to the Lytle Creek via Cajon Wash. Lytle creek is an impaired water body for Pathogens. Runoff will continue to the Santa Ana River (Reach 3) which is an impaired water body for Bacteria Indicators/Pathogens.
  The Hydrologic Unit Number for Santa Ana River (Reach 3) – Primary 801.21 and Secondary 801.27, 801.25.

2. The proximate receiving water for the drainage discharge points on this site is the Cajon Wash/Lytle Creek and the downstream receiving water is the Santa Ana River (Reach 3). In Table B-1, Lytle Creek is listed as an impaired water body for Pathogens. The Santa Ana River (Reach 3) is listed as impaired for Bacteria Indicators/Pathogens. Bacteria/Viruses and Nutrients are not necessarily expected from the project site but are routinely detected in stormwater runoff from paved areas and landscaping.

3. The expected pollutants from the project site are Heavy Metals, Organic Compounds, Trash & Debris and Oil & Grease.

Summarize identified pollutants of concern by checking the applicable boxes in the following table. (For identified pollutants of concern that are causing impairment in receiving waters, the project WQMP shall incorporate one or more Treatment Control BMPs of medium or high effectiveness in reducing those pollutants.)

Pollutant of Concern Summary Table

Pollutant Type	Expected	Potential	Listed for Receiving Water
Bacteria/Virus		X	YES
Heavy Metals	X		NO
Nutrients		X	NO
Pesticides		X	NO
Organic Compounds	X		NO
Sediments		X	NO
Trash & Debris	X		NO
Oxygen Demanding Substances		X	NO
Oil & Grease	X		NO
Other—specify pollutant(s):			

The treatment controls BMPs that will be incorporated into this project, with medium/high effectiveness to reduce the pollutants of concern, are infiltration basins.

2.2 HYDROLOGIC CONDITIONS OF CONCERN (NOT REQUIRED FOR NON-CATEGORY PROJECTS)

All Category projects must identify any hydrologic condition of concern (HCOC) that will be caused by the project, and implement Site Design, Source Control, and/or Treatment Control BMPs to address identified impacts. Project proponents must follow the procedure for identifying HCOCs specified in Section 2.3 of the Model WQMP. Use the following Table and instructions as a guide.

1. (from Section 2.3, Part 2): Determine if the project will create a Hydrologic Condition of Concern. Check "yes" or "no" as applicable and proceed to the appropriate section as outlined below.	**Yes**	**No**
A. All downstream conveyance channels, that will receive runoff from the project, are engineered, hardened (concrete, riprap or other), and regularly maintained to ensure design flow capacity, and no sensitive stream habitat areas will be affected. Engineered, hardened, and maintained channels include channel reaches that have been fully and properly approved (including CEQA review, and permitting by USACOE, RWQCB and California Dept. of Fish & Game) by June 1, 2004 for construction and hardening to achieve design capacity, whether construction of the channels is complete. Discharge from the project will be in full compliance with Agency requirements for connections and discharges to the MS4, including both quality and quantity requirements, and the project will be permitted by the Agency for the connection or discharge to the MS4.		X
B. Project runoff rates, volumes, velocities, and flow duration for the post-development condition will not exceed those of the pre-development condition for 1-year, 2-year and 5-year frequency storm events. This condition will be substantiated with hydrologic modeling methods that are acceptable to the Agency, to the U.S. Army Corps of Engineers (USACOE), and to local watershed authorities.	X	
C. Can the conditions in part A or B above be demonstrated for the project?	X	
▪ If the answer for A, B, and/or C above is yes, then the project does not create a HCOC—in this case go to Section 3. ▪ If the answer for C above is no, the go to section 2.3. Part 3, below.		

2. (from Section 2.3, Part 3): The WQMP for projects that create a HCOC must include an evaluation of whether the project will adversely impact downstream erosion, sedimentation or stream habitat. The Agency may require that the evaluation be conducted by a registered civil engineer in the State of California, with experience in fluvial geomorphology. Perform the required evaluation as specified in A – F below. Check the boxes "yes" or "no" to verify a complete report and proceed to appropriate section based on results.

Does the evaluation include:	Yes	No
A. An evaluation of potential impacts to all downstream channel reaches.		
B. Consideration of the hydrology of the entire watershed. Review all applicable drainage area master plans to the extent available, to identify BMP requirements for new development that address cumulative inputs from development in the watershed.		
C. Consultation with all applicable agencies including the USACOE; local watershed authorities (e.g. San Timoteo Watershed Management Authority and SAWPA [Santa Ana Watershed Project Authority]); U.S. Geological Survey (USGS); California Dept. of Fish & Game (CDFG); and the Principal Permittee; to determine any areas of potential hydrologic impact.		
D. An evaluation of any available hydrologic modeling results. Modeling may have been performed by USGS, USACOE, local watershed authorities, the Principal Permittee, or other local jurisdiction.		
E. A field reconnaissance to evaluate any natural or partially natural downstream reaches, or other sensitive habitat. The field reconnaissance must evaluate representative downstream conditions, including undercutting erosion, slope/bank stability, vegetative stress (due to flooding, erosion, water quality degradation, or loss of water supplies), and the area's susceptibility to adverse impacts resulting from an altered flow regime or change in sediment supply and/or sediment transport .		
F. A report that summarizes the findings of evaluation components A through E above, and that considers the project's location, topography, soil and vegetation conditions, proportion of impervious surfaces, natural and infrastructure drainage features, and any other relevant hydrologic and environmental factors to be protected specific to the project's watershed. The report must provide a determination of whether the project will adversely impact any downstream erosion, sedimentation or stream habitat, and identify any areas where adverse impacts are expected.		

- Is the report required by 2.3, Part 3.f complete? (Attach the report) If not, perform the required evaluation and add to the report.
- Does the report determine that the project will have an adverse downstream impact?
- If yes, then go to Section 2.3, Part 4, below.
- If no, then go to Section 3.

3. (from Section 2.3, Part 4): If the evaluation specified in (3) above, determines that adverse impacts to downstream erosion, sedimentation or stream habitat will occur, then the project proponent must perform the requirements specified in A, B, and C, below. Check the boxes "yes" or "no" to verify all requirements have been completed.	**YES**	**NO**
A. Conduct hydrologic modeling of the project and the potentially impacted areas, according to modeling standards recommended by the Agency or local watershed authority, for the 1-year, 2-year, and 5-year frequency storm events, at a minimum. Hydrologic modeling results must include determination of peak flow rate, flow velocity, runoff volume, time of concentration, and retention volume for the project area.		
B. Ensure that the project will be consistent with any approved master plans of drainage or analogous plans or programs.		
C. Implement Site Design BMPs as specified in Section 2.5.1, and recommend any additional BMPs that will be implemented to mitigate the adverse impacts identified in (3.F) above.		

- Are the requirements for Section 2.3 Part 4 adequate? (Attach report/results)
- Has the project proponent recommended BMPs to mitigate any impacts based on the modeling?
- If yes, then list/describe BMPs:
- If no, then explain how mitigation will be achieved:
- Will the BMPs be effective?
- Does the Agency have any additional requirements?
- Verify with Agency before submitting the project WQMP.

2.3 WATERSHED IMPACT OF PROJECT

The project proponent must include in the project WQMP:

- An evaluation of the pollutants of concern and/or hydrologic conditions of concern associated with the project, and a determination of whether the project will cause any significant impact(s) to any downstream receiving waters, alone or in conjunction with other projects in the watershed.
- A description of how any adverse impacts will effectively be mitigated through the incorporation and implementation of BMPs.

SECTION 3
BEST MANAGEMENT PRACTICE SELECTION PROCESS

3.1 SITE DESIGN BMPS

For listed Site Design BMPs, indicate in the following table whether it will be used (yes/no) and describe how used, or, if not used, provide justification/alternative. Provide detailed descriptions of planned Site Design BMPs, if applicable.

1. Minimize Stormwater Runoff, Minimize Project's Impervious Footprint, and Conserve Natural Areas		
Maximize the permeable area. This can be achieved in various ways, including but not limited to, increasing building density (number of stories above or below ground) and developing land use regulations seeking to limit impervious surfaces.		
Yes X	No	
Describe actions taken or justification/alternative: The site will drain to three infiltration basins.		
Runoff from developed areas may be reduced by using alternative materials or surfaces with a lower Coefficient of Runoff, or "C-Factor".		
Yes	No X	
Describe actions taken or justification/alternative: As an alternative, the site will drain to infiltration basins for treatment of storm water runoff.		
Conserve natural areas. This can be achieved by concentrating or clustering development on the least environmentally sensitive portions of a site while leaving the remaining land in a natural, undisturbed condition.		
Yes	No **X**	
Describe actions taken or justification/alternative: No significant environmentally sensitive natural areas/vegetation is to be preserved.		

Construct walkways, trails, patios, overflow parking lots, alleys, driveways, low-traffic streets, and other low-traffic areas with open-jointed paving materials or permeable surfaces, such as pervious concrete, porous asphalt, unit pavers, and granular materials.		
Yes X	No **X**	
Describe actions taken or justification/alternative: As an alternative, site will drain to infiltration basins.		
Construct streets, sidewalks, and parking lot aisles to the minimum widths necessary, provided that public safety and a pedestrian friendly environment are not compromised[1]. Incorporate landscaped buffer areas between sidewalks and streets.		
Yes **X**	No	
Describe actions taken or justification/alternative: Incorporate landscaped buffer areas between site and streets. Aisles are at the minimum 26', stall are at minimum 17' plus overhang and walks are 5' wide (minimum handicap access).		
Reduce widths of street where off-street parking is available[2].		
Yes	No **X**	
Describe actions taken or justification/alternative: No new public streets are being constructed for this project.		
Maximize canopy interception and water conservation by preserving existing native trees and shrubs, and planting additional native or drought tolerant trees and large shrubs.		
Yes	No **X**	
Describe actions taken or justification/alternative: There are no existing native trees and shrubs to preserve. Proposed landscaping provides additional plants and trees that are appropriate for the area conditions.		

[1] Sidewalk widths must still comply with Americans with Disabilities Act regulations and other life safety requirements.

[2] However, street widths must still comply with life safety requirements for fire and emergency vehicle access.

Other comparable site design options that are equally effective.
Describe actions taken _or justification/alternative: None
Minimize the use of impervious surfaces, such as decorative concrete, in the landscape design.
Yes **X** | No |
Describe actions taken _or justification/alternative: Landscaped area does not use decorative concrete. Walk ways through the landscaped area for building access.
Use natural drainage systems.
Yes | No **X** |
Describe actions taken or justification/alternative: No existing natural drainage systems. Site runoff is directed to infiltration basins that are sized according to the volume based water quality objectives in this WQMP.
Where soils conditions are suitable, use perforated pipe or gravel filtration pits for low flow infiltration[3].
Yes X | No |
Describe actions taken or justification/alternative: Site runoff is directed to infiltration basins.
Construct onsite ponding areas, rain gardens, or retention facilities to increase opportunities for infiltration, while being cognizant of the need to prevent the development of vector breeding areas.
Yes X | No |
Describe actions taken or justification/alternative: Site runoff is directed to infiltration basins.

[3]However, projects must still comply with hillside grading ordinances that limit or restrict infiltration of runoff. Infiltration areas may be subject to regulation as Class V injection wells and may require a report to the USEPA. Consult the Agency for more information on use of this type of facility.

2. Minimize Directly Connected Impervious Areas

Where landscaping is proposed, drain rooftops into adjacent landscaping prior to discharging to the storm drain.

Yes	No X	

Describe actions taken or justification/alternative:

As an alternative, ultimately the roof runoff will discharge into infiltration basins.

Where landscaping is proposed, drain impervious sidewalks, walkways, trails, and patios into adjacent landscaping.

Yes X	No	

Describe actions taken or justification/alternative:

Walkways adjacent to landscaping will be graded to drain to the landscaping.

Increase the use of vegetated drainage swales in lieu of underground piping or imperviously lined swales.

Yes X	No	

Describe actions taken or justification/alternative:

The entire site will drain to infiltration basins.

Use one or more of the following:

Yes	No	Design Feature
	X	Rural swale system: street sheet flows to vegetated swale or gravel shoulder, curbs at street corners, culverts under driveways and street crossings
	X	Urban curb/swale system; street slopes to curb; periodic swale inlets drain to vegetated swale/biofilter.
	X	Dual drainage system: First flush captured in street catch basins and discharged to adjacent vegetated swale or gravel shoulder, high flows connect directly to municipal storm drain systems.
X		Other comparable design concepts that is equally effective.

Describe actions taken or justification/alternative:

No streets on the site, the site and the site drive isles runoff will be directed to infiltration basins.

Use one or more of the following features for design of driveways and private residential parking areas:		
Yes	No	Design Feature
	X	▪ Design driveways with shared access, flared (single lane at street) or wheel strips (paving only under tires); or, drain into landscaping prior to discharging to the municipal storm drain system.
	X	▪ Uncovered temporary or guest parking on private residential lots may be paved with a permeable surface; or designed to drain into landscaping prior to discharging to the municipal storm drain system.
	X	▪ Other comparable design concepts that is equally effective.
Describe actions taken or justification/alternative: This is not a residential development.		

Use one or more of the following design concepts for the design of parking areas:		
Yes	**No**	Design Feature
X		Where landscaping is proposed in parking areas, incorporate landscape areas into the drainage design.
	X	Overflow parking (parking stalls provided in excess of the Agency's minimum parking requirements) may be constructed with permeable paving.
	X	Other comparable design concepts that is equally effective.
Describe actions taken or justification/alternative: All parking areas will drain to infiltration basins.		

3.2 SOURCE CONTROL BMPS

Complete the following selection table for Source Control BMPs, by checking boxes that are applicable. All listed BMPs shall be implemented for the project. Where a required Source Control BMP is not applicable to the project due to project characteristics, justification and/or alternative practices for preventing pollutants must be provided. In addition to completing the following tables, provide detailed descriptions on the implementation of planned Source Control BMPs.

Source Control BMP Selection Matrix*

Project Category	Source Control BMPs																							
	Education of Property Owners	*Activity Restrictions*	*Spill Contingency Plan*	*Employee Training/Education Program*	*Street Sweeping Private Street and Parking Lots*	*Common Areas Catch Basin Inspection*	*Landscape Planning (SD-10)*	*Hillside Landscaping*	*Roof Runoff Controls (SD-11)*	*Efficient Irrigation (SD-12)*	*Protect Slopes and Channels*	*Storm Drain Signage (SD-13)*	*Inlet Trash Racks*	*Energy Dissipaters*	*Trash Storage Areas (SD-32) and Litter Control*	*Fueling Areas (SD-30)*	*Air/Water Supply Area Drainage*	*Maintenance Bays and Docks (SD-31)*	*Vehicle Washing Areas (SD-33)*	*Outdoor Material Storage Areas (SD-34)*	*Outdoor Work Areas (SD-35)*	*Outdoor Processing Areas (SD-36)*	*Wash Water Controls for Food Preparation Areas*	*Pervious Pavement (SD-20)*	*Alternative Building Materials (SD-21)*
Significant Re-development																								
Home subdivisions of 10 or more units																								
Commercial/ Industrial Development >100,000 ft^2	X	X	X	X	X	X	X			X		X	X		X									
Automotive Repair Shop																								
Restaurants																								
Hillside Development >10,000 ft^2																								
Development of impervious surface >2,500 ft^2																								
Parking Lots >5,000 ft^2 of exposed storm water	X	X	X	X	X	X	X			X		X	X		X									

* Provide justification of each Source Control BMP that will not be incorporated in the project WQMP, or explanation of proposed equally effective alternatives in the following table.

Justification for Source Control BMPs not incorporated into the project WQMP			
Source Control BMP	Used in Project (yes/no)?	Justification/Alternative*	Implementation Description
Education of Property Owners	YES		Property owner will familiarize himself with the educational materials in Attachment "E".
Activity Restrictions	YES		No outdoor work areas, processing, storage w/o proper BMP's and WQMP amendment.
Spill Contingency Plan	YES		Owner/tenant will have spill contingency plan based on individual site needs.
Employee Training/Education Program	YES		The owner will familiarize themselves with educational materials and BMP fact sheets in attachment "E". The owner will ensure that the tenant is also familiar with onsite BMP's and necessary maintenance required of the tenant. Employees shall be trained to clean up spills and participate in ongoing maintenance. Maintenance schedule: owner will check with City and County at least once a year to obtain new or updated educational materials and provide these materials to tenants. Employees shall be trained to clean up spills and participate in ongoing maintenance. The WQMP requires annual employee training and new hires within 2 months.
Street Sweeping Private Street and Parking Lots	YES		All landscape maintenance contractors will be required to sweep up all landscape cuttings, mowings and fertilizer Materials off paved areas and dispose of properly. Weekly/as needed by sweeping contractor.
Common Areas Catch Basin Inspection	YES		Monthly inspection by property owner.
Landscape Planning (SD-10)	YES		All landscaped areas are to conserve irrigation water as well as rainwater, fertilizers, pesticides, etc.
Hillside Landscaping	NO	There are no hillsides.	
Roof Runoff Controls (SD-11)	NO		Roof runoff will ultimately drain to the infiltration basins.
Efficient Irrigation (SD-12)	YES		Rain shutoff/pressure drop valves, timers and inspection by the owner to limit over watering.
Protect Slopes and Channels	NO	No slopes or channels to protect	
Storm Drain Signage (SD-13)	YES		Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with

			prohibitive language such as "NO DUMPING-DRAINS TO OCEAN / RIVER"
Inlet Trash Racks	YES		Grate inlets prevent trash from entering storm drains.
Energy Dissipaters	YES		Riprap in the infiltration basin to prevent erosion in the basins.
Trash Storage Areas (SD-32) and Litter Control	YES		Weekly inspection, cleaning and sweeping of trash area by property owner. Trash to be removed weekly or more as needed. The trash enclosure areas will be paved with an impervious surface to mitigate spills. The trash container areas will not be below grade. The trash containers shall have lids or awning to prevent rainfall from entering containers. In addition, storm water runoff from adjoining roofs and pavement must be diverted around the trash area and signs should be posted informing users that hazardous materials are not to be disposed of therein.
Fueling Areas (SD-30)	NO	No fueling areas on site.	
Air/Water Supply Area Drainage	NO	No air/water supply area drainage	
Maintenance Bays and Docks (SC-30)	YES		Loading/unloading truck docks will be kept in a clean and orderly condition through a regular program of sweeping and litter control and immediate cleanup of spills and broken containers.
Vehicle Washing Areas (SD-33)	NO	No wash areas on site.	
Outdoor Material Storage Areas (SD-34)	NO	No material storage areas.	
Outdoor Work Areas (SD-35)	NO	No outdoor work areas.	
Outdoor Processing Areas (SD-36)	NO	No outdoor processing areas.	
Wash Water Controls for Food Preparation Areas	NO	No food preparation areas.	
Pervious Pavement (SD-20)	NO		As an alternative, runoff from the site will be directed to the infiltration basins.
Alternative Building Materials (SD-21)	NO	N/A	Standard building materials are being used in lieu of alternative materials. Infiltration basins and the pretreatment filters are more than adequate BMP controls.
*Attach additional sheets if necessary for justification.			

3.3 TREATMENT CONTROL BMPS (Not required for Non-Category projects)

- Complete the following Treatment Control BMP Selection Matrix. For each pollutant of concern enter "yes" if identified in Section 2.1, above, or "no" if not identified for the project. Check the boxes of selected BMPs that will be implemented for the project to address each pollutant of concern from the project as listed above in section 2.1. Treatment Control BMPs must be selected and installed with respect to identified pollutant characteristics and concentrations that will be discharged from the site. For any identified pollutants of concern not listed in the Treatment Control BMP Selection Matrix, provide an explanation of how they will be addressed by Treatment Control BMPs. For identified pollutants of concern that are causing an impairment in receiving waters (as identified in Section 2.1, above), the project WQMP shall incorporate one or more Treatment Control BMPs of medium or high effectiveness in reducing those pollutants. It is the responsibility of the project proponent to demonstrate, and document in the project WQMP, that all pollutants of concern will be fully addressed. The Agency may require information beyond the minimum requirements of this WQMP to demonstrate that adequate pollutant treatment is being accomplished.

- In addition to completing the Selection Matrix, provide detailed descriptions on the location, implementation, installation, and long-term O&M of planned Treatment Control BMPs.

Treatment Control BMP Selection Matrix

Pollutant of Concern	Treatment Control BMP Categories							
	Biofilters Vegetated Swales	**Detention Basins**	**Infiltration Basins**	**Wet Ponds or Wetlands**	**Filtration**	**Water Quality Inlets**	**Hydrodynamic Separator**	**Manufactured/ Proprietary Devices (FGP)**
Sediment/Turbidity	H/M	M	H/M	H/M	H/M	L	H/M (L for turbidity)	U
Yes/No? Yes			X					X
Nutrients	L	M	H/M	H/M	L/M	L	L	U
Yes/No? Yes			X					X
Organic Compounds	U	U	U	U	H/M	L	L	U
Yes/No? Yes			X					X
Trash & Debris	L	M	U	U	H/M	M	H/M	U
Yes/No? Yes			X					X
Oxygen Demanding Substances	L	M	H/M	H/M	H/M	L	L	U
Yes/No? Yes			X					X
Bacteria & Viruses	U	U	H/M	U	H/M	L	L	U
Yes/No? Yes			X					X
Oils & Grease	H/M	M	U	U	H/M	M	L/M	U
Yes/No? Yes			X					X
Pesticides (non-soil bound)	U	U	U	U	U	L	L	U
Yes/No? Yes			X					X
Metals	H/M	M	H	H	H	L	L	U
Yes/No? Yes			X					X

3.4 BMP DESIGN CRITERIA

- The following Treatment Control BMP(s) (Flow Based or Volume Based) will be implemented for this project (***check "Implemented" box, if used***):

Design Basis of Treatment Control BMPs

Implemented	Treatment Control BMP	Design Basis
	Vegetated Buffer Strips	Flow Based
	Vegetated Swale	
	Multiple Systems	
X	Manufactured/Proprietary (FGP)	
	Bioretention	Volume Based
	Wet Pond	
	Constructed Wetland	
	Extended Detention Basin	
	Water Quality Inlet	
	Retention/Irrigation	
X	Infiltration Basin	
	Infiltration Trench	
	Media Filter	
	Pervious Pavement	

3.4.1 Flow Based design Criteria

- Calculate the BMP design flow by using the approach presented in the WQMP Guidance (Section 2.5.2.1). Show calculations in detail—attach a separate sheet of calculations. See Attachment "D" for calculations.

3.4.2 VOLUME BASED DESIGN CRITERIA

- Calculate the required capture volume of the BMP using the approach presented in the WQMP Guidance (Section 2.5.2.2). Show calculations in detail—attach a separate sheet of calculations. See Attachment "D" for calculations.

Section 4
Operation and Maintenance

4.1 Operations and maintenance

Operation and maintenance (O&M) requirements for all Source Control, Site Design, and Treatment Control BMPs shall be identified within the WQMP. The WQMP shall include the following:

4.1.1 O&M DESCRIPTION AND SCHEDULE THAT MUST:

SD-10: Site Design & Landscape Planning

Description of BMP: Landscaping has been incorporated into the project plan and will be designed to promote conservation of rainwater, irrigation water, fertilizer, and pesticides. There is no significant environmentally sensitive natural areas/vegetation to preserve.

Maintenance Responsibility: Owner

Funding Source: Owner

Maintenance Schedule: Ongoing Landscape maintenance.

Start up date: Starting when landscaping is complete.

SD-12: Efficient Irrigation/**SC-73:** Landscape Maintenance

Description of BMP: Irrigation systems shall include reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines. Timers will be used to avoid over watering and watering cycles and duration shall be adjusted seasonally by the landscape maintenance contractor. The landscaping areas will be grouped with plants that have similar water requirements. Native or drought tolerant species shall also be used where appropriate to reduce excess irrigation runoff and promote surface filtration.

Maintenance Responsibility: Owner

Funding Source: Owner

Maintenance Schedule: Irrigation system shall be inspected monthly by landscape contractor to check for over-watering, leaks, or excessive runoff to paved areas. Landscape maintenance will be inspected and maintained weekly by a qualified contractor and all landscape waste will be disposed of properly.

Start up date: When landscaping is complete.

SD-13: Storm Drain Signage

Description of BMP: All storm drain catch basins and culverts shall have stenciling or labeling such as "No Dumping - Drains to River" and/or other graphical icons to alert the public to the

destination of pollutants discharged into storm water. The City can be contacted to determine specific requirements for placard types and methods of application.

Maintenance Responsibility: Owner

Funding Source: Owner

Maintenance Schedule: Legibility of stencils and signs must be maintained.

Start up date: When storm drain system is complete.

SD-31: Loading/Unloading Docks

Description of BMP: Loading/unloading docks will be kept in a clean and orderly condition through a regular program of sweeping and litter control and immediate cleanup of spills and broken containers.

Maintenance Responsibility: Owner/Tenant

Funding Source: Owner

Maintenance Schedule: Weekly inspections and continuous monitoring during loading and unloading of materials.

Start up date: When construction is complete.

SD-32: Trash Storage Area

Description of BMP: The trash enclosure areas will be paved with an impervious surface to mitigate spills. The trash container areas will not be below grade. The trash containers shall have lids or awning to prevent rainfall from entering containers. In addition, storm water runoff from adjoining roofs and pavement must be diverted around the trash area and signs should be posted informing users that hazardous materials are not to be disposed of therein.

Maintenance Responsibility: Owner/Tenant

Funding Source: Owner/tenant

Maintenance Schedule: Weekly inspection of trash area. Remove trash as needed.

Start up date: When construction is complete.

SC-11: Spill Prevention, Control and Cleanup

Description of BMP: Tenant shall have a spill contingency plan in place appropriate for anticipated materials that will be kept onsite. Proper clean up materials will be available for any spills. Any spills of liquid or materials will be cleaned up immediately.

Maintenance Responsibility: Tenant

Funding Source: tenant

Maintenance Schedule: Ongoing

Start up date: When project site is complete.

SC-41: Building and Grounds Maintenance

Description of BMP: Ongoing maintenance includes mowing, trimming, and planting in the landscaped areas. All plant cuttings, leaves, mowing and trimming waste will be swept up and removed from the property by the landscape contractor. Fertilizers and pesticides should be used properly and only when necessary and any waste fertilizer materials that spill onto paved areas will be swept up immediately by landscape contractor. Irrigation systems will be checked for leaks and over watering. Periodic washing of buildings and roof may also be needed.

Maintenance Responsibility: Owner

Funding Source: Owner

Maintenance Schedule: The owner will maintain site weekly or more often if necessary.

Start up date: When project site is complete.

SC-43: Parking/Storage Area Maintenance

Description of BMP: Parking lots and drive aisles will be swept weekly by a sweeping contractor to prevent sediment, garden waste, and trash from entering the storm drain systems.

Maintenance Responsibility: Owner

Funding Source: Owner

Maintenance Schedule: The owner will maintain site weekly or more often if necessary

Start up date: When paving is complete.

SC-44: Drainage System Maintenance

Description of BMP: The storm drain and catch basins shall be maintained by a qualified maintenance service contractor

Maintenance Responsibility: Owner

Funding Source: Owner

Maintenance Schedule: The catch basins shall be inspected and cleaned on a semi-annual basis by the owner and shall be inspected and cleaned by the vendor or an equally qualified contractor on an annual frequency.

Start up date: When storm drain system is complete.

SC-60: Housekeeping Practices

Description of BMP: Overall good housekeeping practices shall be implemented daily.

Maintenance Responsibility: Owner/Tenant

Funding Source: Owner/Tenant

Maintenance Schedule: Ongoing

Start up date: When project site is complete.

TC-11: Infiltration Basin

Description of BMP: The infiltration basins are located in the westerly, southerly and easterly portions of the site. The infiltration basins will be utilized as treatment of stormwater runoff from the site. The basins shall be inspected monthly and maintained at least twice a year, prior to October 1. Basins shall also be inspected after large storms. Basins shall be inspected and maintained by a qualified technician with proper disposal of all waste.

Maintenance Responsibility: Owner

Funding Source: Owner

Maintenance Schedule: Monthly inspection and maintenance as needed.

Start up date: When construction is complete.

MP-52: Drain Insert

Description of BMP: Catch basin inserts will need to be inspected. Debris will be removed that may cause the drain to clog. Perlite pouches needs to be replaced per manufactures specifications. Flo-Gard Plus inserts (model FGP-2436F)

Maintenance Responsibility: Owner

Funding Source: Owner

Maintenance Schedule: Per manufactures specifications after September 1 and prior to October 1.

Start up date: When storm drain system is complete

4.1.2 INSPECTION & MONITORING REQUIREMENTS THAT MUST:

IDS Real Estate Group-L.A. is the property owner and will be responsible for the management of the grounds, parking areas and landscaping. Trash will be removed on a regular basis. It will be the owner's responsibility to have the site inspected twice a week and cleaned as necessary. The owner will be responsible for cleaning the private catch basins, /infiltration basins and storm drain system as well as maintenance of the storm water treatment devices per manufacturers' recommendations.

A schedule will be established for all maintenance and a log for all cleanups shall be recorded. All documents relating to site maintenance and BMP's will be kept on site and be made available to Federal, State, County, or City inspectors upon request. Future tenant use may require additional industrial permits and storm water monitoring.

4.1.3 IDENTIFICATION OF RESPONSIBLE PARTIES THAT MUST:

IDS Real Estate Group-L.A. is the property owner and will be responsible for operation and maintenance of onsite BMP's. Patrick Spillane is the contact for this site. He can be reached at the following address:

- IDS Real Estate Group-L.A.
  515 South Figueroa Street-16TH Floor
  Los Anageles, California 90071
  P. (213) 362-9300
  Contact person: Patrick Spillane

SECTION 5
FUNDING

5.1 Funding

The Permit requires that for all Treatment Control BMPs, a funding source or sources for operation and maintenance of each BMP be identified within the WQMP. Project proponents must:

- Indicate funding sources or sources for O&M for this project. For each funding source, include the responsible party's name, address, contact name and telephone number.

FOR FUNDING INFORMATION
PLEASE SEE PREVIOUS PAGES, PAGE A-25 to A-30, SECTION 4.1.1 O&M DESCRIPTION AND SCHEDULE.

- IDS Real Estate Group-L.A.
  515 South Figueroa Street-16TH Floor
  Los Anageles, California 90071
  P. (213) 362-9300
  Contact person: Patrick Spillane

SECTION 6
WQMP Certification

6.1 Certification

- The applicant is required to sign and certify that the WQMP is in conformance with Santa Ana Regional Water Quality Control Board Order Number R8-2002-0012 (NPDES Permit No. CAS618036).

- The applicant is required to sign and date the following statement 'word-for-word' certifying that the provisions of the WQMP have been accepted by the applicant and that the applicant will have the plan transferred to future successors (transferability statement). The certification must be signed by the property owner, unless a written designation by the owner allows a designee to sign on the owner's behalf.

"This Water Quality Management Plan has been prepared for IDS Real Estate Group-L.A. by Thienes Engineering, Inc. It is intended to comply with the requirements of the County of San Bernardino for the Site, Palm Avenue Distribution Center, Condition Number(s) _____ requiring the preparation of a Water Quality Management Plan (WQMP). The undersigned is aware that Best Management Practices (BMPs) are enforceable pursuant to the City's/County's Water Quality Ordinance No. _____. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with San Bernardino County's Municipal Stormwater Management Program and the intent of the NPDES Permit for San Bernardino County and the incorporated cities of San Bernardino County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors in interest and the city/county shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity. "

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

_____ _____
Applicant's Signature Date

_____ _____
Applicant's Name Applicant's Telephone Number

Attachment A-1

Maintenance Mechanisms

A-1.1 The Agency shall not accept stormwater structural BMPs as meeting the WQMP requirements standard, unless an O&M Plan is prepared (see WQMP Section 2.6) and a mechanism is in place that will ensure ongoing long-term maintenance of all structural and non-structural BMPs. This mechanism can be provided by the Agency or by the project proponent. As part of project review, if a project proponent is required to include interim or permanent structural and non-structural BMPs in project plans, and if the Agency does not provide a mechanism for BMP maintenance, the Agency shall require that the applicant provide verification of maintenance requirements through such means as may be appropriate, at the discretion of the Agency, including, but not limited to covenants, legal agreements, maintenance agreements, conditional use permits and/or funding arrangements (OC 2003)

A-1.2 Maintenance Mechanisms

1. **Public entity maintenance**: The Agency may approve a public or acceptable quasi-public entity (e.g., the County Flood Control District, or annex to an existing assessment district, an existing utility district, a state or federal resource agency, or a conservation conservancy) to assume responsibility for operation, maintenance, repair and replacement of the BMP. Unless otherwise acceptable to individual Agencies, public entity maintenance agreements shall ensure estimated costs are front-funded or reliably guaranteed, (e.g., through a trust fund, assessment district fees, bond, letter of credit or similar means). In addition, the Permittees may seek protection from liability by appropriate releases and indemnities.

   The Agency shall have the authority to approve stormwater BMPs proposed for transfer to any other public entity within its jurisdiction before installation. The Permittee shall be involved in the negotiation of maintenance requirements with any other public entities accepting maintenance responsibilities within their respective jurisdictions; and in negotiations with the resource agencies responsible for issuing permits for the construction and/or maintenance of the facilities. The Agency must be identified as a third party beneficiary empowered to enforce any such maintenance agreement within their respective jurisdictions.

2. **Project proponent agreement to maintain stormwater BMPs:** The Agency may enter into a contract with the project proponent obliging the project proponent to maintain, repair and replace the stormwater BMP as necessary into perpetuity. Security or a funding mechanism with a "no sunset" clause may be required.

3. **Assessment districts:** The Agency may approve an Assessment District or other funding mechanism created by the project proponent to provide funds for stormwater

BMP maintenance, repair and replacement on an ongoing basis. Any agreement with such a District shall be subject to the Public Entity Maintenance Provisions above.

4. **Lease provisions:** In those cases where the Agency holds title to the land in question, and the land is being leased to another party for private or public use, the Agency may assure stormwater BMP maintenance, repair and replacement through conditions in the lease.

5. **Conditional use permits:** For discretionary projects only, the Agency may assure maintenance of stormwater BMPs through the inclusion of maintenance conditions in the conditional use permit. Security may be required.

6. **Alternative mechanisms:** The Agency may accept alternative maintenance mechanisms if such mechanisms are as protective as those listed above.

IF TO CITY:

_____
_____
_____
_____

IF TO OWNER:

_____
_____
_____
_____

IN WITNESS THEREOF, the parties hereto have affixed their signatures as of the date first written above.

APPROVED AS TO FORM:

_____
City Attorney

_____
CITY OF

_____
Name

_____
Title

ATTEST:

_____
City Clerk Date

OWNER:

_____
Name

_____
Title

OWNER:

_____
Name

_____
Title

NOTARIES ON FOLLOWING PAGE

Attachment A-2

Water Quality Management Plan and Stormwater BMP Transfer, Access and Maintenance Agreement (adapted from documents from the Ventura County Stormwater Management Program)

Recorded at the request of:

City of _____

After recording, return to:

City of _____

City Clerk _____

Water Quality Management Plan and Stormwater BMP Transfer, Access and Maintenance Agreement

OWNER: IDS Real Estate Group-L.A.

PROPERTY ADDRESS: Easterly Corner of Palm Avenue and Industrial Parkway

San Bernardino County, California 92407

APN: # 0266-041-62

THIS AGREEMENT is made and entered into in

_____, California, this _____ day of

_____ , by and between

_____, herein after

referred to as "Owner" and the County of San Bernardino, a municipal corporation, located in the County of San Bernardino, State of California hereinafter referred to as "CITY";

WHEREAS, the Owner owns real property ("Property") in the City of

_____, County of San Bernardino, State of California, more specifically described in Exhibit "A" and depicted in Exhibit "B", each of which exhibits is attached hereto and incorporated herein by this reference;

WHEREAS, at the time of initial approval of development project known as

_____ within the Property described herein, the City required the project to employ Best Management Practices, hereinafter referred to as "BMPs," to minimize pollutants in urban runoff;

WHEREAS, the Owner has chosen to install and/or implement BMPs as described in the Water Quality Management Plan, on file with the City, hereinafter referred to as "WQMP", to minimize pollutants in urban runoff and to minimize other adverse impacts of urban runoff;

WHEREAS, said WQMP has been certified by the Owner and reviewed and approved by the City;

WHEREAS, said BMPs, with installation and/or implementation on private property and draining only private property, are part of a private facility with all maintenance or replacement, therefore, the sole responsibility of the Owner in accordance with the terms of this Agreement;

WHEREAS, the Owner is aware that periodic and continuous maintenance, including, but not necessarily limited to, filter material replacement and sediment removal, is required to assure peak performance of all BMPs in the WQMP and that, furthermore, such maintenance activity will require compliance with all Local, State, or Federal laws and regulations, including those pertaining to confined space and waste disposal methods, in effect at the time such maintenance occurs;

NOW THEREFORE, it is mutually stipulated and agreed as follows:

1. Owner hereby provides the City of City's designee complete access, of any duration, to the BMPs and their immediate vicinity at any time, upon reasonable notice, or in the event of emergency, as determined by City's Director of Public Works no advance notice, for the purpose of inspection, sampling, testing of the Device, and in case of emergency, to undertake all necessary repairs or other preventative measures at owner's expense as provided in paragraph 3 below. City shall make every effort at all times to minimize or avoid interference with Owner's use of the Property.

2. Owner shall use its best efforts diligently to maintain all BMPs in a manner assuring peak performance at all times. All reasonable precautions shall be exercised by Owner and Owner's representative or contractor in the removal and extraction of any material(s) from the BMPs and the ultimate disposal of the material(s) in a manner consistent with all relevant laws and regulations in effect at the time. As may be requested from time to time by the City, the Owner shall provide the City with documentation identifying the material(s) removed, the quantity, and disposal destination.

3. In the event Owner, or its successors or assigns, fails to accomplish the necessary maintenance contemplated by this Agreement, within five (5) days of being given written notice by the City, the City is hereby authorized to cause any maintenance necessary to be done and charge the entire cost and expense to the Owner or Owner's successors or assigns, including administrative costs, attorneys fees and interest thereon at the maximum rate authorized by the Civil Code from the date of the notice of expense until paid in full.

4. The City may require the owner to post security in form and for a time period satisfactory to the city to guarantee the performance of the obligations state herein. Should the Owner fail to perform the obligations under the Agreement, the City may, in the case of a cash bond, act for the Owner using the proceeds from it, or in the case of a surety bond, require the sureties to perform the obligations of the Agreement. As an additional remedy, the Director may withdraw any previous stormwater-related approval with respect to the property on which BMPs have been installed and/or implemented until such time as Owner repays to City its reasonable costs incurred in accordance with paragraph 3 above.

5. This agreement shall be recorded in the Office of the Recorder of San Bernardino County, California, at the expense of the Owner and shall constitute notice to all successors and assigns of the title to said Property of the obligation herein set forth, and also a lien in such amount as will fully reimburse the City, including interest as herein above set forth, subject to foreclosure in event of default in payment.

6. In event of legal action occasioned by any default or action of the Owner, or its successors or assigns, then the Owner and its successors or assigns agree(s) to pay all costs incurred by the City in enforcing the terms of this Agreement, including reasonable attorney's fees and costs, and that the same shall become a part of the lien against said Property.

7. It is the intent of the parties hereto that burdens and benefits herein undertaken shall constitute covenants that run with said Property and constitute a lien there against.

8. The obligations herein undertaken shall be binding upon the heirs, successors, executors, administrators and assigns of the parties hereto. The term "Owner" shall include not only the present Owner, but also its heirs, successors, executors, administrators, and assigns. Owner shall notify any successor to title of all or part of the Property about the existence of this Agreement. Owner shall provide such notice prior to such successor obtaining an interest in all or part of the Property. Owner shall provide a copy of such notice to the City at the same time such notice is provided to the successor.

9. Time is of the essence in the performance of this Agreement.

10. Any notice to a party required or called for in this Agreement shall be served in person, or by deposit in the U.S. Mail, first class postage prepaid, to the address set forth below. Notice(s) shall be deemed effective upon receipt, or seventy-two (72) hours after deposit in the U.S. Mail, whichever is earlier. A party may change a notice address only by providing written notice thereof to the other party.

IF TO CITY:

_____

_____

_____

_____

IF TO OWNER:

_____

_____

_____

_____

IN WITNESS THEREOF, the parties hereto have affixed their signatures as of the date first written above.

APPROVED AS TO FORM:

_____
City Attorney

_____
CITY OF

_____
Name

_____
Title

ATTEST:

_____
City Clerk Date

OWNER:

_____
Name

_____
Title

OWNER:

_____
Name

_____
Title

NOTARIES ON FOLLOWING PAGE

EXHIBIT A
(LEGAL DESCRIPTION)

PARCEL 1:

THAT PORTION OF SECTION 12, TOWNSHIP 1 NORTH, RANGE 5 WEST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE EXTENSION OF THE LINES OF THE OFFICIAL GOVERNMENT SURVEY, EXTENDED INTO RANCHO MUSCUPIABE, DESCRIBED AS FOLLOWS:

BEGINNING AT THE SOUTHWEST CORNER OF THAT CERTAIN PARCEL OF LAND AS CONVEYED TO THE STATE OF CALIFORNIA BY DEED RECORDED OCTOBER 25, 1955, IN BOOK 3772, PAGE 93, OFFICIAL RECORDS AND DESCRIBED AS PARCEL "C" IN THE ABOVE-MENTIONED DEED, SAID SOUTHWEST CORNER BEING ON THE EASTERLY LINE OF PALM AVENUE, 40 FEET WIDE, AS IT NOW EXISTS; THENCE SOUTH 27° 15' 41" WEST, 598.90 FEET ALONG THE EASTERLY LINE OF PALM AVENUE TO THE INTERSECTION OF THE NORTHERLY LINE OF THE PROPOSED ROAD; THENCE ALONG THE NORTHERLY LINE OF SAID PROPOSED ROAD THE FOLLOWING COURSES AND DISTANCES: SOUTH 38° 55' 29" EAST, 1383.853 FEET TO A TANGENT CURVE CONCAVE TO THE NORTHEAST, HAVING A RADIUS OF 450 FEET AND A CENTRAL ANGLE OF 61° 22' 04"; THENCE SOUTHEASTERLY ALONG SAID CURVE, A DISTANCE OF 481.981 FEET; THENCE NORTH 79° 42' 27" EAST, 354.26 FEET TO A TANGENT CURVE CONCAVE TO THE SOUTH HAVING A RADIUS OF 300 FEET AND A CENTRAL ANGLE OF 61° 34'; THENCE EASTERLY AND SOUTHEASTERLY ALONG SAID CURVE, 322.363 FEET; THENCE CONTINUING ALONG THE NORTHERLY LINE OF SAID PROPOSED ROAD, SOUTH 38° 43' 33" EAST, 30 FEET; THENCE LEAVING THE NORTHERLY LINE OF SAID PROPOSED ROAD, NORTH 21° 29' 53" EAST, 634.659 FEET TO THE SOUTHERLY LINE OF SAID PARCEL "C", AS CONVEYED TO THE STATE OF CALIFORNIA; THENCE ALONG SAID SOUTHEASTERLY LINE NORTH 50° 24' WEST, 300 FEET TO A POINT IN SAID LINE; THENCE NORTH 51° 30' 32" WEST, 465.08 FEET; THENCE NORTH 89° 51' 28" WEST, 695.51 FEET; THENCE NORTH 35° 36' 13" WEST, 488.48 FEET; THENCE NORTH 43° 19' 06" WEST, 497.92 FEET TO THE POINT OF BEGINNING.

EXCEPTING THEREFROM THAT PORTION CONVEYED TO THE STATE OF CALIFORNIA BY DEED RECORDED AUGUST 20, 1958, IN BOOK 4582, PAGE 307, OFFICIAL RECORDS, DESCRIBED AS FOLLOWS:

BEGINNING AT THE SOUTHWEST CORNER OF THAT CERTAIN PARCEL OF LAND, AS CONVEYED TO THE STATE OF CALIFORNIA BY DEED RECORDED OCTOBER 25, 1955, IN BOOK 3772, PAGE 93, OFFICIAL RECORDS OF SAID COUNTY, AND DESCRIBED AS PARCEL "C" IN THE ABOVE-MENTIONED DEED, SAID SOUTHWEST CORNER BEING ON THE EASTERLY LINE OF PALM AVENUE, 40 FEET WIDE, AS IT NOW EXISTS; THENCE ALONG THE SOUTHWESTERLY LINE OF SAID PARCEL "C", SOUTH 43° 19' 06" EAST, 33.02 FEET; THENCE SOUTH 61° 23' 07" WEST, 53.48 FEET TO SAID EASTERLY LINE OF PALM AVENUE, DISTANT ALONG SAID EASTERLY LINE SOUTH 27° 15' 41" WEST, 55.44 FEET FROM THE POINT OF BEGINNING; THENCE ALONG SAID EASTERLY LINE NORTH 27° 15' 41" EAST, 55.44 FEET TO THE POINT OF BEGINNING.

ALSO EXCEPTING THEREFROM THAT PORTION CONVEYED TO GLENN HAGEN ENTERPRISES, A PARTNERSHIP, BY DEED RECORDED AUGUST 28, 1963 IN BOOK 5977, PAGE 887, OFFICIAL RECORDS, DESCRIBED AS FOLLOWS:

BEGINNING AT THE SOUTHWEST CORNER OF THAT CERTAIN PARCEL OF LAND, AS CONVEYED TO THE STATE OF CALIFORNIA BY DEED RECORDED OCTOBER 25, 1955, IN BOOK 3772, PAGE 93, OFFICIAL RECORDS AND DESCRIBED AS PARCEL "C", SAID SOUTHWEST CORNER BEING ON THE EASTERLY LINE OF PALM AVENUE, 40 FEET WIDE, AS THE SAME NOW EXISTS; THENCE ALONG THE SOUTHERLY LINE OF SAID PARCEL "C", SOUTH 42° 19' 06" EAST, 174 FEET; THENCE SOUTH 27° 40' 03" WEST, PARALLEL WITH EASTERLY LINE OF SAID PALM AVENUE, 253.44 FEET; THENCE NORTH 42° 19' 06" WEST, PARALLEL WITH SAID SOUTHERLY LINE OF PARCEL "C", 174 FEET TO A POINT IN THE EASTERLY LINE OF SAID PALM AVENUE; THENCE NORTHERLY ALONG THE EASTERLY LINE OF PALM AVENUE, 253.44 FEET TO THE POINT OF BEGINNING.

ALSO EXCEPTING THEREFROM THAT PORTION CONVEYED TO THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA, A PUBLIC CORPORATION, BY DEED RECORDED NOVEMBER 5, 1971, IN BOOK 7788, PAGE 363, OFFICIAL RECORDS, DESCRIBED AS FOLLOWS:

SAID PARCEL OF LAND BEING THAT PART OF SAID CERTAIN PORTION LYING SOUTHEASTERLY OF A LINE WHICH IS PARALLEL WITH AND DISTANT NORTHWESTERLY 40 FEET, MEASURED AT RIGHT ANGLES, OR RADIALLY, FROM THE FOLLOWING DESCRIBED SURVEY LINE:

IN THE FOLLOWING DESCRIPTION ALL CURVES ARE TANGENT TO THE STRAIGHT LINES WHICH THEY JOIN:

BEGINNING AT A POINT ON THE NORTHEASTERLY LINE OF LOT 61 OF THE SEMI-TROPIC LAND AND WATER COMPANY SUBDIVISION IN SAID COUNTY AND STATE, AS PER PLAT RECORDED IN BOOK 6 OF MAPS, PAGE 12, IN THE OFFICE OF THE RECORDER OF SAID COUNTY, SAID POINT BEING DISTANT ALONG SAID NORTHEASTERLY LINE, NORTH 53° 48' 31" WEST, 330.74 FEET FROM THE MOST EASTERLY CORNER OF SAID LOT 61; THENCE NORTH 88° 11' 10" EAST 137.93 FEET; THENCE NORTH 84° 40' 18" EAST, 2391.46 FEET TO THE BEGINNING OF A CURVE CONCAVE NORTHWESTERLY AND HAVING A RADIUS OF 580 FEET; THENCE NORTHEASTERLY ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 58° 40' 34", AN ARC DISTANCE OF 593.97 FEET; THENCE NORTH 25° 59' 44" EAST, 6375.03 FEET TO THE BEGINNING OF A CURVE CONCAVE SOUTHEASTERLY AND HAVING A RADIUS OF 3,020 FEET; THENCE NORTHEASTERLY ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 43° 36' 47", AN ARC DISTANCE OF 2246.09 FEET; THENCE NORTH 68° 36' 31" EAST, 6002.78 FEET TO THE BEGINNING OF A CURVE CONCAVE SOUTHEASTERLY AND HAVING A RADIUS OF 520 FEET; TH NORTHEASTERLY ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 11° 06' 46", AN ARC DISTANCE OF 100.84 FEET; THENCE NORTH 79° 43' 11" EAST, 907.26 FEET TO THE BEGINNING OF A CURVE CONCAVE NORTHWESTERLY AND HAVING A RADIUS OF 480 FEET; THENCE NORTHEASTERLY ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 9° 18' 32", AN ARC DISTANCE OF 77.99 FEET; THENCE NORTH 70° 24' 39" EAST, 1,383.05 FEET TO A POINT ON THE CENTER LINE OF KENDALL DRIVE, 80 FEET WIDE, DISTANT THEREON SOUTH 58° 07' 14" EAST, 193.02 FEET FROM THE NORTHWESTERLY TERMINUS OF THAT CERTAIN COURSE DESCRIBED IN DEED RECORDED MAY 28, 1943, IN BOOK 1803, PAGE 234, OFFICIAL RECORDS, IN THE OFFICE OF THE SAID RECORDER, AS HAVING A BEARING AND DISTANCE OF NORTH 57° 20' WEST, 698.00 FEET.

ALSO EXCEPTING THEREFROM THAT PORTION LYING WITHIN PARCEL 1 OF PARCEL MAP NO. 14977, IN THE CITY OF SAN BERNARDINO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA AS PER MAP FILED IN BOOK 174 PAGES 18 AND 19 OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

PARCEL NO. 2:

THAT PORTION OF SECTION 12, TOWNSHIP 1 NORTH, RANGE 5 WEST, IN THE RANCHO MUSCUPIABE, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL GOVERNMENT SURVEY, EXTENDED INTO SAID RANCHO, DESCRIBED AS FOLLOWS:

BEGINNING AT THE EASTERLY TERMINUS OF THAT CERTAIN COURSE DESCRIBED AS: "NORTH 89° 51' 27" WEST, 695.51 FEET" IN PARCEL "C" OF DEED TO THE STATE OF CALIFORNIA, RECORDED OCTOBER 25, 1955, IN BOOK 3772, PAGE 93, OFFICIAL RECORDS; THENCE ALONG THE LINES OF SAID PARCEL "C": (1) NORTH 89° 51' 27" WEST 695.51 FEET; AND (2) NORTH 35° 36' 13" WEST, 298.48 FEET; THENCE (COURSE "A") NORTH 85° 11' 40" EAST, 453.68 FEET; THENCE (COURSE "B") SOUTH 56° 05' 21" EAST, 304.39 FEET TO THE POINT OF BEGINNING.

EXCEPTING THEREFROM ALL MINERALS, OILS, GASES AND OTHER HYDROCARBONS BY WHATSOEVER NAME KNOWN THAT MAY BE WITHIN OR UNDER SAID PROPERTY, BUT WITHOUT, HOWEVER, THE RIGHT TO DRILL, DIG OR MINE THROUGH THE SURFACE THEREOF, AS RESERVED IN THE DEED FROM THE STATE OF CALIFORNIA, RECORDED JUNE 3, 1964, IN BOOK 6162, PAGE 97, OFFICIAL RECORDS.

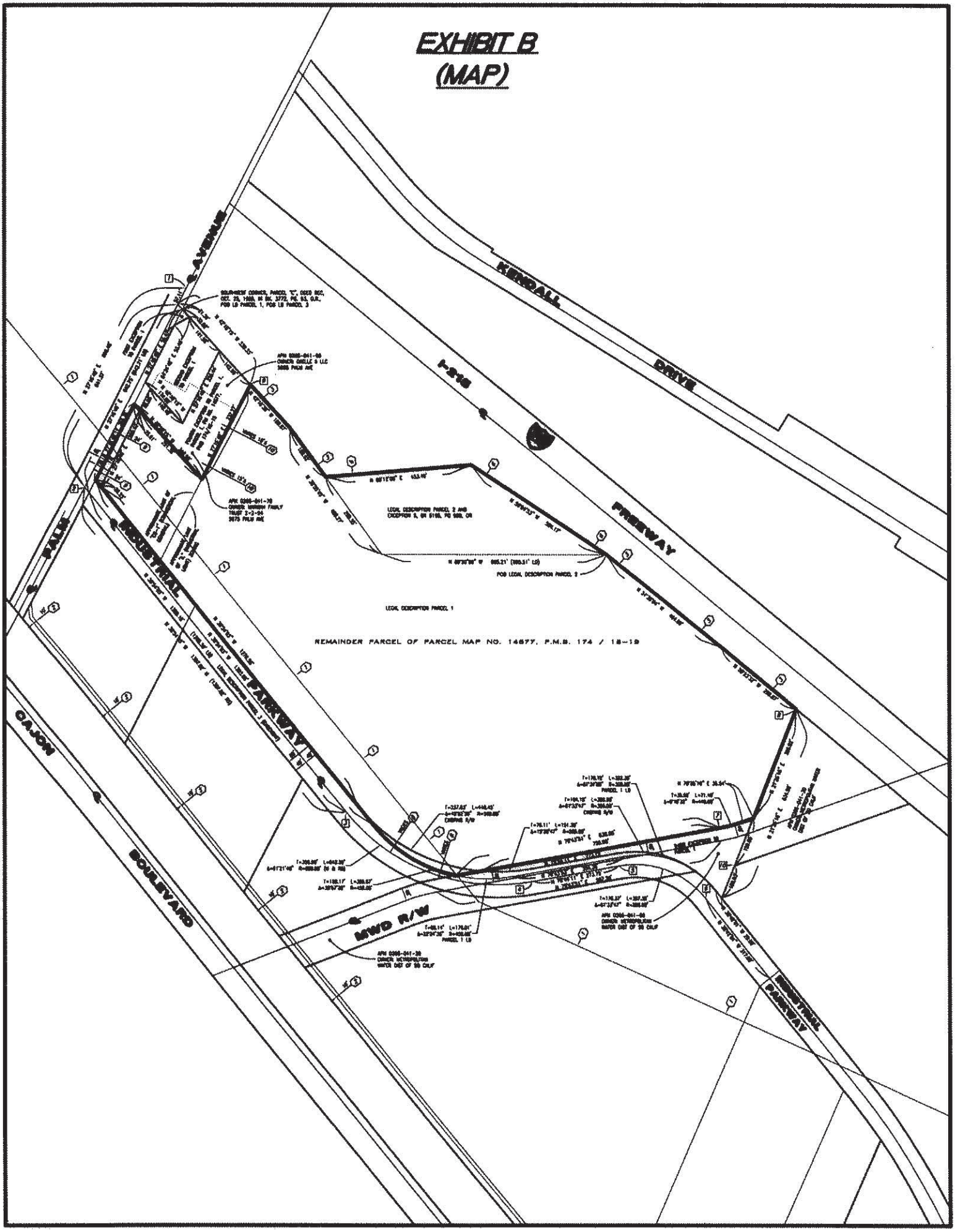
PARCEL NO. 3:

AN EASEMENT 80 FEET WIDE, FOR ROAD PURPOSES OVER A PORTION OF SECTIONS 12 AND 13, TOWNSHIP 1 NORTH, RANGE 5 WEST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE EXTENSION OF THE LINES OF THE OFFICIAL GOVERNMENT SURVEY, EXTENDED INTO RANCHO MUSCUPIABE, BEING 40 FEET ON EITHER SIDE OF THE CENTER LINE WHICH IS DESCRIBED AS FOLLOWS:

(THE 40 FOOT LINES BEING LENGTHENED OR SHORTENED TO INTERSECT THE SOUTHEASTERLY LINE OF PALM AVENUE AND THE WESTERLY LINE OF SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT RIGHT-OF-WAY.)

BEGINNING AT THE SOUTHWEST CORNER OF THAT CERTAIN PARCEL OF LAND, AS CONVEYED TO THE STATE OF CALIFORNIA BY DEED RECORDED OCTOBER 25, 1955, IN BOOK 3772, PAGE 93, OFFICIAL RECORDS, AND DESCRIBED AS PARCEL "C" IN THE ABOVE-MENTIONED DEED, SAID SOUTHWEST CORNER BEING ON THE EASTERLY LINE OF PALM AVENUE, 40 FEET WIDE, AS IT NOW EXISTS; THENCE SOUTH 27° 15' 41" WEST, 642.71 FEET TO THE TRUE POINT OF BEGINNING OF SAID CENTER LINE; THENCE SOUTH 38° 55' 29" EAST, 1385.30 FEET TO A TANGENT CURVE CONCAVE TO THE NORTHEAST, HAVING A RADIUS OF 600.00 FEET AND A CENTRAL ANGLE OF 61° 22' 04"; THENCE SOUTHEASTERLY AND EASTERLY ALONG THE CENTER LINE OF SAID CURVE, A DISTANCE OF 642.64 FEET TO A TANGENT CURVE CONCAVE TO THE SOUTH, HAVING A RADIUS OF 260.00 FEET AND A CENTRAL ANGLE OF 61° 34'; THENCE EASTERLY AND SOUTHEASTERLY ALONG THE CENTER LINE OF SAID CURVE, A DISTANCE OF 307.32 FEET TO A TANGENT LINE; THENCE SOUTH 38° 43' 33" EAST, 780.25 FEET TO A TANGENT CURVE CONCAVE TO THE SOUTHWEST, HAVING A RADIUS OF 1986.00 FEET AND A CENTRAL ANGLE OF 11° 29' 20"; THENCE SOUTHEASTERLY 398.33 FEET ALONG THE CENTER LINE OF SAID CURVE TO A TANGENT LINE; THENCE SOUTH 27° 14' 13" EAST, 920.65 FEET ALONG SAID LINE TO A POINT IN A TANGENT CURVE CONCAVE TO THE NORTHEAST AND HAVING A RADIUS OF 600.00 FEET; TH SOUTHEASTERLY AND EASTERLY ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 81° 39' 13", AN ARC LENGTH OF 855.07 FEET TO A POINT OF REVERSE CURVE CONCAVE TO THE SOUTHEAST, HAVING A RADIUS OF 640.00 FEET; THENCE NORTHEASTERLY ALONG SAID CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 13° 38' 13", AN ARC LENGTH OF 152.33 FEET TO A POINT OF TERMINATION IN SAID RIGHT-OF-WAY OF THE SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT.

EXHIBIT B
(MAP)



Attachment B
Tables

Table B-1
303(d) List of Impaired Water Bodies

Waterbody	Pollutant					
	Bacteria Indicators/ Pathogens	Metals	Nutrients	Organic Enrichment	Sedimentation/Siltation	Suspended Solids
Big Bear Lake		X	X		X	
Canyon Lake (Railroad Canyon Reservoir)	X		X			
Chino Creek Reach 1	X		X			
Chino Creek Reach 2	X					
Cucamonga Creek, Valley Reach	X					
Grout Creek		X	X			
Knickerbocker Creek	X	X				
Lytle Creek	X					
Mill Creek (Prado Area)	X		X			X
Mill Creek Reach 1	X					
Mill Creek Reach 2	X					
Mountain Home Creek	X					
Mountain Home Creek, East Fork	X					
Prado Park Lake	X		X			
Rathbone (Rathbun Creek)			X		X	
Santa Ana River, Reach 3	X					
Santa Ana River, Reach 4	X					
Summit Creek			X			

NOTES:

1) Summary of the 2002 303(d) Listed Water Bodies and Associated Pollutants of Concern from RWQCB Region 8. Check for updated lists from the RWQCB.

2) Chlorides, pesticides, salinity, total dissolved solids (TDS), toxicity, and trash are listed impairments within the 303(d) table, however, they are not impairments in the above waterbodies.

Table B-2
C Values Based on Impervious/Pervious Area Ratios

% Impervious	% Pervious	C
0	100	0.15
5	95	0.19
10	90	0.23
15	85	0.26
20	80	0.30
25	75	0.34
30	70	0.38
35	65	0.41
40	60	0.45
45	55	0.49
50	50	0.53
55	45	0.56
60	40	0.60
65	35	0.64
70	30	0.68
75	25	0.71
80	20	0.75
85	15	0.79
90	10	0.83
95	5	0.86
100	0	0.90

NOTE:

Obtain individual runoff coefficient C-Factors from the local agency or from the local flood control district.

If C-Factors are not available locally, obtain factors from hydrology text books or estimate using this table.

Composite the individual C-Factors using area-weighted averages to calculate the Composite C Factor for the area draining to a treatment control BMP.

Do not use the C-Factors in this table for flood control design or related work.

Attachment C
Pollutants of Concern

Pollutants of Concern

- *Bacteria and Viruses* – Bacteria and Viruses are ubiquitous microorganisms that thrive under certain environmental conditions. Their proliferation is typically cause by the transport of animal or human fecal wastes from the watershed. Water, containing excessive bacteria and viruses, can alter the aquatic habitat and create a harmful environment for humans and aquatic life. Also, the decomposition of excess organic waste causes increased growth of undesirable organisms in the water.

- *Metals* – The primary source of metal pollution in stormwater is typically commercially available metals and metal products. Metals of concern include cadmium, chromium, copper, lead, mercury, and zinc. Lead and chromium have been used as corrosion inhibitors in primer coatings and cooling tower systems. Metals are also raw material components in non-metal products such as fuels, adhesives, paints, and other coatings. At low concentrations naturally occurring in soil, metals may not be toxic. However, at higher concentrations, certain metals can be toxic to aquatic life. Humans can be impacted from contaminated groundwater resources, and bioaccumulation of metals in fish and shellfish. Environmental concerns, regarding the potential for release of metals to the environment, have already led to restricted metal usage in certain applications (OC 2003).

- *Nutrients* – Nutrients are inorganic substances, such as nitrogen and phosphorus. Excessive discharge of nutrients to water bodies and streams causes eutrophication, where aquatic plants and algae growth can lead to excessive decay of organic matter in the water body, loss of oxygen in the water, release of toxins in sediment, and the eventual death of aquatic organisms. Primary sources of nutrients in urban runoff are fertilizers and eroded soils.

- *Pesticides* – Pesticides (including herbicides) are chemical compounds commonly used to control nuisance growth or prevalence of organisms. Relatively low levels of the active component of pesticides can result in conditions of aquatic toxicity. Excessive or improper application of a pesticide may result in runoff containing toxic levels of its active ingredient (OC 2003).

- *Organic Compounds* – Organic compounds are carbon-based. Commercially available or naturally occurring organic compounds are found in pesticides, solvents, and hydrocarbons. Organic compounds can, at certain concentrations, indirectly or directly constitute a hazard to life or health. When rinsing off objects, toxic levels of solvents and cleaning compounds can be discharged to storm drains. Dirt, grease, and grime retained in the cleaning fluid or rinse water may also adsorb levels of organic compounds that are harmful or hazardous to aquatic life (OC 2003).

- *Sediments* – Sediments are solid materials that are eroded from the land surface. Sediments can increase turbidity, clog fish gills, reduce spawning habitat, lower young aquatic organisms survival rates, smother bottom dwelling organisms, and suppress aquatic vegetation growth.

- *Trash and Debris* – Trash (such as paper, plastic, polystyrene packing foam, and aluminum materials) and biodegradable organic matter (such as leaves, grass cuttings, and food waste) are general waste products on the landscape. The presence of trash and debris may

have a significant impact on the recreational value of a water body and aquatic habitat. Trash impacts water quality by increasing biochemical oxygen demand.

- *Oxygen-Demanding Substances* – This category includes biodegradable organic material as well as chemicals that react with dissolved oxygen in water to form other compounds. Proteins, carbohydrates, and fats are examples of biodegradable organic compounds. Compounds such as ammonia and hydrogen sulfide are examples of oxygen-demanding compounds. The oxygen demand of a substance can lead to depletion of dissolved oxygen in a water body and possibly the development of septic conditions. A reduction of dissolved oxygen is detrimental to aquatic life and can generate hazardous compounds such as hydrogen sulfides.

- *Oil and Grease* – Oil and grease in water bodies decreases the aesthetic value of the water body, as well as the water quality. Primary sources of oil and grease are petroleum hydrocarbon products, motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular-weight fatty acids.

Attachment D

Volume-Based BMP Design Calculations

VOLUME-BASED BMP DESIGN RUNOFF QUANTITIES

A. Volume-Based BMP Design

1) Calculate the "Watershed Imperviousness Ratio", i, which is equal to the percent of impervious area in the BMP Drainage Area divided by 100.

2) Calculate the composite runoff coefficient C_{BMP} for the Drainage Area above using the following equation:

$$C_{BMP} = 0.858i^3 - 0.78i^2 + 0.774i + 0.04$$

where: C_{BMP} = composite runoff coefficient; and,

i = watershed imperviousness ratio.

3) Determine which Region the Drainage Area is located (Valley, Mountain or Desert).

4) Determine the area-averaged "6-hour Mean Storm Rainfall", P6, for the Drainage Area. This is calculated by multiplying the area averaged 2-year 1-hour value by the appropriate regression coefficient from Table 1.

5) Determine the appropriate drawdown time. Use the regression constant a = 1.582 for 24 hours and a = 1.963 for 48 hours. Note: Regression constants are provided for both 24 hour and 48 hour drawdown times; however, 48 hour drawdown times should be used in most areas of California. Drawdown times in excess of 48 hours should be used with caution as vector breeding can be a problem after water has stood in excess of 72 hours. (Use of the 24 hour drawdown time should be limited to drainage areas with coarse soils that readily settle and to watersheds where warming may be detrimental to downstream fisheries.)

6) Calculate the "Maximized Detention Volume", P_0, using the following equation:

$$P_0 = a \cdot C_{BMP} \cdot P_6$$

where: P_0 = Maximized Detention Volume, in inches

a = 1.582 for 24 hour and a = 1.963 for 48 hour drawdown,

C_{BMP} = composite runoff coefficient; and,

P_6 = 6-hour Mean Storm Rainfall, in inches

7) Calculate the "Target Capture Volume", V_0, using the following equation:

$$V_0 = (P_0 \cdot A) / 12$$

where: V_0 = Target Capture Volume, in acre-feet

P_0 = Maximized Detention Volume, in inches; and,

A = BMP Drainage Area, in acres

B. Volume-Based BMP Design Calculations

BMP Design Volume: Area 1 = 5.0 AC.

1) "Watershed Imperviousness Ratio"

$$\mathbf{i} = 0.76$$

2) Composite runoff coefficient C_{BMP} for the Drainage Area.

$$\mathbf{C_{BMP} = 0.858i^3 - 0.78i^2 + 0.774i + 0.04}$$

$$\mathbf{C_{BMP} = 0.858(0.76)^3 - 0.78(0.76)^2 + 0.774(0.76) + 0.04 = 0.56}$$

3) Region of Drainage Area: Valley

4) P_6, for the Drainage Area: 1.0 = (1.487 x .67) (1.487 per table D-1) (.67 per 2yr. 1 hr. rainfall map)

5) Drawdown time: 1.582

6) "Maximized Detention Volume", P_0:

$$\mathbf{P_0 = a \cdot C_{BMP} \cdot P_6}$$

$$\mathbf{P_0 = 1.582 \cdot 0.56 \cdot 1.0 = 0.89}$$

7) "Target Capture Volume", V_0:

$$\mathbf{V_0 = (P_0 \cdot A) / 12}$$

$$\mathbf{V_0 = (0.89 \cdot 5.0) / 12 = 0.37 \text{ acre-feet}}$$

0.37 acre-feet (43560 square-ft / 1 acre) = <u>16,117.2</u> cubic-feet

Drains to an infiltration basin for infiltration of storm water runoff.

BMP Design Volume: Area 3 = 13.6 AC.

1) "Watershed Imperviousness Ratio"

$i = 0.90$

2) Composite runoff coefficient C_{BMP} for the Drainage Area.

$$C_{BMP} = 0.858i^3 - 0.78i^2 + 0.774i + 0.04$$

$$C_{BMP} = 0.858(0.90)^3 - 0.78(0.90)^2 + 0.774(0.90) + 0.04 = 0.73$$

3) Region of Drainage Area: Valley

4) P_6, for the Drainage Area: 1.0 = (1.487 x .67) (1.487 per table D-1) (.67 per 2yr. 1 hr. rainfall map)

5) Drawdown time: 1.582

6) "Maximized Detention Volume", P_0:

$$P_0 = a \cdot C_{BMP} \cdot P_6$$

$$P_0 = 1.582 \cdot 0.73 \cdot 1.0 = 1.15$$

7) "Target Capture Volume", V_0:

$$V_0 = (P_0 \cdot A) / 12$$

$$V_0 = (1.15 \cdot 13.6) / 12 = 1.3 \text{ acre-feet}$$

1.3 acre-feet (43560 square-ft / 1 acre) = <u>56,628.0</u> cubic-feet

Drains to an infiltration basin for infiltration of storm water runoff.

BMP Design Volume: Area 4 = 12.6 AC.

1) "Watershed Imperviousness Ratio"

$\mathbf{i} = 0.90$

2) Composite runoff coefficient C_{BMP} for the Drainage Area.

$$\mathbf{C_{BMP} = 0.858i^3 - 0.78i^2 + 0.774i + 0.04}$$

$$\mathbf{C_{BMP} = 0.858(0.90)^3 - 0.78(0.90)^2 + 0.774(0.90) + 0.04 = 0.73}$$

3) Region of Drainage Area: Valley

4) P_6, for the Drainage Area: 1.0 = (1.487 x .67) (1.487 per table D-1) (.67 per 2yr. 1 hr. rainfall map)

5) Drawdown time: 1.582

6) "Maximized Detention Volume", P_0:

$$\mathbf{P_0 = a \cdot C_{BMP} \cdot P_6}$$

$$\mathbf{P_0 = 1.582 \cdot 0.73 \cdot 1.0 = 1.15}$$

7) "Target Capture Volume", V_0:

$$\mathbf{V_0 = (P_0 \cdot A) / 12}$$

$$\mathbf{V_0 = (1.15 \cdot 12.6) / 12 = 1.21 \text{ acre-feet}}$$

1.21 acre-feet (43560 square-ft / 1 acre) = 52,707.6 cubic-feet

Drains to an infiltration basin for infiltration of storm water runoff.

Attachment D

Flow-Based BMP Design Calculations

FLOW-BASED BMP DESIGN RUNOFF QUANTITIES

A. Flow-Based BMP Design

1) Project site rainfall value from the NOAA Atlas 14 Precipitation Depths (2-year 1-hour Rainfall) map: 0.67 in/hr

2) Region the BMP Drainage Area is located in (Valley, Mountain or Desert): Valley

Table D-1: Regression Coefficients for Intensity (I) and 6-hour mean storm rainfall (P_6).

Quantity	**Valley** 85% upper confidence limit	**Mountain** 85% upper confidence limit	**Desert** 85% upper confidence limit
I	**0.2787**	**0.3614**	**0.3250**
P_6	**1.4807**	**1.9090**	**1.2371**

Table D-2: Use of the flow-based formula for BMP Design (CASQA 2003).

	Composite Runoff Coefficient, "C"			
BMP Drainage Area (Acres)	**0.00 to 0.25**	**0.26 to 0.50**	**0.51 to 0.75**	**0.76 to 1.00**
0 to 25	**Caution**	**Yes**	**Yes**	**Yes**
26 to 50	**High Caution**	**Caution**	**Yes**	**Yes**
51 to 75	**Not Recommended**	**High Caution**	**Caution**	**Yes**
76 to 100	**Not Recommended**	**High Caution**	**Caution**	**Yes**

If the flow-based BMP formula use case, as determined by Table D-2, shows "Caution," "High Caution," or "Not Recommended," considering the project's characteristics, then he project proponent must calculate the BMP design flow using the unit hydrograph method, as specified in the most current version of the San Bernardino County Hydrology Manual, using the design storm pattern with rainfall return frequency such that the peak one hour rainfall depth equals the 85th-percentile 1-hour rainfall multiplied by two.

B. Flow-Based BMP Design Calculations

BMP Design Flow: AREA 2 = 0.8 Acres:

1) Composite runoff coefficient, CBMP: 0.90

2) Determine BMP design rainfall intensity, I_{BMP}, by multiplying the area-averaged 2-year 1-hour value from the NOAA Atlas 14 map by the appropriate regression coefficient from Table D-1 ("I"), and then multiplying by the safety factor specified in the criteria--usually a factor of 2.

$$I_{BMP} = 0.67 \cdot 0.2787 \cdot 2 = 0.37$$

3) Calculate BMP drainage area (A) in acres: 0.8

4) Calculate the target BMP flow rate, Q, by using the following formula (see Table D-2 for limitations on the use of this formula):

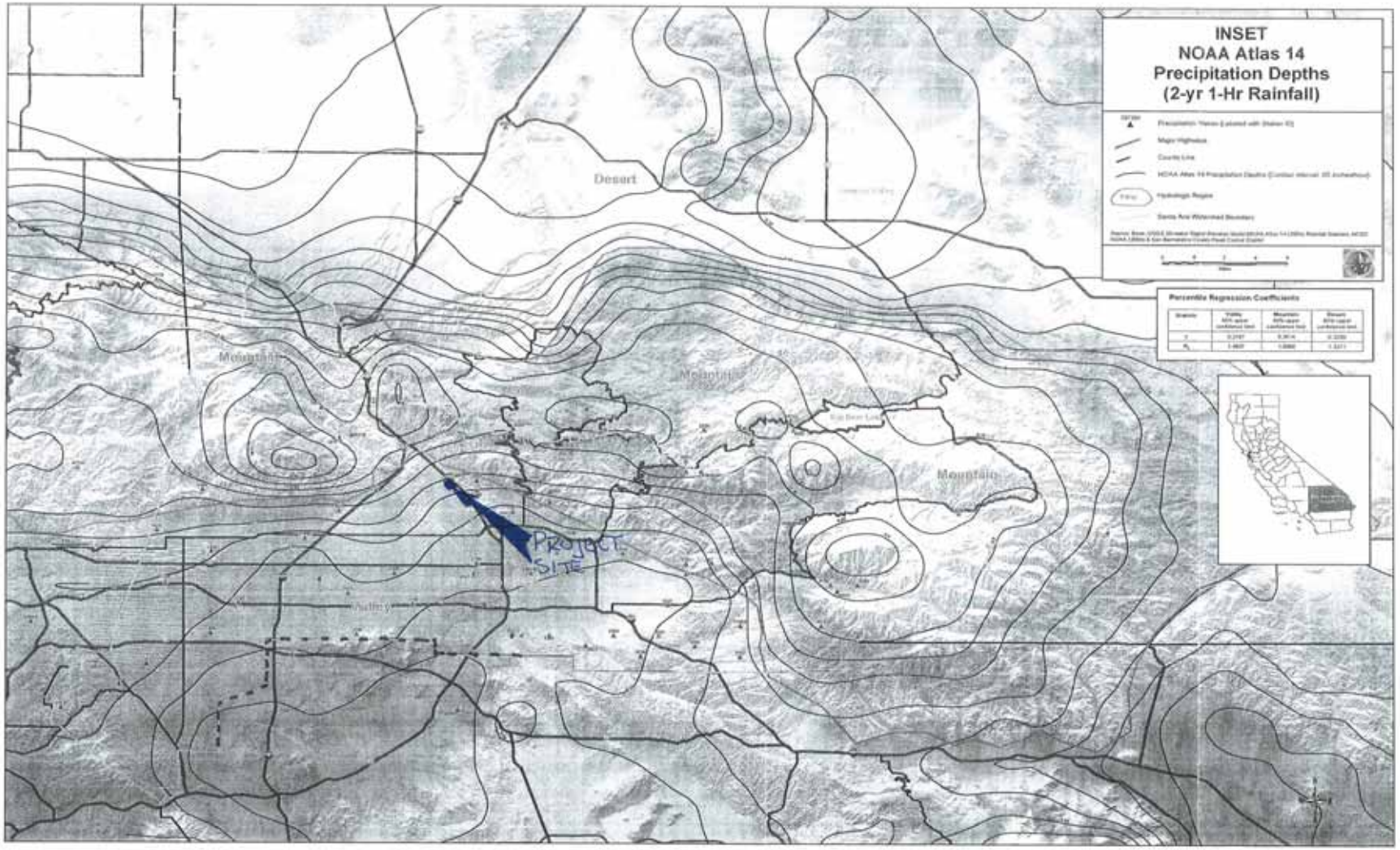
$$Q = C_{BMP} \cdot I_{BMP} \cdot A$$

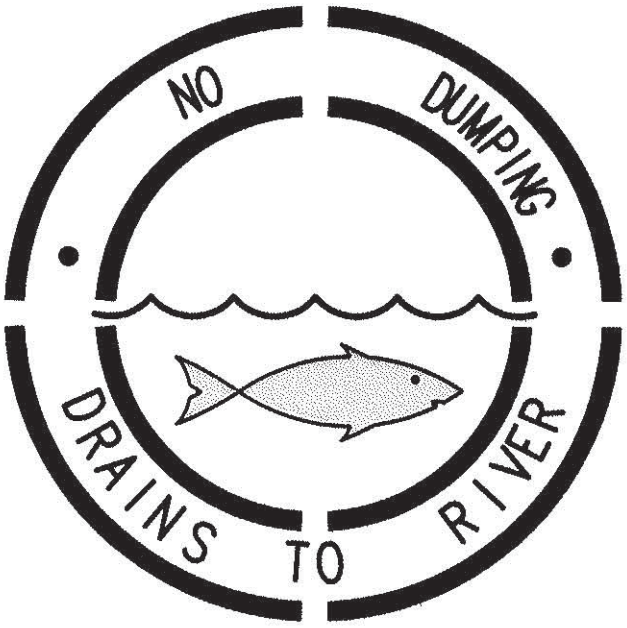
where: Q = flow in ft^3/s
I_{BMP} = BMP design rainfall intensity, in inches/hour
A = Drainage Area in acres
C_{BMP} = composite runoff coefficient

$$Q = 0.90 \cdot 0.37 \cdot 0.8 = 0.27 \ ft^3/s$$

Drains to a FloGard Plus Catch Basin Insert.

Figure D-1: NOAA Atlas 14 Inset Map.





SAMPLE STENCIL TO BE USED NEAR
GRATE AND CURB OPENING INLETS
SYMBOL TO BE 24" IN DIAMETER

Thienes Engineering
CIVIL ENGINEERING • LAND SURVEYING
14349 FIRESTONE BOULEVARD
LA MIRADA, CALIFORNIA 90638
PH.(714)521-4811 FAX(714)521-4173

SAMPLE CATCH BASIN STENCIL
PER BMP SD-13

CLEAN UP LOG

Date	Cleaned up By (person)	What was spilled/broken	Clean up method	Comments

BMP Inspection & Maintenance Verification Form

Using the table below, please indicate which BMP(s) you are responsible for at your site, and the status of operation and maintenance.

BMP Type	# Onsite	Operational (Y/N)	Date of Last Maintenance	Description of Maintenance * If no maintenance was performed indicate when it will be performed
TC-10 Infiltration Trench				
TC-11 Infiltration Basin				
TC-12 Retention/Irrigation				
TC-20 Wet Ponds				
TC-21 Constructed Wetlands				
TC-22 Extended Detention Basin				
TC-30 Vegetated Swale				
TC-31 Vegetated Buffer Strip				
TC-32 Bio-filtration				
TC-40 Media Filter				
TC-50 Water Quality Inlet				
TC-60 Multiple Systems				
MP-20 Wetland				
MP-40 Media Filter				
MP-50 Wet Vault				
MP-51 Vortex Separator				
MP-52 Drain Inserts				
(No fact sheet) Downspout Filter				

Definitions and Maintenance Requirements for the above BMP Types can be found online at http://www.cabmphandbooks.com/Development.asp

Printed Name of Responsible Party | Title | Signature of Responsible Party | Date

Daytime Phone | Email (optional)

Mailing Address of Responsible Party (Only update if the address on the letter is inaccurate; otherwise, this item may be left blank)

Project: <Project Name>, <Project Address>, <PTS Number>

Permit Number:_____
(to be provided by DWQ)
Drainage Area Number:_____

Infiltration Basin Operation and Maintenance Agreement

I will keep a maintenance record on this BMP. This maintenance record will be kept in a log in a known set location. Any deficient BMP elements noted in the inspection will be corrected, repaired or replaced immediately. These deficiencies can affect the integrity of structures, safety of the public, and the removal efficiency of the BMP.

Important maintenance procedures:

- The drainage area will be carefully managed to reduce the sediment load to the infiltration basin.
- Immediately after the infiltration basin is established, the vegetation will be watered twice weekly if needed until the plants become established (commonly six weeks).
- No portion of the infiltration basin will be fertilized after the initial fertilization that is required to establish the vegetation.
- The vegetation in and around the basin will be maintained at a height of approximately six inches.

After the infiltration basin is established, it will be inspected **once a quarter and within 24 hours after every storm event greater than 1.0 inches (or 1.5 inches if in a Coastal County)**. Records of operation and maintenance will be kept in a known set location and will be available upon request.

Inspection activities shall be performed as follows. Any problems that are found shall be repaired immediately.

BMP element:	Potential problem:	How I will remediate the problem:
The entire BMP	Trash/debris is present.	Remove the trash/debris.
The perimeter of the infiltration basin	Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, and then plant a ground cover and water until it is established. Provide lime and a one-time fertilizer application.
The inlet device: pipe or swale	The pipe is clogged (if applicable).	Unclog the pipe. Dispose of the sediment off-site.
	The pipe is cracked or otherwise damaged (if applicable).	Replace the pipe.
	Erosion is occurring in the swale (if applicable).	Regrade the swale if necessary to smooth it over and provide erosion control devices such as reinforced turf matting or riprap to avoid future problems with erosion.

BMP element:	Potential problem:	How I will remediate the problem:
The forebay	Sediment has accumulated and reduced the depth to 75% of the original design depth.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.
	Erosion has occurred or riprap is displaced.	Provide additional erosion protection such as reinforced turf matting or riprap if needed to prevent future erosion problems.
	Weeds are present.	Remove the weeds, preferably by hand. If pesticides are used, wipe them on the plants rather than spraying.
The main treatment area	A visible layer of sediment has accumulated.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP. Replace any media that was removed in the process. Revegetate disturbed areas immediately.
	Water is standing more than 5 days after a storm event.	Replace the top few inches of filter media and see if this corrects the standing water problem. If so, revegetate immediately. If not, consult an appropriate professional for a more extensive repair.
	Weeds and noxious plants are growing in the main treatment area.	Remove the plants by hand or by wiping them with pesticide (do not spray).
The embankment	Shrubs or trees have started to grow on the embankment.	Remove shrubs or trees immediately.
	An annual inspection by an appropriate professional shows that the embankment needs repair.	Make all needed repairs.
The outlet device	Clogging has occurred.	Clean out the outlet device. Dispose of the sediment off-site.
	The outlet device is damaged	Repair or replace the outlet device.
The receiving water	Erosion or other signs of damage have occurred at the outlet.	Contact the NC Division of Water Quality 401 Oversight Unit at 919-733-1786.

Infiltration Basin TC-11

Design Considerations

- Soil for Infiltration
- Slope
- Aesthetics

Targeted Constituents

☑	Sediment	■
☑	Nutrients	■
☑	Trash	■
☑	Metals	■
☑	Bacteria	■
☑	Oil and Grease	■
☑	Organics	■

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

Description

An infiltration basin is a shallow impoundment that is designed to infiltrate stormwater. Infiltration basins use the natural filtering ability of the soil to remove pollutants in stormwater runoff. Infiltration facilities store runoff until it gradually exfiltrates through the soil and eventually into the water table. This practice has high pollutant removal efficiency and can also help recharge groundwater, thus helping to maintain low flows in stream systems. Infiltration basins can be challenging to apply on many sites, however, because of soils requirements. In addition, some studies have shown relatively high failure rates compared with other management practices.

California Experience

Infiltration basins have a long history of use in California, especially in the Central Valley. Basins located in Fresno were among those initially evaluated in the National Urban Runoff Program and were found to be effective at reducing the volume of runoff, while posing little long-term threat to groundwater quality (EPA, 1983; Schroeder, 1995). Proper siting of these devices is crucial as underscored by the experience of Caltrans in siting two basins in Southern California. The basin with marginal separation from groundwater and soil permeability failed immediately and could never be rehabilitated.

Advantages

- Provides 100% reduction in the load discharged to surface waters.
- The principal benefit of infiltration basins is the approximation of pre-development hydrology during which a

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

significant portion of the average annual rainfall runoff is infiltrated and evaporated rather than flushed directly to creeks.

- If the water quality volume is adequately sized, infiltration basins can be useful for providing control of channel forming (erosion) and high frequency (generally less than the 2-year) flood events.

Limitations

- May not be appropriate for industrial sites or locations where spills may occur.
- Infiltration basins require a minimum soil infiltration rate of 0.5 inches/hour, not appropriate at sites with Hydrologic Soil Types C and D.
- If infiltration rates exceed 2.4 inches/hour, then the runoff should be fully treated prior to infiltration to protect groundwater quality.
- Not suitable on fill sites or steep slopes.
- Risk of groundwater contamination in very coarse soils.
- Upstream drainage area must be completely stabilized before construction.
- Difficult to restore functioning of infiltration basins once clogged.

Design and Sizing Guidelines

- Water quality volume determined by local requirements or sized so that 85% of the annual runoff volume is captured.
- Basin sized so that the entire water quality volume is infiltrated within 48 hours.
- Vegetation establishment on the basin floor may help reduce the clogging rate.

Construction/Inspection Considerations

- Before construction begins, stabilize the entire area draining to the facility. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction or remove the top 2 inches of soil after the site is stabililized. Stabilize the entire contributing drainage area, including the side slopes, before allowing any runoff to enter once construction is complete.
- Place excavated material such that it can not be washed back into the basin if a storm occurs during construction of the facility.
- Build the basin without driving heavy equipment over the infiltration surface. Any equipment driven on the surface should have extra-wide ("low pressure") tires. Prior to any construction, rope off the infiltration area to stop entrance by unwanted equipment.
- After final grading, till the infiltration surface deeply.
- Use appropriate erosion control seed mix for the specific project and location.

Performance

As water migrates through porous soil and rock, pollutant attenuation mechanisms include precipitation, sorption, physical filtration, and bacterial degradation. If functioning properly, this approach is presumed to have high removal efficiencies for particulate pollutants and moderate removal of soluble pollutants. Actual pollutant removal in the subsurface would be expected to vary depending upon site-specific soil types. This technology eliminates discharge to surface waters except for the very largest storms; consequently, complete removal of all stormwater constituents can be assumed.

There remain some concerns about the potential for groundwater contamination despite the findings of the NURP and Nightingale (1975; 1987a,b,c; 1989). For instance, a report by Pitt et al. (1994) highlighted the potential for groundwater contamination from intentional and unintentional stormwater infiltration. That report recommends that infiltration facilities not be sited in areas where high concentrations are present or where there is a potential for spills of toxic material. Conversely, Schroeder (1995) reported that there was no evidence of groundwater impacts from an infiltration basin serving a large industrial catchment in Fresno, CA.

Siting Criteria

The key element in siting infiltration basins is identifying sites with appropriate soil and hydrogeologic properties, which is critical for long term performance. In one study conducted in Prince George's County, Maryland (Galli, 1992), all of the infiltration basins investigated clogged within 2 years. It is believed that these failures were for the most part due to allowing infiltration at sites with rates of less than 0.5 in/hr, basing siting on soil type rather than field infiltration tests, and poor construction practices that resulted in soil compaction of the basin invert.

A study of 23 infiltration basins in the Pacific Northwest showed better long-term performance in an area with highly permeable soils (Hilding, 1996). In this study, few of the infiltration basins had failed after 10 years. Consequently, the following guidelines for identifying appropriate soil and subsurface conditions should be rigorously adhered to.

- Determine soil type (consider RCS soil type 'A, B or C' only) from mapping and consult USDA soil survey tables to review other parameters such as the amount of silt and clay, presence of a restrictive layer or seasonal high water table, and estimated permeability. The soil should not have more than 30% clay or more than 40% of clay and silt combined. Eliminate sites that are clearly unsuitable for infiltration.

- Groundwater separation should be at least 3 m from the basin invert to the measured ground water elevation. There is concern at the state and regional levels of the impact on groundwater quality from infiltrated runoff, especially when the separation between groundwater and the surface is small.

- Location away from buildings, slopes and highway pavement (greater than 6 m) and wells and bridge structures (greater than 30 m). Sites constructed of fill, having a base flow or with a slope greater than 15% should not be considered.

- Ensure that adequate head is available to operate flow splitter structures (to allow the basin to be offline) without ponding in the splitter structure or creating backwater upstream of the splitter.

- Base flow should not be present in the tributary watershed.

Secondary Screening Based on Site Geotechnical Investigation

- At least three in-hole conductivity tests shall be performed using USBR 7300-89 or Bouwer-Rice procedures (the latter if groundwater is encountered within the boring), two tests at different locations within the proposed basin and the third down gradient by no more than approximately 10 m. The tests shall measure permeability in the side slopes and the bed within a depth of 3 m of the invert.

- The minimum acceptable hydraulic conductivity as measured in any of the three required test holes is 13 mm/hr. If any test hole shows less than the minimum value, the site should be disqualified from further consideration.

- Exclude from consideration sites constructed in fill or partially in fill unless no silts or clays are present in the soil boring. Fill tends to be compacted, with clays in a dispersed rather than flocculated state, greatly reducing permeability.

- The geotechnical investigation should be such that a good understanding is gained as to how the stormwater runoff will move in the soil (horizontally or vertically) and if there are any geological conditions that could inhibit the movement of water.

Additional Design Guidelines

(1) Basin Sizing - The required water quality volume is determined by local regulations or sufficient to capture 85% of the annual runoff.

(2) Provide pretreatment if sediment loading is a maintenance concern for the basin.

(3) Include energy dissipation in the inlet design for the basins. Avoid designs that include a permanent pool to reduce opportunity for standing water and associated vector problems.

(4) Basin invert area should be determined by the equation:

$$A = \frac{WQV}{kt}$$

where A = Basin invert area (m^2)

WQV = water quality volume (m^3)

k = 0.5 times the lowest field-measured hydraulic conductivity (m/hr)

t = drawdown time (48 hr)

(5) The use of vertical piping, either for distribution or infiltration enhancement shall not be allowed to avoid device classification as a Class V injection well per 40 CFR146.5(e)(4).

Maintenance

Regular maintenance is critical to the successful operation of infiltration basins. Recommended operation and maintenance guidelines include:

- Inspections and maintenance to ensure that water infiltrates into the subsurface completely (recommended infiltration rate of 72 hours or less) and that vegetation is carefully managed to prevent creating mosquito and other vector habitats.
- Observe drain time for the design storm after completion or modification of the facility to confirm that the desired drain time has been obtained.
- Schedule semiannual inspections for beginning and end of the wet season to identify potential problems such as erosion of the basin side slopes and invert, standing water, trash and debris, and sediment accumulation.
- Remove accumulated trash and debris in the basin at the start and end of the wet season.
- Inspect for standing water at the end of the wet season.
- Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and regrade when the accumulated sediment volume exceeds 10% of the basin.
- If erosion is occurring within the basin, revegetate immediately and stabilize with an erosion control mulch or mat until vegetation cover is established.
- To avoid reversing soil development, scarification or other disturbance should only be performed when there are actual signs of clogging, rather than on a routine basis. Always remove deposited sediments before scarification, and use a hand-guided rotary tiller, if possible, or a disc harrow pulled by a very light tractor.

Cost

Infiltration basins are relatively cost-effective practices because little infrastructure is needed when constructing them. One study estimated the total construction cost at about $2 per ft (adjusted for inflation) of storage for a 0.25-acre basin (SWRPC, 1991). As with other BMPs, these published cost estimates may deviate greatly from what might be incurred at a specific site. For instance, Caltrans spent about $18/ft^3 for the two infiltration basins constructed in southern California, each of which had a water quality volume of about 0.34 ac.-ft. Much of the higher cost can be attributed to changes in the storm drain system necessary to route the runoff to the basin locations.

Infiltration basins typically consume about 2 to 3% of the site draining to them, which is relatively small. Additional space may be required for buffer, landscaping, access road, and fencing. Maintenance costs are estimated at 5 to 10% of construction costs.

One cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly maintained, infiltration basins have a high failure rate. Thus, it may be necessary to replace the basin with a different technology after a relatively short period of time.

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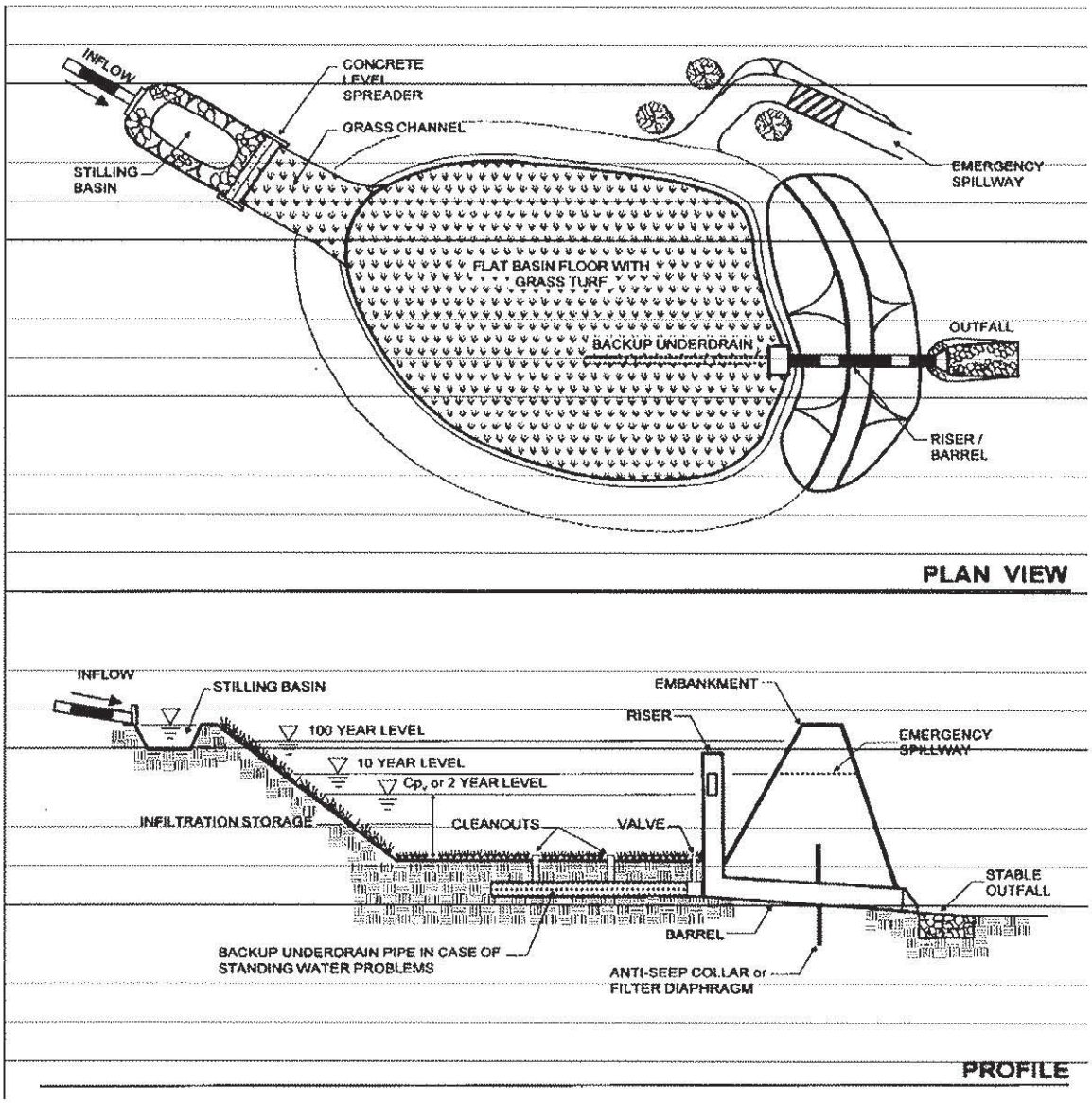

INFLOW
CONCRETE LEVEL SPREADER
GRASS CHANNEL
STILLING BASIN
EMERGENCY SPILLWAY
FLAT BASIN FLOOR WITH GRASS TURF
OUTFALL
BACKUP UNDERDRAIN
RISER / BARREL
PLAN VIEW
INFLOW
STILLING BASIN
EMBANKMENT
RISER
EMERGENCY SPILLWAY
100 YEAR LEVEL
10 YEAR LEVEL
Cp, or 2 YEAR LEVEL
INFILTRATION STORAGE
CLEANOUTS
VALVE
STABLE OUTFALL
BARREL
BACKUP UNDERDRAIN PIPE IN CASE OF STANDING WATER PROBLEMS
ANTI-SEEP COLLAR or FILTER DIAPHRAGM
PROFILE

Innovative stormwater management products

FloGard® +PLUS
Catch Basin Insert Filter

INSTALLATION AND MAINTENANCE
Filter shall be installed and maintained in accordance with manufacturer's general instructions and recommendations.

PERFORMANCE
Filter shall provide 80% removal of total suspended solids (TSS) from treated flow with a particle size distribution consistent with typical urban street deposited sediments. Filter shall capture at least 70% of oil and grease and 40% of total phosphorus (TP) associated with organic debris from treated flow. Unit shall provide for isolation of trapped pollutants, including debris, sediments, and floatable trash and hydrocarbons, from bypass flow such that re-suspension and loss of pollutants is minimized during peak flow events.

FloGard®+PLUS COMPETITIVE FEATURE COMPARISON

Evaluation of FloGard+PLUS Units (Based on flow-comparable units) (Scale 1-10, 10 being best)	**FloGard+PLUS**	**Other Insert Filter Types****
Flow Rate	10	7
Removal Efficiency*	80%	45%
Capacity – Sludge and Oil	7	7
Service Life	10	3
Installation – Ease of Handling / Installation	8	6
Ease of Inspections & Maintenance	7	7
Value	**10**	**2**

*approximate, based on field sediment removal testing in urban street application **average

Long-Term Cost Comparison (Scale 1-10, 10 being lowest cost, higher number being best)	**FloGard+PLUS**	**Other Insert Filter Types**
Unit cost — initial ($/cfs treated)	10	4
Installation cost ($/cfs treated)	9	6
Adsorbent replacement (annual avg $/cfs treated)	10	2
Unit materials replacement (annual avg $/cfs treated)	10	10
Maintenance cost (annual avg $/cfs treated)	9	6
Total first yr ($/cfs treated)	10	5
Total Annual Avg ($/cfs treated, avg over 20 yrs)*	**10**	**5**

*assumes 3% annual inflation

Captured debris from FloGard+PLUS, Dana Point, CA

FloGard+PLUS Combination Inlet

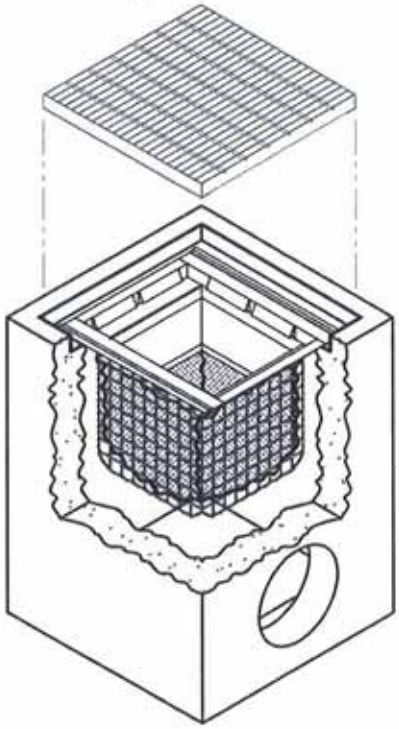
FloGard+PLUS Flat Grate

FloGard+PLUS Round Gated Inlet

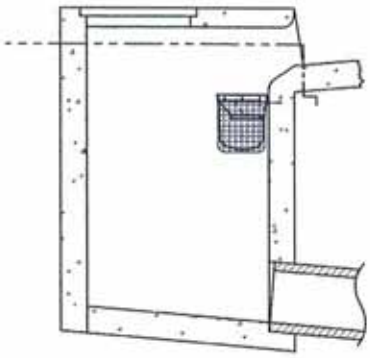
KriStar Enterprises, Inc.
P.O. Box 6419
Santa Rosa, CA 95406-1419

PH: 800-579-8819
FAX: 707-524-8186
www.kristar.com

Flat grated inlet



Curb inlet



FloGard+PLUS™ / Installation Guide

FloGard+PLUS™ Catch Basin Insert Filters are designed for installation in flat grated catch basins, combination (grated and curb opening) catch basins and curb opening catch basins.

They may be "Frame" mounted or "Wall" mounted depending on the type of catch basin.

Key elements of installation of the various devices and mounting methods are:

Frame Mount Insert Filter (for standard or irregular-dimensioned flat grated inlets):

- Remove the inlet grate and clean and remove any collected debris and trash from the catch basin.

- Clean off the grate bearing ledge and lower the filter assembly onto the ledge.

- Insure that the two floatable adsorbent pouches are tethered to the D-rings in the bottom corners of the assembly.

- Replace the inlet grate.

KRISTAR ENTERPRISES, INC.

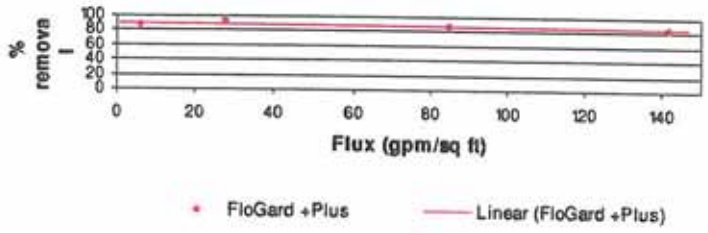
Performance Summary

Tech Bulletin
KS-FGPWWC-082205-C

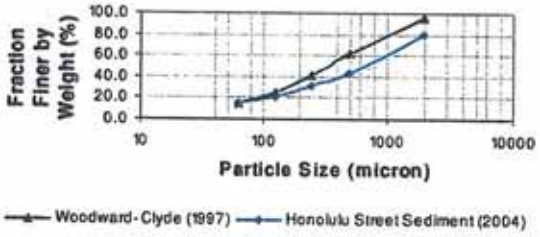
Kristar FloGard +PLUS® Catch Basin Insert Filter

Independent field tests conducted in Hawaii and New Zealand on FloGard +PLUS® Catch Basin Insert Filters to determine TSS removal efficiency. Results were extrapolated to a typical street deposited sediment particle size. Removal efficiencies were plotted and reflect effective TSS removal over the typical range of operating flow rates. Results are shown below as a function of unit internal surface area.

FloGard +Plus®
TSS Removal
Typical Urban Runoff Distribution*
***extrapolated from available field test data**



Street Deposited Sediment
Typical Particle Size Distribution
from urban runoff TSS survey data



Units are sized to fit most common styles of drainage inlet grate frames or inlet widths. Rated filtered flow capacities for each model typically exceed the required "first flush" treatment flow rate, and account for reduction in capacity as the unit accumulates suspended pollutants. Rated bypass capacity for each model also typically exceeds the inlet capacity of the catch basin.

See product specifications for standard model details

Kristar's FloGard +PLUS® Catch Basin Insert Filter is an efficient inlet prefilter designed to remove suspended sediment and floatable trash and hydrocarbons from stormwater runoff in new or retrofit applications. It is ideally suited for removal of primary pollutants from paved surfaces in commercial and residential areas, or may form part of a treatment train. The device features a unique dual-bypass design, durable components, flexible installation options and easy maintenance access.

FloGard +PLUS® Test Results Summary

Testing Agency	% TSS Removal	% Oil & Grease Removal
UCLA	80*	70-80
U of Auckland Tonkin & Taylor Ltd (for City of Auckland)	95** 78-86***	
U of Hawaii (for City of Honolulu)	80***	

*Sand larger than ~575 µm
**Sand distribution ~100-1000 µm
***Local street sweep material (distribution consistent with NURP)

Kristar Enterprises
1219 Briggs Avenue
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95401

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www.kristar.com

Innovative stormwater management products

KRISTAR

FloGard®
+PLUS
Catch Basin Insert Filter

FloGard®+PLUS Catch Basin Insert Filter

GENERAL FILTER CONFIGURATION

FloGard®+PLUS catch basin insert filter shall provide solids filtration through a filter screen or filter liner, and hydrocarbon capture shall be effected using a non-leaching absorbent material contained in a pouch or similar removable restraint. Hydrocarbon absorbent shall not be placed at an exposed location at the entry to the filter that would allow blinding by debris and sediment without provision for self-cleaning in operation.

Filter shall conform to the dimensions of the inlet in which it is applied, allow removal and replacement of all internal components, and allow complete inspection and cleaning in the field.

FLOW CAPACITY

Filter shall provide two internal high-flow bypass locations that in total exceed the inlet peak flow capacity. Filter shall provide filtered flow capacity in excess of the required "first flush" treatment flow. Unit shall not impede flow into or through the catch basin when properly sized and installed.

MATERIALS

Filter support frame shall be constructed of type 304 stainless steel. Filter screen, when used in place of filter liner, shall be type 304 or 316 stainless steel, with an apparent opening size of not less than 4 U.S. mesh. Filter liner, when used in place of filter screen, shall be woven polypropylene geotextile fabric liner with an apparent opening size (AOS) of not less than 40 U.S. mesh as determined by ASTM D 4751. Filter liner shall include a support basket of polypropylene geogrid with stainless steel cable reinforcement.

Filter frame shall be rated at a minimum 25-year service life. All other materials, with the exception of the hydrocarbon absorbent, shall have a rated service life in excess of 2 years.

FloGard®+PLUS TEST RESULTS SUMMARY

Testing Agency	% TSS Removal	% Oil and Grease Removal	% PAH Removal
UCLA	80	70 to 80	
U of Auckland Tonking & Taylor Ltd. (for city of Auckland)	78 to 95		
U of Hawaii (for city of Honolulu)	80		20 to 40

FEATURES

- Easy to install, inspect and maintain
- Can be retrofitted to existing drain catch basins – or used in new projects
- Economical and efficient
- Catches pollutants where they are easiest to catch (at the inlet)
- No standing water – minimizes vector, bacteria and odor problems
- Can be incorporated as part of a "Treatment Train"

BENEFITS

- Lower installation, inspection and maintenance costs
- Versatile installation applications
- Higher return on investment
- Allows for installation on small and confined sites
- Minimizes vector, bacteria and odor problems
- Allows user to target specific pollutants

GENERAL SPECIFICATIONS FOR MAINTENANCE OF *FLOGARD® LO PRO TRENCH DRAIN FILTERS*

SCOPE:

Federal, State and Local Clean Water Act regulations and those of insurance carriers require that stormwater filtration systems be maintained and serviced on a recurring basis. The intent of the regulations is to ensure that the systems, on a continuing basis, efficiently remove pollutants from stormwater runoff thereby preventing pollution of the nation's water resources. These Specifications apply to the FloGard® LoPro Trench Drain Filter.

RECOMMENDED FREQUENCY OF SERVICE:

Drainage Protection Systems (DPS) recommends that installed FloGard® LoPro Trench Drain Filters be serviced on a recurring basis. Ultimately, the frequency depends on the amount of runoff, pollutant loading and interference from debris (leaves, vegetation, cans, paper, etc.); however, it is recommended that each installation be serviced a minimum of three times per year, with a change of filter medium once per year. DPS technicians are available to do an on-site evaluation, upon request.

RECOMMENDED TIMING OF SERVICE:

DPS guidelines for the timing of service are as follows:

1. For areas with a definite rainy season: Prior to, during and following the rainy season.
2. For areas subject to year-round rainfall: On a recurring basis (at least three times per year).
3. For areas with winter snow and summer rain: Prior to and just after the snow season and during the summer rain season.
4. For installed devices not subject to the elements (wash racks, parking garages, etc.): On a recurring basis (no less than three times per year).

SERVICE PROCEDURES:

1. The trench drain grate(s) shall be removed and set to one side.
2. The service shall commence with collection and removal of sediment and debris (litter, leaves, papers, cans, etc.)
3. The trench drain shall be visually inspected for defects and possible illegal dumping. If illegal dumping has occurred, the proper authorities and property owner representative shall be notified as soon as practicable.
4. Using an industrial vacuum, the collected materials shall be removed from the filter liner. (Note: DPS uses a truck-mounted vacuum for servicing FloGard® LoPro Trench Drain Filters.)
5. When all of the collected materials have been removed, the filter assembly shall be removed from the drainage inlet. The outer filter liner shall be removed from the filter assembly and filter medium pouches shall be removed by unsnapping the tether from the interior ring and set to one side. The filter liner, PVC body and fittings shall be inspected for continued serviceability. Minor damage or defects found shall be corrected on the spot and a notation made on the Maintenance Record. More extensive deficiencies that affect the efficiency of the filter (torn liner, etc.), if approved by the customer representative, will be corrected and a quote submitted to the representative along with the Maintenance Record.
6. The filter liner and filter medium pouches shall be inspected for defects and continued serviceability and replaced as necessary and the pouch tethers re-attached to the PVC body interior ring.
7. The grate(s) shall be replaced.

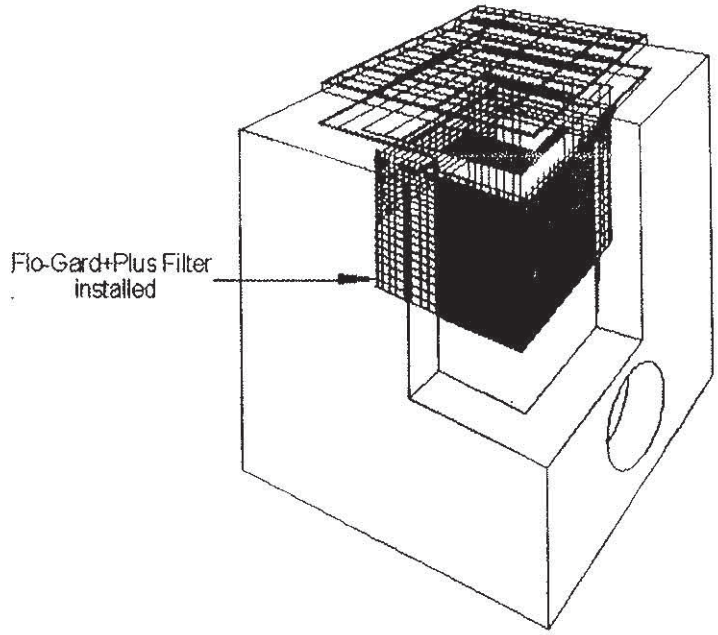
REPLACEMENT AND DISPOSAL OF EXPOSED FILTER MEDIUM AND COLLECTED DEBRIS

The frequency of filter medium pouch exchange will be in accordance with the existing DPS-Customer Maintenance Contract. DPS recommends that the medium be changed at least once per year. During the appropriate service, or if so determined by the service technician during a non-scheduled service, the filter medium pouches will be replaced. Once the exposed pouches and debris have been placed in the container, DPS has possession and must dispose of it in accordance with local, state and federal agency requirements.

Note: As the generator, the landowner is ultimately responsible for the proper disposal of the exposed filter medium and debris. Because the filter media likely contain petroleum hydrocarbons, heavy metals and other harmful pollutants, the materials must be treated as an EPA Class 2 Hazardous Waste and properly disposed of. DPS relieves the landowner of the actual disposal task, and provides certification of its completion in accordance with appropriate regulations.

DPS also has the capability of servicing all types of catch basin inserts and catch basins without inserts, underground oil/water separators, stormwater interceptors and other treatment devices. All DPS personnel are highly qualified technicians and are confined space trained and certified. Call us at (888) 950-8826 for further information and assistance.

04/07



Model No.	Inlet ID (in x in)	Grate OD (in x in)	Solids Storage Cap. (cu ft)	Filtered Flow (cfs)	Initial Bypass Cap. (cfs)	Secondary Bypass Cap. (cfs)	Total Bypass Cap. (cfs)
FGP-12F	12 x 12	14 x 14	0.3	0.4	2.7	0.1	2.8
FGP-1530F	15 x 30	16 x 36	2.3	1.6	6.5	0.4	6.9
FGP-16F	16 x 16	18 x 18	0.8	0.7	4.4	0.2	4.7
FGP-18F	18 x 18	20 x 20	0.8	0.7	4.4	0.2	4.7
FGP-1822F	20 x 24	18 x 22	2.1	1.4	5.6	0.3	5.9
FGP-1824F	16 x 22	20 x 24	1.5	1.2	4.8	0.2	5.0
FGP-1836F	18 x 36	18 x 40	2.3	1.6	6.5	0.4	6.9
FGP-2024F	20 x 24	22 x 24	1.2	1.0	5.6	0.3	5.9
FGP-21F	22 x 22	24 x 24	2.2	1.5	5.8	0.3	6.1
FGP-2142F	21 x 42	26 x 42	4.3	2.4	8.7	0.4	9.1
FGP-24F	24 x 24	26 x 26	2.2	1.5	5.8	0.3	6.1
FGP-2436F	24 x 36	24 x 40	3.4	2.0	7.5	0.4	8.0
FGP-2445F	24 x 45	26 x 47	4.4	2.4	8.9	0.4	9.3
FGP-2448F	24 x 48	26 x 48	4.4	2.4	8.9	0.4	9.3
FGP-28F	28 x 28	30 x 30	2.2	1.5	5.8	0.5	6.3
FGP-30F	30 x 30	30 x 34	3.6	2.0	7.5	0.5	8.1
FGP-36F	36 x 36	36 x 40	4.6	2.4	8.6	0.5	9.1
FGP-3648F	36 x 48	40 x 48	6.8	3.2	10.8	0.6	11.5
FGP-48F (2 pc)	48 x 48	48 x 52	9.5	3.9	12.5	0.7	13.2

NOTES:

1. Storage capacity reflects 80% of maximum solids collection prior to impeding filtering bypass.
2. Filtered flow rate includes a safety factor of 2.
3. Flo-Gard+Plus Catch Basin Filter inserts are available in the standard sizes (see above) or in custom sizes. Call for details on custom size inserts.
4. Flo-Gard+Plus filter inserts should be used in conjunction with a regular maintenance program. Refer to manufacturer's recommended maintenance guidelines.

US PATENT PENDING

FLO-GARD™ +PLUS

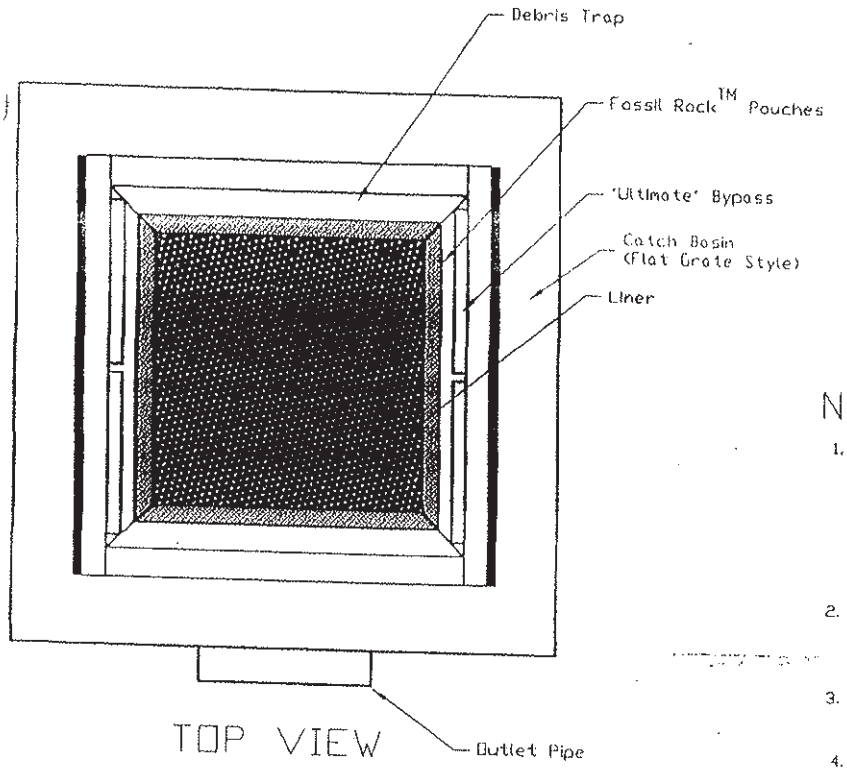
CATCH BASIN FILTER INSERT

(Frame Mount)

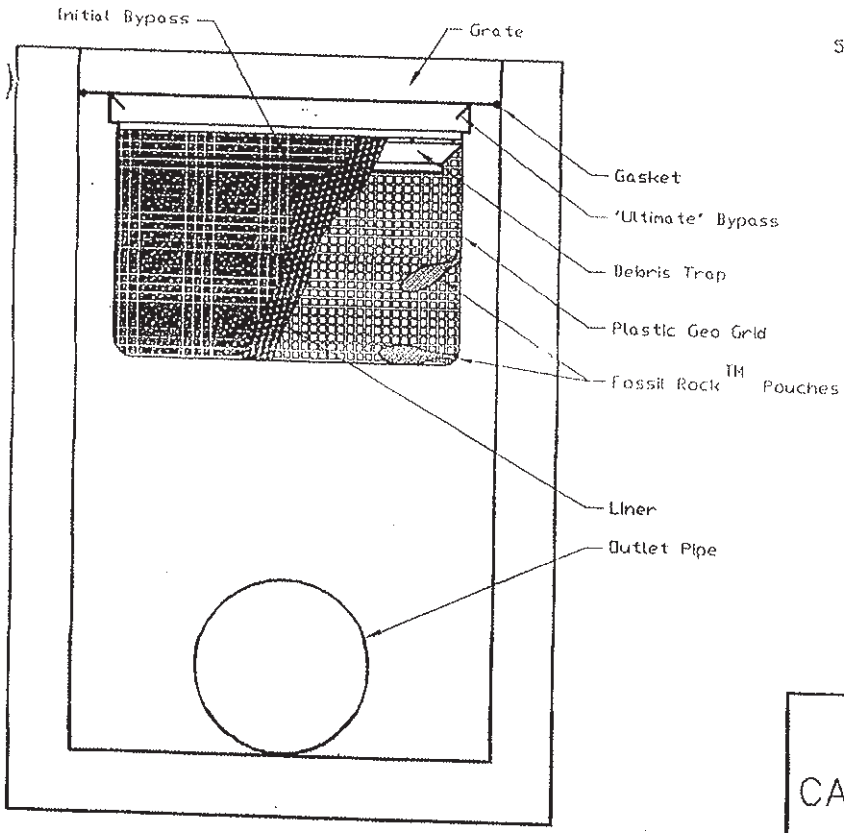
FLAT GRATED INLET

SHEET 1 OF 2

KriStar Enterprises, Inc., Santa Rosa, CA (800) 579-8619



TOP VIEW



SIDE VIEW

NOTES:

1. FloGard+Plus™ (frame mount) high capacity catch basin insets are available in sizes to fit most industry-standard catch basin sizes and styles (see specifier chart) Refer to the FloGard+Plus™ (wall mount).
2. Filter insert shall have both an 'initial' filtering bypass and 'ultimate' high-flow bypass.
3. Filter assembly shall be constructed from stainless steel (type 304).
4. Allow a minimum of 2'-0' of clearance between the bottom of grate and top of inlet or outlet pipe(s). Refer to the FloGard™ insert for 'shallow' installations.
5. Filter medium shall be FOSSIL ROCK™ installed and maintained in accordance with manufacturer recommendations.

FLOGARD+PLUS™ CATCH BASIN FILTER INSERT

(FRAME MOUNT)

FLAT GRATED INLET

SHEET 2 OF 2

KriStar Enterprises, Inc., Santa Rosa, CA
(800) 579-8819

CATCH BASIN MAINTENANCE RECORD

SITE INFORMATION	
Contact:	Phone: ( )
Project Name:	
Address:	
Filter No. & Filter Model:	

SERVICE INFORMATION		
Date of Service:	By:	
☐ Inspection	☐ Clean Debris	☐ Clean Silt/Sediment
☐ Replace Pouch	☐ Replace Rock	☐ Repair/Replace Parts
Comments:		
Approval Signature:		

SITE INFORMATION	
Contact:	Phone: ( )
Project Name:	
Address:	
Filter No. & Filter Model:	

SERVICE INFORMATION		
Date of Service:	By:	
☐ Inspection	☐ Clean Debris	☐ Clean Silt/Sediment
☐ Replace Pouch	☐ Replace Rock	☐ Repair/Replace Parts
Comments:		
Approval Signature:		

Drain Inserts MP-52

Description

Drain inserts are manufactured filters or fabric placed in a drop inlet to remove sediment and debris. There are a multitude of inserts of various shapes and configurations, typically falling into one of three different groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are one box; that is, the setting area and filtration through media occur in the same box. Some products consist of one or more trays or mesh grates. The trays may hold different types of media. Filtration media vary by manufacturer. Types include polypropylene, porous polymer, treated cellulose, and activated carbon.

California Experience

The number of installations is unknown but likely exceeds a thousand. Some users have reported that these systems require considerable maintenance to prevent plugging and bypass.

Advantages

- Does not require additional space as inserts as the drain inlets are already a component of the standard drainage systems.
- Easy access for inspection and maintenance.
- As there is no standing water, there is little concern for mosquito breeding.
- A relatively inexpensive retrofit option.

Limitations

Performance is likely significantly less than treatment systems that are located at the end of the drainage system such as ponds and vaults. Usually not suitable for large areas or areas with trash or leaves than can plug the insert.

Design and Sizing Guidelines

Refer to manufacturer's guidelines. Drain inserts come any many configurations but can be placed into three general groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are

Design Considerations

- Use with other BMPs
- Fit and Seal Capacity within Inlet

Targeted Constituents

- ☑ Sediment
- ☑ Nutrients
- ☑ Trash
- ☑ Metals
- Bacteria
- ☑ Oil and Grease
- ☑ Organics

Removal Effectiveness

See New Development and Redevelopment Handbook-Section 5.

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one box; that is, the setting area and filtration through media occurs in the same box. One manufacturer has a double-box. Stormwater enters the first box where setting occurs. The stormwater flows into the second box where the filter media is located. Some products consist of one or more trays or mesh grates. The trays can hold different types of media. Filtration media vary with the manufacturer: types include polypropylene, porous polymer, treated cellulose, and activated carbon.

Construction/Inspection Considerations

Be certain that installation is done in a manner that makes certain that the stormwater enters the unit and does not leak around the perimeter. Leakage between the frame of the insert and the frame of the drain inlet can easily occur with vertical (drop) inlets.

Performance

Few products have performance data collected under field conditions.

Siting Criteria

It is recommended that inserts be used only for retrofit situations or as pretreatment where other treatment BMPs presented in this section area used.

Additional Design Guidelines

Follow guidelines provided by individual manufacturers.

Maintenance

Likely require frequent maintenance, on the order of several times per year.

Cost

- The initial cost of individual inserts ranges from less than $100 to about $2,000. The cost of using multiple units in curb inlet drains varies with the size of the inlet.
- The low cost of inserts may tend to favor the use of these systems over other, more effective treatment BMPs. However, the low cost of each unit may be offset by the number of units that are required, more frequent maintenance, and the shorter structural life (and therefore replacement).

References and Sources of Additional Information

Hrachovec, R., and G. Minton, 2001, Field testing of a sock-type catch basin insert, Planet CPR, Seattle, Washington

Interagency Catch Basin Insert Committee, Evaluation of Commercially-Available Catch Basin Inserts for the Treatment of Stormwater Runoff from Developed Sites, 1995

Larry Walker Associates, June 1998, NDMP Inlet/In-Line Control Measure Study Report

Manufacturers literature

Santa Monica (City), Santa Monica Bay Municipal Stormwater/Urban Runoff Project - Evaluation of Potential Catch basin Retrofits, Woodward Clyde, September 24, 1998

Woodward Clyde, June 11, 1996, Parking Lot Monitoring Report, Santa Clara Valley Nonpoint Source Pollution Control Program.

Spill Prevention, Control & Cleanup SC-11

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Description

Many activities that occur at an industrial or commercial site have the potential to cause accidental or illegal spills. Preparation for accidental or illegal spills, with proper training and reporting systems implemented, can minimize the discharge of pollutants to the environment.

Spills and leaks are one of the largest contributors of stormwater pollutants. Spill prevention and control plans are applicable to any site at which hazardous materials are stored or used. An effective plan should have spill prevention and response procedures that identify potential spill areas, specify material handling procedures, describe spill response procedures, and provide spill clean-up equipment. The plan should take steps to identify and characterize potential spills, eliminate and reduce spill potential, respond to spills when they occur in an effort to prevent pollutants from entering the stormwater drainage system, and train personnel to prevent and control future spills.

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Approach

Pollution Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- Develop a Spill Prevention Control and Countermeasure (SPCC) Plan. The plan should include:

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- Description of the facility, owner and address, activities and chemicals present
- Facility map
- Notification and evacuation procedures
- Cleanup instructions
- Identification of responsible departments
- Identify key spill response personnel

- Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of process materials that are brought into the facility.

Suggested Protocols (including equipment needs)

Spill Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- If consistent illegal dumping is observed at the facility:
  - **Post "No Dumping" signs** with a phone number for reporting illegal dumping and disposal. Signs should also indicate fines and penalties applicable for illegal dumping.
  - Landscaping and beautification efforts may also discourage illegal dumping.
  - Bright lighting and/or entrance barriers may also be needed to discourage illegal dumping.

- Store and contain liquid materials in such a manner that if the tank is ruptured, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters, or groundwater.

- If the liquid is oil, gas, or other material that separates from and floats on water, install a spill control device (such as a tee section) in the catch basins that collects runoff from the storage tank area.

- Routine maintenance:
  - Place drip pans or absorbent materials beneath all mounted taps, and at all potential drip and spill locations during filling and unloading of tanks. Any collected liquids or soiled absorbent materials must be reused/recycled or properly disposed.
  - Store and maintain appropriate spill cleanup materials in a location known to all near the tank storage area; and ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.
  - Sweep and clean the storage area monthly if it is paved, *do not hose down the area to a storm drain.*

  - Check tanks (and any containment sumps) daily for leaks and spills. Replace tanks that are leaking, corroded, or otherwise deteriorating with tanks in good condition. Collect all spilled liquids and properly dispose of them.

- Label all containers according to their contents (e.g., solvent, gasoline).
- Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).
- Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).
- Identify key spill response personnel.

Spill Control and Cleanup Activities

- Follow the Spill Prevention Control and Countermeasure Plan.
- Clean up leaks and spills immediately.
- Place a stockpile of spill cleanup materials where it will be readily accessible (e.g., near storage and maintenance areas).
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste. Physical methods for the cleanup of dry chemicals include the use of brooms, shovels, sweepers, or plows.
- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Chemical cleanups of material can be achieved with the use of adsorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Reporting

- Report spills that pose an immediate threat to human health or the environment to the Regional Water Quality Control Board.
- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour).
- Report spills to local agencies, such as the fire department; they can assist in cleanup.
- Establish a system for tracking incidents. The system should be designed to identify the following:

  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)

- Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
- Responsible parties

Training

- Educate employees about spill prevention and cleanup.
- Well-trained employees can reduce human errors that lead to accidental releases or spills:
  - The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
  - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.
- Employees should be educated about aboveground storage tank requirements. Employees responsible for aboveground storage tanks and liquid transfers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.
- Train employees to recognize and report illegal dumping incidents.

Other Considerations (Limitations and Regulations)

- State regulations exist for facilities with a storage capacity of 10,000 gallons or more of petroleum to prepare a Spill Prevention Control and Countermeasure (SPCC) Plan (Health & Safety Code Chapter 6.67).
- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.
- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.

Requirements

Costs (including capital and operation & maintenance)

- Will vary depending on the size of the facility and the necessary controls.
- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil or water can be quite expensive.

Maintenance (including administrative and staffing)

- This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills, which results in increased labor costs.

Supplemental Information

Further Detail of the BMP

Reporting

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the facility and the effectiveness of BMPs. A good record keeping system helps the facility minimize incident recurrence, correctly respond with appropriate cleanup activities, and comply with legal requirements. A record keeping and reporting system should be set up for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm sewer. These records should contain the following information:

- Date and time of the incident
- Weather conditions
- Duration of the spill/leak/discharge
- Cause of the spill/leak/discharge
- Response procedures implemented
- Persons notified
- Environmental problems associated with the spill/leak/discharge

Separate record keeping systems should be established to document housekeeping and preventive maintenance inspections, and training activities. All housekeeping and preventive maintenance inspections should be documented. Inspection documentation should contain the following information:

- The date and time the inspection was performed
- Name of the inspector
- Items inspected
- Problems noted
- Corrective action required
- Date corrective action was taken

Other means to document and record inspection results are field notes, timed and dated photographs, videotapes, and drawings and maps.

Aboveground Tank Leak and Spill Control

Accidental releases of materials from aboveground liquid storage tanks present the potential for contaminating stormwater with many different pollutants. Materials spilled, leaked, or lost from

tanks may accumulate in soils or on impervious surfaces and be carried away by stormwater runoff.

The most common causes of unintentional releases are:

- Installation problems
- Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves)
- External corrosion and structural failure
- Spills and overfills due to operator error
- Leaks during pumping of liquids or gases from truck or rail car to a storage tank or vice versa

Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code. Practices listed below should be employed to enhance the code requirements:

- Tanks should be placed in a designated area.
- Tanks located in areas where firearms are discharged should be encapsulated in concrete or the equivalent.
- Designated areas should be impervious and paved with Portland cement concrete, free of cracks and gaps, in order to contain leaks and spills.
- Liquid materials should be stored in UL approved double walled tanks or surrounded by a curb or dike to provide the volume to contain 10 percent of the volume of all of the containers or 110 percent of the volume of the largest container, whichever is greater. The area inside the curb should slope to a drain.
- For used oil or dangerous waste, a dead-end sump should be installed in the drain.
- All other liquids should be drained to the sanitary sewer if available. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Accumulated stormwater in petroleum storage areas should be passed through an oil/water separator.

Maintenance is critical to preventing leaks and spills. Conduct routine inspections and:

- Check for external corrosion and structural failure.
- Check for spills and overfills due to operator error.
- Check for failure of piping system (pipes, pumps, flanger, coupling, hoses, and valves).
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.

- Visually inspect new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Frequently relocate accumulated stormwater during the wet season.
- Periodically conduct integrity testing by a qualified professional.

Vehicle Leak and Spill Control

Major spills on roadways and other public areas are generally handled by highly trained Hazmat teams from local fire departments or environmental health departments. The measures listed below pertain to leaks and smaller spills at vehicle maintenance shops.

In addition to implementing the spill prevention, control, and clean up practices above, use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- Perform all vehicle fluid removal or changing inside or under cover to prevent the run-on of stormwater and the runoff of spills.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Immediately drain all fluids from wrecked vehicles.
- Store wrecked vehicles or damaged equipment under cover.
- Place drip pans or absorbent materials under heavy equipment when not in use.
- Use adsorbent materials on small spills rather than hosing down the spill.
- Remove the adsorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- Oil filters disposed of in trashcans or dumpsters can leak oil and contaminate stormwater. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.

- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- Design the fueling area to prevent the run-on of stormwater and the runoff of spills:
  - Cover fueling area if possible.
  - Use a perimeter drain or slope pavement inward with drainage to a sump.
  - Pave fueling area with concrete rather than asphalt.
- If dead-end sump is not used to collect spills, install an oil/water separator.
- Install vapor recovery nozzles to help control drips as well as air pollution.
- Discourage **"topping-off" of fuel tanks**.
- Use secondary containment when transferring fuel from the tank truck to the fuel tank.
- Use adsorbent materials on small spills and general cleaning rather than hosing down the area. Remove the adsorbent materials promptly.
- Carry out all Federal and State requirements regarding underground storage tanks, or install above ground tanks.
- Do not use mobile fueling of mobile industrial equipment around the facility; rather, transport the equipment to designated fueling areas.
- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Train employees in proper fueling and cleanup procedures.

Industrial Spill Prevention Response

For the purposes of developing a spill prevention and response program to meet the stormwater regulations, facility managers should use information provided in this fact sheet and the spill prevention/response portions of the fact sheets in this handbook, for specific activities. The program should:

- Integrate with existing emergency response/hazardous materials programs (e.g., Fire Department)
- Develop procedures to prevent/mitigate spills to storm drain systems
- Identify responsible departments
- Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures
- Address spills at municipal facilities, as well as public areas

- Provide training concerning spill prevention, response and cleanup to all appropriate personnel

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Stormwater Managers Resource Center http://www.stormwatercenter.net/

Outdoor Loading/Unloading SC-30

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Description

The loading/unloading of materials usually takes place outside on docks or terminals; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move materials. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials.

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- Limit exposure of material to rainfall whenever possible.
- Prevent stormwater run-on.
- Check equipment regularly for leaks.

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Suggested Protocols

Loading and Unloading – General Guidelines

- Develop an operations plan that describes procedures for loading and/or unloading.
- Conduct loading and unloading in dry weather if possible.
- Cover designated loading/unloading areas to reduce exposure of materials to rain.
- Consider placing a seal or door skirt between delivery vehicles and building to prevent exposure to rain.
- Design loading/unloading area to prevent stormwater run-on, which would include grading or berming the area, and position roof downspouts so they direct stormwater away from the loading/unloading areas.
- Have employees load and unload all materials and equipment in covered areas such as building overhangs at loading docks if feasible.
- Load/unload only at designated loading areas.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip collected materials must be disposed of properly.
- Pave loading areas with concrete instead of asphalt.
- Avoid placing storm drains in the area.
- Grade and/or berm the loading/unloading area to a drain that is connected to a deadend.

Inspection

- Check loading and unloading equipment regularly for leaks, including valves, pumps, flanges and connections.
- Look for dust or fumes during loading or unloading operations.

Training

- Train employees (e.g., fork lift operators) and contractors on proper spill containment and cleanup.
- Have employees trained in spill containment and cleanup present during loading/unloading.
- Train employees in proper handling techniques during liquid transfers to avoid spills.
- Make sure forklift operators are properly trained on loading and unloading procedures.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Contain leaks during transfer.
- Store and maintain appropriate spill cleanup materials in a location that is readily accessible and known to all and ensure that employees are familiar with the site's spill control plan and proper spill cleanup procedures.
- Have an emergency spill cleanup plan readily available.
- Use drip pans or comparable devices when transferring oils, solvents, and paints.

Other Considerations (Limitations and Regulations)

- Space and time limitations may preclude all transfers from being performed indoors or under cover.
- It may not be possible to conduct transfers only during dry weather.

Requirements

Costs

Costs should be low except when covering a large loading/unloading area.

Maintenance

- Conduct regular inspections and make repairs as necessary. The frequency of repairs will depend on the age of the facility.
- Check loading and unloading equipment regularly for leaks.
- Conduct regular broom dry-sweeping of area.

Supplemental Information

Further Detail of the BMP

Special Circumstances for Indoor Loading/Unloading of Materials

Loading or unloading of liquids should occur in the manufacturing building so that any spills that are not completely retained can be discharged to the sanitary sewer, treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- For loading and unloading tank trucks to above and below ground storage tanks, the following procedures should be used:
  - The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
  - The transfer area should be designed to prevent run-on of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.

- The transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer. A positive control valve should be installed on the drain.

- For transfer from rail cars to storage tanks that must occur outside, use the following procedures:

  - Drip pans should be placed at locations where spillage may occur, such as hose connections, hose reels, and filler nozzles. Use drip pans when making and breaking connections.

  - Drip pan systems should be installed between the rails to collect spillage from tank cars.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Building & Grounds Maintenance SC-41

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	
Organics	

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.

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- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

Suggested Protocols

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.
- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.
- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

Landscaping Activities

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.

Building Repair, Remodeling, and Construction

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures when soils are exposed.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.
- Use hand weeding where practical.

Fertilizer and Pesticide Management

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.
- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.
- Apply pesticides only when wind speeds are low.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Dispose of empty pesticide containers according to the instructions on the container label.

- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering and repair leaks in the irrigation system as soon as they are observed.

Training

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- Clean up spills immediately.

Other Considerations

Alternative pest/weed controls may not be available, suitable, or effective in many cases.

Requirements

Costs

- Cost will vary depending on the type and size of facility.
- Overall costs should be low in comparison to other BMPs.

Maintenance

Sweep paved areas regularly to collect loose particles. Wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

Supplemental Information

Further Detail of the BMP

Fire Sprinkler Line Flushing

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Parking/Storage Area Maintenance SC-43

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

The goal of this program is to ensure stormwater pollution prevention practices are considered when conducting activities on or around parking areas and storage areas to reduce potential for pollutant discharge to receiving waters. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook)
- Keep accurate maintenance logs to evaluate BMP implementation.

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SC-43 Parking/Storage Area Maintenance

Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low quantities.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Discharge soapy water remaining in mop or wash buckets to the sanitary sewer through a sink, toilet, clean-out, or wash area with drain.

Controlling Litter

- **Post "No Littering" signs** and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel, and dispose of litter in the trash.

Surface Cleaning

- Use dry cleaning methods (e.g., sweeping, vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system if possible.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- Follow the procedures below if water is used to clean surfaces:
  - Block the storm drain or contain runoff.
  - Collect and pump wash water to the sanitary sewer or discharge to a pervious surface. Do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- Follow the procedures below when cleaning heavy oily deposits:
  - Clean oily spots with absorbent materials.
  - Use a screen or filter fabric over inlet, then wash surfaces.

- Do not allow discharges to the storm drain.
- Vacuum/pump discharges to a tank or discharge to sanitary sewer.
- Appropriately dispose of spilled materials and absorbents.

Surface Repair

- Preheat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets where applicable (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.
- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of parking facilities and stormwater conveyance systems associated with parking facilities on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible or at a central location.
- Clean up fluid spills immediately with absorbent rags or material.
- Dispose of spilled material and absorbents properly.

Other Considerations

Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

SC-43 Parking/Storage Area Maintenance

Requirements

Costs

Cleaning/sweeping costs can be quite large. Construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot regularly to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities regularly to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Only use only as much water as is necessary for dust control to avoid runoff.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Drainage System Maintenance SC-44

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	
Bacteria	✓
Oil and Grease	
Organics	

Approach

Pollution Prevention

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Suggested Protocols

Catch Basins/Inlet Structures

- Staff should regularly inspect facilities to ensure compliance with the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC34 Waste Handling and Disposal).

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- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a Steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS.

Illicit Connections and Discharges

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:
  - Is there evidence of spills such as paints, discoloring, etc?

- Are there any odors associated with the drainage system?
- Record locations of apparent illegal discharges/illicit connections?
- Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
- Eliminate the discharge once the origin of flow is established.

- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Inspect and clean up hot spots and other storm drainage areas regularly where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.
- Allow only properly trained individuals to handle hazardous materials/wastes.
- Have staff involved in detection and removal of illicit connections trained in the following:
  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).

- OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).
- Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

Spill Response and Prevention

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.
- Clean up all spills and leaks using "dry" methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.
- Refer to fact sheet SC-11 Spill Prevention, Control, and Cleanup.

Other Considerations (Limitations and Regulations)

- Clean-up activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and prohibition against disposal of flushed effluent to sanitary sewer in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.
- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:
  - Purchase and installation of signs.
  - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.
  - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.
  - Purchase of landfill space to dispose of illegally-dumped items and material.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.

Supplemental Information

Further Detail of the BMP

Storm Drain Flushing

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. Deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, thereby releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream may be used to recollect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to recollect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75% for organics and 55-65% for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm sewer flushing.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

Ferguson, B.K. 1991. Urban Stream Reclamation, p. 324-322, Journal of Soil and Water Conservation.

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line:
http://www.epa.gov/npdes/menuofbmps/poll_16.htm

Housekeeping Practices SC-60

Description

Promote efficient and safe housekeeping practices (storage, use, and cleanup) when handling potentially harmful materials such as fertilizers, pesticides, cleaning solutions, paint products, automotive products, and swimming pool chemicals. Related information is provided in BMP fact sheets SC-11 Spill Prevention, Control & Cleanup and SC-34 Waste Handling & Disposal.

Approach

Pollution Prevention

- Purchase only the amount of material that will be needed for foreseeable use. In most cases this will result in cost savings in both purchasing and disposal. See SC-61 Safer Alternative Products for additional information.
- Be aware of new products that may do the same job with less environmental risk and for less or the equivalent cost. Total cost must be used here; this includes purchase price, transportation costs, storage costs, use related costs, clean up costs and disposal costs.

Suggested Protocols

General

- Keep work sites clean and orderly. Remove debris in a timely fashion. Sweep the area.
- Dispose of wash water, sweepings, and sediments, properly.
- Recycle or dispose of fluids properly.
- Establish a daily checklist of office, yard and plant areas to confirm cleanliness and adherence to proper storage and security. Specific employees should be assigned specific inspection responsibilities and given the authority to remedy any problems found.
- Post waste disposal charts in appropriate locations detailing for each waste its hazardous nature (poison, corrosive, flammable), prohibitions on its disposal (dumpster, drain, sewer) and the recommended disposal method (recycle, sewer, burn, storage, landfill).
- Summarize the chosen BMPs applicable to your operation and post them in appropriate conspicuous places.

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑
Oxygen Demanding	☑

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- Require a signed checklist from every user of any hazardous material detailing amount taken, amount used, amount returned and disposal of spent material.
- Do a before audit of your site to establish baseline conditions and regular subsequent audits to note any changes and whether conditions are improving or deteriorating.
- Keep records of water, air and solid waste quantities and quality tests and their disposition.
- Maintain a mass balance of incoming, outgoing and on hand materials so you know when there are unknown losses that need to be tracked down and accounted for.
- Use and reward employee suggestions related to BMPs, hazards, pollution reduction, work place safety, cost reduction, alternative materials and procedures, recycling and disposal.
- Have, and review regularly, a contingency plan for spills, leaks, weather extremes etc. Make sure all employees know about it and what their role is so that it comes into force automatically.

Training

- Train all employees, management, office, yard, manufacturing, field and clerical in BMPs and pollution prevention and make them accountable.
- Train municipal employees who handle potentially harmful materials in good housekeeping practices.
- Train personnel who use pesticides in the proper use of the pesticides. The California Department of Pesticide Regulation license pesticide dealers, certify pesticide applicators and conduct onsite inspections.
- Train employees and contractors in proper techniques for spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and Countermeasure (SPCC) plant up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- There are no major limitations to this best management practice.
- There are no regulatory requirements to this BMP. Existing regulations already require municipalities to properly store, use, and dispose of hazardous materials

Requirements

Costs

- Minimal cost associated with this BMP. Implementation of good housekeeping practices may result in cost savings as these procedures may reduce the need for more costly BMPs.

Maintenance

- Ongoing maintenance required to keep a clean site. Level of effort is a function of site size and type of activities.

Supplemental Information

Further Detail of the BMP

- The California Integrated Waste Management Board's Recycling Hotline, 1-800-553-2962, provides information on household hazardous waste collection programs and facilities.

Examples

There are a number of communities with effective programs. The most pro-active include Santa Clara County and the City of Palo Alto, the City and County of San Francisco, and the Municipality of Metropolitan Seattle (Metro).

References and Resources

British Columbia Lake Stewardship Society. Best Management Practices to Protect Water Quality from Non-Point Source Pollution. March 2000.
http://www.nalms.org/bclss/bmphome.html#bmp

King County Stormwater Pollution Control Manual - http://dnr.metrokc.gov/wlr/dss/spcm.htm

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities, Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July, 1998, Revised by California Coastal Commission, February 2002.

Orange County Stormwater Program
http://www.ocwatersheds.com/stormwater/swp_introduction.asp

San Mateo STOPPP - (http://stoppp.tripod.com/bmp.html)

Landscape Maintenance SC-73

Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	
Bacteria	
Oil and Grease	
Organics	
Oxygen Demanding	☑

Description

Landscape maintenance activities include vegetation removal; herbicide and insecticide application; fertilizer application; watering; and other gardening and lawn care practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute pollutants to the storm drain system. The major objectives of this BMP are to minimize the discharge of pesticides, herbicides and fertilizers to the storm drain system and receiving waters; prevent the disposal of landscape waste into the storm drain system by collecting and properly disposing of clippings and cuttings, and educating employees and the public.

Approach

Pollution Prevention

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.
- Choose low water using flowers, trees, shrubs, and groundcover.
- Consider alternative landscaping techniques such as naturescaping and xeriscaping.
- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

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- Consider grass cycling (grass cycling is the natural recycling of grass by leaving the clippings on the lawn when mowing. Grass clippings decompose quickly and release valuable nutrients back into the lawn).

Suggested Protocols

Mowing, Trimming, and Weeding

- Whenever possible use mechanical methods of vegetation removal (e.g mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.
- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.
- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.
- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.
- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).
- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

Planting

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.
- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.
- Consider using low water use groundcovers when planting or replanting.

Waste Management

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

- Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

Irrigation

- Where practical, use automatic timers to minimize runoff.
- Use popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken.
- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.
- If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.
- Apply water at rates that do not exceed the infiltration rate of the soil.

Fertilizer and Pesticide Management

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:
  - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.
  - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.
  - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.
  - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.
  - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).
  - Small mammals and birds can be excluded using fences, netting, tree trunk guards.
  - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.
- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use pesticides only if there is an actual pest problem (not on a regular preventative schedule).
- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).
- Do not mix or prepare pesticides for application near storm drains.
- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Periodically test soils for determining proper fertilizer use.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.
- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- Train/encourage municipal maintenance crews to use IPM techniques for managing public green areas.
- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.

- Employees who are not authorized and trained to apply pesticides should be periodically (at least annually) informed that they cannot use over-the-counter pesticides in or around the workplace.
- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a know in location
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in "agricultural use" areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.
- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.
- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

Requirements

Costs

Additional training of municipal employees will be required to address IPM techniques and BMPs. IPM methods will likely increase labor cost for pest control which may be offset by lower chemical costs.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Waste Management

Composting is one of the better disposal alternatives if locally available. Most municipalities either have or are planning yard waste composting facilities as a means of reducing the amount of waste going to the landfill. Lawn clippings from municipal maintenance programs as well as private sources would probably be compatible with most composting facilities

Contractors and Other Pesticide Users

Municipal agencies should develop and implement a process to ensure that any contractor employed to conduct pest control and pesticide application on municipal property engages in pest control methods consistent with the IPM Policy adopted by the agency. Specifically, municipalities should require contractors to follow the agency's IPM policy, SOPs, and BMPs; provide evidence to the agency of having received training on current IPM techniques when feasible; provide documentation of pesticide use on agency property to the agency in a timely manner.

References and Resources

King County Stormwater Pollution Control Manual. Best Management Practices for Businesses. 1995. King County Surface Water Management. July. On-line: http://dnr.metrokc.gov/wlr/dss/spcm.htm

Los Angeles County Stormwater Quality Model Programs. Public Agency Activities http://ladpw.org/wmd/npdes/model_links.cfm

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

Orange County Stormwater Program http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Landscaping and Lawn Care. Office of Water. Office of Wastewater Management. On-line: http://www.epa.gov/npdes/menuofbmps/poll_8.htm

Site Design & Landscape Planning SD-10

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- ☑ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

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Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.
- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

SD-10 Site Design & Landscape Planning

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Efficient Irrigation SD-12

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

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- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Storm Drain Signage SD-13

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING

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– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.
- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Trash Storage Areas SD-32

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

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- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

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"VICINITY MAP"

FOR

PALM AVENUE DISTRIBUTION CENTER

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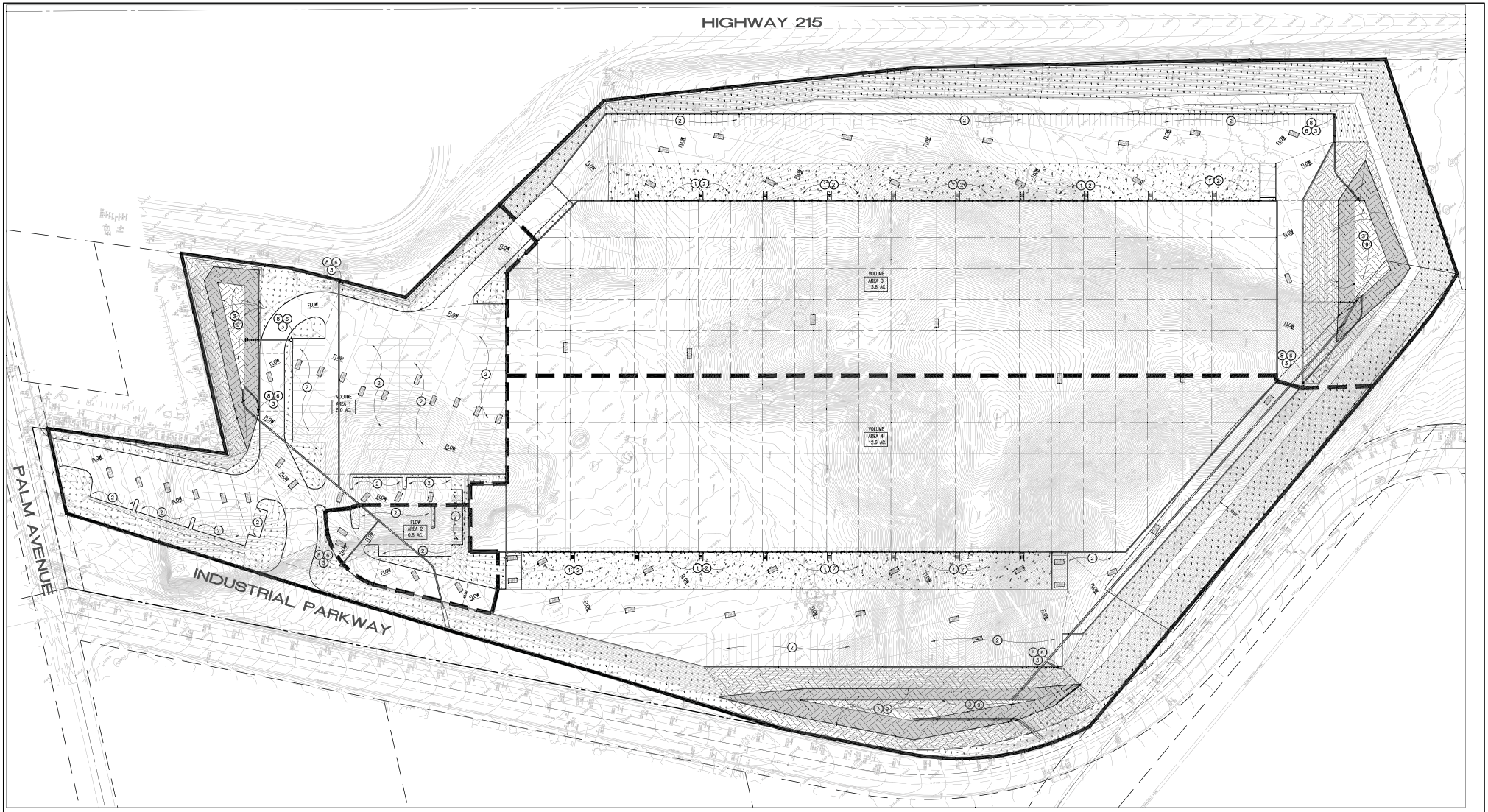
"RECEIVING WATERS MAP"

FOR

PALM AVENUE DISTRIBUTION CENTER

FLOW



VICINITY MAP
N.T.S.

LEGEND

1. SC-30: OUTDOOR LOADING/UNLOADING TRUCK DOCKS
2. SC-43: PARKING AREA MAINTENANCE
3. SC-44: DRAINAGE SYSTEM MAINTENANCE
4. SC-73: LANDSCAPE MAINTENANCE
5. SD-12: EFFICIENT IRRIGATION
6. SD-13: STORM DRAIN SYSTEM SIGNS
7. SD-32: TRASH ENCLOSURES
8. MP-52: DRAIN INSERTS
9. TC-11: INFILTRATION BASIN

NOTE:
SC-11: SPILL PREVENTION, CONTROL AND CLEANUP
SC-41: BUILDING AND GROUNDS MAINTENANCE
SC-60: HOUSEKEEPING PRACTICES
SD-10: SITE DESIGN AND LANDSCAPE PLANNING

ONGOING OVER THE ENTIRE SITE

BOUNDARY
DRAINAGE AREA
FLOW LINE

0 30 60 120 180
SCALE:1"=60'

Last Updated: 3/4/11
O:\3000-3099\3032\SCHEME 1\3032-BMP-SITE-MAP 10.dwg

COUNTY OF SAN BERNARDINO
PUBLIC WORKS DEPARTMENT

BMP SITE PLAN

FOR

"PALM AVENUE DISTRIBUTION CENTER"
EASTERLY CORNER OF PALM AVENUE
AND INDUSTRIAL PARKWAY
SCHEME 1D

PREPARED FOR:
IDS REAL ESTATE GROUP
515 S. FIGUEROA STREET, 16TH FLOOR
LOS ANGELES, CA 90071
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Designed by _____ Date _____
Checked by _____ Date _____
Designed by _____ Date _____
Checked by _____ Date _____

Aproved by _____ Date _____
Public Works Director _____ R.C.E. 28129

Sheet 1 of 1 Sheets

3032/1 OF 1 SHEET