Appendix K Water Resources Data

Preliminary Hydrology Study

PRELIMINARY HYDROLOGY STUDY
FOR
LE BARD SCHOOL SITE
CITY OF HUNTINGTON BEACH

FOR
MSA
LAND SOLUTIONS, INC.
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1 INTRODUCTION

1.1 BACKGROUND

The LeBard project is located in the City of Huntington Beach in the County of Orange on an 11.7 acre site north of Cynthia Drive and west of Craimer Lane. The site is tributary to the Santa Ana River located just east of the property (see vicinity map). The existing development encompasses both a school and park site (baseball diamonds, tennis courts, sand lot play areas etc.). The proposed project will redevelop the existing school site and a portion of the existing parking lot for 15-single family residences. A detention basin and water quality features will be included as part of the development.

This drainage report evaluates the pre and post-development hydrological conditions of the site and provides the criteria for the design of the on-site storm drain systems for flood protection of the proposed structures.

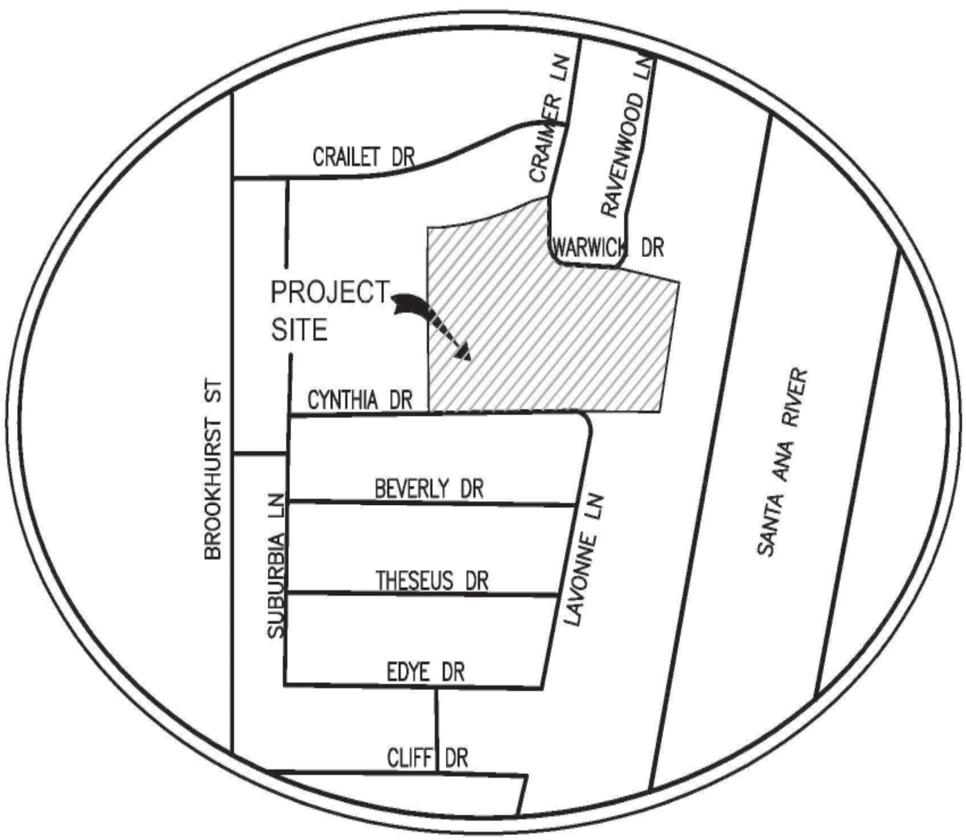
1.2 PROJECT DESCRIPTION

The project consists of 15-single family residences and associated parking lot modifications (park site). A new street will be constructed off of Craimer Lane to serve the proposed residential subdivision. The existing driveway entrance on Warwick Drive will remain as the entrance to the park site parking lot.

The project will have one storm water detention basin for flood control purposes located adjacent to the proposed cul-de-sac between Lots 10 and 11 of the new subdivision. The entire new subdivision will drain to this basin. Water quality treatment facilities are also provided as outlined in the associated water quality management plan.

1.3 EXISTING SYSTEM

The project consists of two main drainages (see hydrology maps). The south drainage (Drainage A) and the north drainage (Drainage B). There are no existing storm drain facilities on site or immediately adjacent. Drainage A is the larger of the two drainage areas and sheet flows south to Cynthia Drive where flows are conveyed west and south and collected by local drainage facilities at the NE corner of Beverly Drive and Suburbia Lane. Drainage B sheet flows to both Warwick Drive and Craimer Lane where flows are conveyed north to local drainage facilities at Craimer Lane and Jon Day Drive. These drainages all ultimately discharge to the Santa Ana River.



VICINITY MAP

NTS

2 STUDY PURPOSE

The purpose of this study is to support the design of drainage improvements for the project. This study analyzes the 2-, 10-, 25- and 100-year High Confidence storms for design purposes. The rational method and unit hydrograph method were used for basin design and impact mitigation evaluation. The study will also comply with the project "Water Quality Management Plan" that describes the effective implementation of structural BMPs to treat on-site runoff for the expected and potential pollutants. As required by the City of Huntington Beach, Post-Developed 100-year storm flows shall not exceed the Pre-Developed 25-year flows. To accomplish this, a detention basin has been added downstream of the proposed residential subdivision. Details of the proposed basin design and flood routing analysis can be found in subsequent sections herein.

3 ENGINEERING CRITERIA AND METHODOLOGY

3.1 HYDROLOGY CRITERIA

The Orange County Hydrology Manual, OCHM (OC Public Works, 1986) and its Addendum No. 1 (OC Public Works, 1996) establish the guidelines for the use of high confidence models.

3.2 HYDROLOGY METHODOLOGY

All models were run in conformance with the OCHM including Addendum No. 1. The CIVILD computer program designed for Orange County was used for the Rational Method Time of Concentration (Tc) calculations. For the proposed condition which includes a detention basin at the outlet of the new subdivision the OCHM Unit Hydrograph and Basin Routing portion of the CIVILD software was used. Different models were created for each storm event to calculate the time of concentration, volumes and peak flow rates.

The site is in soil group B based on the county soil index map, Figure C-1. However, based on soil characteristics defined by the preliminary soils investigation and the direction of the City of Huntington Beach, soil group D was used instead of group B for all the studies. Stage-Discharge tables as well as basin outfall calculations used for the modeling of the proposed detention basin can be found in subsequent section of the report.

4 EXISTING HYDROLOGY ANALYSIS

4.1 EXISTING WATERSHED DESCRIPTION

The LeBard watershed is divided into two watersheds. The south drainage (Drainage A) and the north drainage (Drainage B).

Drainage A is 8.9 acres in size. 2.1 acres of this area is characterized as school facilities and surrounding paved drive isles and parking areas. The remaining 6.8 acres consists of baseball fields and a small portion of the park area.

Drainage B is 2.9 acres and consists of the remaining school facilities and parking lot.

The off-site drainage courses for both areas was previously discussed in Section 1.3.

4.2 EXISTING HYDROLOGY ANALYSIS

The existing hydrology analysis consists of the rational method analysis for both watersheds for the 2, 10, 25 and 100-year storm events.

In order to establish runoff calculations in the models, pervious area calculations were performed on each subarea to establish representative percent pervious ratios to be used in the rational method study. This was done in lieu of using the standard development types outlined in the OCHM.

Table 1 shows the results for the AES rational method hydrology analysis

Table 1: Existing Rational Method Results

Discharge Point	Area	100-year	25-year	10-year	2-year
Node 5 (cfs) – DRAINAGE A	8.9	31.1	24.0	19.8	10.3
Node 7 (cfs) – DRAINAGE B	2.9	7.9	6.1	5.0	2.6

5 PROPOSED HYDROLOGY ANALYSIS

5.1 PROPOSED WATERSHED DESCRIPTION

The proposed development will alter drainage patterns in the watershed in the following ways:

Drainage A (south) will increase from 8.9 acres to 10.9 acres. This is a result of the additional area from the proposed subdivision and a portion of the parking lot area being added to the watershed.

Drainage B (north) will decrease from 2.9 acres to 0.9 acres as a result of the changes noted above.

In order to mitigate increases in runoff from Drainage A due to additional tributary area a detention basin has been added south of the proposed cul-de-sac between Lots 10 and 11 (see hydrology map). The basin design and hydrology results are discussed in Section 5.3.

5.2 PROPOSED HYDROLOGY ANALYSIS

The proposed hydrology analysis consists of the rational method analysis for Drainage A and B, and additionally, unit hydrograph and basin routing analysis for Drainage A for the 2, 10, 25 and 100-year storm events.

In order to establish runoff calculations in the models, pervious area calculations were performed on each subarea to establish representative percent pervious ratios to be used in the rational method study. This was done in lieu of using the standard development types outlined in the OCHM. Part of this effort involved studying the percent previous of the existing residences along Crailet Drive to accurately model the new residential subdivision as it better reflects the amount of impervious area witnessed in the surrounding area. The results of that study are provided in the Technical Appendices and incorporated into the models.

Table 2 shows the results for the AES rational method hydrology analysis

Table 2: Proposed Rational Method Hydrograph Results

Discharge Point	Area	100-year	25-year	10-year	2-year
Node 7 (cfs) – DRAINAGE A	10.9	24.0	18.4	14.9	7.2
Node 10 (cfs) – DRAINAGE B	0.9	2.9	2.3	1.9	1.0

5.3 PROPOSED BASIN AND ROUTING ANALYSIS

There will be a single detention basin located near the cul-de-sac of the proposed subdivision. The results of Table 2 reflect mitigated flows from the detention basin. The goal of the basin is to detain storm flows so that Post-Development 100-year storm flows do not exceed Pre-Development 25-year storm flows as these storm flows exit the project area in the southwest corner.

To accomplish this, outflows from the basin are restricted by means of a 1.25 ft. wide x 6 inch high rectangular pipe culvert placed at the bottom of the basin. In larger storm events flows are limited by the amount of ponding (head) over the outlet pipe. Flows in excess of what the pipe can carry pond in the basin to mitigate outflows. There will be no ponding in the detention basin beyond 24 hours following a storm event. Table 3 contains weir and orifice calculations for various depths within the proposed basin.

Weir/Orifice Parameters:
Orifice Coefficient C=0.63
Weir Coefficient C=3.32
Pipe Size: 1.25 ft. wide x 6 in. high
Flow Area: 0.63 sq. ft.

Table 3: Basin Outfall Calculation

Elevation (ft)	Head (ft)	Weir Flow (cfs)	Orifice Flow (cfs)	Total Outflow (cfs)
9.8	0	0	0	0
10.0	0.2	0.4	0.4	0.4
10.2	0.4	0	0.8	0.8
10.4	0.6	0	1.6	1.6
10.6	0.8	0	2.2	2.2
10.8	1.0	0	2.6	2.6
11.0	1.2	0	2.9	2.9
11.2	1.4	0	3.3	3.3
11.4	1.6	0	3.6	3.6
11.6	1.8	0	3.8	3.8

The change from weir outflow to orifice outflow occurs between elevation 10.0 and 10.2. Table 4 shows the elevation-storage calculations with outflows at the desired elevation. For ease of calculations, a conservative constant Area was used at each depth (8,060 sf or 0.185 ac).

Table 4: Stage Table for Proposed Basin				
Elevation (ft)	**Head Water (ft)**	**Area (ac)**	**∑ Volume (ac-ft)**	**Outflow (cfs)**
9.8	0	0.185	0.000	0.0
10.0	0.2	0.185	0.037	0.4
10.2	0.4	0.185	0.074	0.8
10.4	0.6	0.185	0.111	1.6
10.6	0.8	0.185	0.148	2.2
10.8	1.0	0.185	0.185	2.6
11.0	1.2	0.185	0.222	2.9
11.2	1.4	0.185	0.259	3.3
11.4	1.6	0.185	0.296	3.6
11.6	1.8	0.185	0.333	3.8

Table 5 shows results for discharge of the basin.

Table 5: Basin Hydrograph Results					
Discharge Point	**Area (ac)**	**100-year**	**25-year**	**10-year**	**2-year**
Inflow (cfs)	3.14	9.3	7.3	6.0	3.3
Outflow (cfs)		4.6	2.8	2.5	1.3

6 CONCLUSION AND MITIGATION DISCUSSION

The LeBard Preliminary Hydrology Study contains the existing and proposed condition 2, 10-, 25-, and 100-year storms.

The results of the study demonstrate that the proposed detention basin and outlet facility is adequately sized to mitigate the proposed condition 100-year storm event to not exceed the existing condition 25-year storm event.

A comparison of the existing, proposed without mitigation and proposed with mitigation outflow is shown on Table 6 and Table 7 for Drainage A and B.

Table 6: Hydrology Results-Drainage A

Condition	Area (ac)	100-year	25-year	10-year	2-year
Existing	8.9	31.1	24.0	19.8	10.3
Proposed without Mitigation	10.8	27.6	20.9	16.9	8.3
Proposed Mitigated		24.0	18.4	14.9	7.2

Table 7: Hydrology Results-Drainage B

Condition	Area (ac)	100-year	25-year	10-year	2-year
Existing	2.9	7.9	6.1	5.0	2.6
Proposed	0.9	2.9	2.3	1.9	1.0

(no mitigation needed for Drainage B)

Appendices

Appendix A- Pre-Development Hydrology Calculations

(Rational Method)

100-year, 25-year, 10-year & 2-year

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              Orange County Rational Hydrology Program

      (Hydrology Manual Date(s) October 1986 & November 1996)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2004 Version 8.0
        Rational Hydrology Study, Date: 10/28/14  File Name: EXLEB.roc
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PRE-DEVELOPMENT HYDROLOGY
2-YEAR STORM

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Program License Serial Number 6201

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

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Rational hydrology study storm event year is     2.0

Decimal fraction of study above 2000 ft., 600M  =     0.0000
English Units Used for input data


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Process from Point/Station       1.000 to Point/Station       2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   322.000(Ft.)
Top (of initial area) elevation =    13.200(Ft.)
Bottom (of initial area) elevation =    11.800(Ft.)
Difference in elevation =     1.400(Ft.)
Slope =    0.00435  s(%)=       0.43
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.086 min.
Rainfall intensity =      1.607(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.889
Subarea runoff =      1.342(CFS)
Total initial stream area =        0.940(Ac.)


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Process from Point/Station       2.000 to Point/Station       3.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
Soil group(s) classification and AP  values input by user
USER INPUT of soil data for subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 89.59
Pervious ratio(Ap) = 0.0100  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.002(In/Hr)
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Time of concentration =     9.09 min.
Rainfall intensity =      1.607(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.894
Subarea runoff =      1.632(CFS) for    1.130(Ac.)
Total runoff =      2.974(CFS)  Total area =        2.07(Ac.)
Area averaged Fm value =    0.010(In/Hr)


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Process from Point/Station        3.000 to Point/Station        4.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    11.800(Ft.)
Downstream point elevation =     8.600(Ft.)
Channel length thru subarea  =   165.000(Ft.)
Channel base width      =   10.000(Ft.)
Slope or 'Z' of left channel bank = 100.000
Slope or 'Z' of right channel bank = 100.000
Estimated mean flow rate at midpoint of channel =      4.403(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      4.403(CFS)
Depth of flow =   0.137(Ft.), Average velocity =   1.353(Ft/s)
Channel flow top width =   37.436(Ft.)
Flow Velocity =    1.35(Ft/s)
Travel time  =    2.03 min.
Time of concentration =   11.12 min.
Critical depth =      0.123(Ft.)
 Adding area flow to channel
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Rainfall intensity =      1.431(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.836
Subarea runoff =      2.782(CFS) for    2.740(Ac.)
Total runoff =      5.756(CFS)  Total area =        4.81(Ac.)
Area averaged Fm value =    0.101(In/Hr)
Depth of flow =   0.155(Ft.), Average velocity =   1.452(Ft/s)
Critical depth =      0.141(Ft.)


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Process from Point/Station        4.000 to Point/Station        5.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =     8.600(Ft.)
End of street segment elevation =     8.300(Ft.)
Length of street segment  =     4.100(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
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Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      8.084(CFS)
Depth of flow =   0.341(Ft.), Average velocity =   6.344(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  10.713(Ft.)
Flow velocity =   6.34(Ft/s)
Travel time =    0.01 min.     TC =   11.13  min.
 Adding area flow to street
Soil group(s) classification and AP  values input by user
USER INPUT of soil data for subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 89.59
Pervious ratio(Ap) = 0.9500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.190(In/Hr)
Rainfall intensity =      1.430(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.811
Subarea runoff =      4.573(CFS) for    4.100(Ac.)
Total runoff =     10.329(CFS)  Total area =        8.91(Ac.)
Area averaged Fm value =    0.142(In/Hr)
Street flow at end of street =     10.329(CFS)
Half street flow at end of street =     10.329(CFS)
Depth of flow =   0.364(Ft.), Average velocity =   6.717(Ft/s)
Flow width (from curb towards crown)=  11.878(Ft.)


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Process from Point/Station       6.000 to Point/Station       7.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(2 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.7000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.140(In/Hr)
Initial subarea data:
Initial area flow distance =   688.000(Ft.)
Top (of initial area) elevation =    15.700(Ft.)
Bottom (of initial area) elevation =    10.500(Ft.)
Difference in elevation =     5.200(Ft.)
Slope =    0.00756  s(%)=       0.76
TC = k(0.438)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   15.879 min.
NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
for this Development Type
Rainfall intensity =      1.166(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.792
Subarea runoff =      2.641(CFS)
Total initial stream area =       2.860(Ac.)
End of computations, total study area =          11.77 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
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effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.708
Area averaged SCS curve number (AMC 2) = 81.5

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              Orange County Rational Hydrology Program

        (Hydrology Manual Date(s) October 1986 & November 1996)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2004 Version 8.0
        Rational Hydrology Study, Date: 10/28/14  File Name: EXLEB.roc
------------------------------------------------------------------------


PRE-DEVELOPMENT HYDROLOGY
10-YEAR STORM
------------------------------------------------------------------------


Program License Serial Number 6201

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

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

Rational hydrology study storm event year is    10.0

Decimal fraction of study above 2000 ft., 600M  =     0.0000
English Units Used for input data


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   322.000(Ft.)
Top (of initial area) elevation =    13.200(Ft.)
Bottom (of initial area) elevation =    11.800(Ft.)
Difference in elevation =     1.400(Ft.)
Slope =    0.00435  s(%)=       0.43
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.086 min.
Rainfall intensity =      2.883(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.894
Subarea runoff =      2.422(CFS)
Total initial stream area =        0.940(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       2.000 to Point/Station       3.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
Soil group(s) classification and AP  values input by user
USER INPUT of soil data for subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 89.59
Pervious ratio(Ap) = 0.0100  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.002(In/Hr)
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Time of concentration =     9.09 min.
Rainfall intensity =      2.883(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.897
Subarea runoff =      2.930(CFS) for    1.130(Ac.)
Total runoff =      5.352(CFS)  Total area =        2.07(Ac.)
Area averaged Fm value =    0.010(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       3.000 to Point/Station       4.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    11.800(Ft.)
Downstream point elevation =     8.600(Ft.)
Channel length thru subarea  =   165.000(Ft.)
Channel base width      =   10.000(Ft.)
Slope or 'Z' of left channel bank = 100.000
Slope or 'Z' of right channel bank = 100.000
Estimated mean flow rate at midpoint of channel =      8.130(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      8.130(CFS)
Depth of flow =   0.182(Ft.), Average velocity =   1.588(Ft/s)
Channel flow top width =   46.344(Ft.)
Flow Velocity =    1.59(Ft/s)
Travel time  =    1.73 min.
Time of concentration =   10.82 min.
Critical depth =      0.168(Ft.)
 Adding area flow to channel
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Rainfall intensity =      2.609(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.865
Subarea runoff =      5.503(CFS) for    2.740(Ac.)
Total runoff =     10.855(CFS)  Total area =        4.81(Ac.)
Area averaged Fm value =    0.101(In/Hr)
Depth of flow =   0.207(Ft.), Average velocity =   1.711(Ft/s)
Critical depth =      0.191(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       4.000 to Point/Station       5.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =     8.600(Ft.)
End of street segment elevation =     8.300(Ft.)
Length of street segment  =     4.100(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
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Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     15.355(CFS)
Depth of flow =   0.406(Ft.), Average velocity =   7.381(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  13.978(Ft.)
Flow velocity =   7.38(Ft/s)
Travel time =    0.01 min.     TC =   10.83  min.
 Adding area flow to street
Soil group(s) classification and AP  values input by user
USER INPUT of soil data for subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 89.59
Pervious ratio(Ap) = 0.9500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.190(In/Hr)
Rainfall intensity =      2.607(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.851
Subarea runoff =      8.915(CFS) for    4.100(Ac.)
Total runoff =     19.770(CFS)  Total area =        8.91(Ac.)
Area averaged Fm value =    0.142(In/Hr)
Street flow at end of street =     19.770(CFS)
Half street flow at end of street =     19.770(CFS)
Depth of flow =   0.436(Ft.), Average velocity =   7.843(Ft/s)
Flow width (from curb towards crown)=  15.472(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       6.000 to Point/Station       7.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(2 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.7000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.140(In/Hr)
Initial subarea data:
Initial area flow distance =   688.000(Ft.)
Top (of initial area) elevation =    15.700(Ft.)
Bottom (of initial area) elevation =    10.500(Ft.)
Difference in elevation =     5.200(Ft.)
Slope =    0.00756  s(%)=       0.76
TC = k(0.438)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   15.879 min.
NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
for this Development Type
Rainfall intensity =      2.094(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.840
Subarea runoff =      5.029(CFS)
Total initial stream area =        2.860(Ac.)
End of computations, total study area =           11.77 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
```

effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.708
Area averaged SCS curve number (AMC 2) = 81.5

```
              Orange County Rational Hydrology Program

          (Hydrology Manual Date(s) October 1986 & November 1996)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2004 Version 8.0
        Rational Hydrology Study, Date: 10/28/14  File Name: EXLEB.roc
------------------------------------------------------------------------


PRE-DEVELOPMENT HYDROLOGY
25-YEAR STORM
------------------------------------------------------------------------


Program License Serial Number 6201

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

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

Rational hydrology study storm event year is    25.0

Decimal fraction of study above 2000 ft., 600M  =     0.0000
English Units Used for input data


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   322.000(Ft.)
Top (of initial area) elevation =    13.200(Ft.)
Bottom (of initial area) elevation =    11.800(Ft.)
Difference in elevation =     1.400(Ft.)
Slope =    0.00435  s(%)=       0.43
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.086 min.
Rainfall intensity =      3.440(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.895
Subarea runoff =      2.893(CFS)
Total initial stream area =        0.940(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       2.000 to Point/Station       3.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
Soil group(s) classification and AP  values input by user
USER INPUT of soil data for subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 89.59
Pervious ratio(Ap) = 0.0100  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.002(In/Hr)
```

```
Time of concentration =     9.09 min.
Rainfall intensity =      3.440(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.897
Subarea runoff =      3.497(CFS) for    1.130(Ac.)
Total runoff =      6.390(CFS)  Total area =        2.07(Ac.)
Area averaged Fm value =    0.010(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        4.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    11.800(Ft.)
Downstream point elevation =     8.600(Ft.)
Channel length thru subarea  =   165.000(Ft.)
Channel base width      =   10.000(Ft.)
Slope or 'Z' of left channel bank = 100.000
Slope or 'Z' of right channel bank = 100.000
Estimated mean flow rate at midpoint of channel =      9.779(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      9.779(CFS)
Depth of flow =   0.197(Ft.), Average velocity =   1.666(Ft/s)
Channel flow top width =   49.482(Ft.)
Flow Velocity =    1.67(Ft/s)
Travel time  =    1.65 min.
Time of concentration =   10.74 min.
Critical depth =      0.184(Ft.)
 Adding area flow to channel
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Rainfall intensity =      3.130(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.871
Subarea runoff =      6.721(CFS) for    2.740(Ac.)
Total runoff =     13.111(CFS)  Total area =        4.81(Ac.)
Area averaged Fm value =    0.101(In/Hr)
Depth of flow =   0.225(Ft.), Average velocity =   1.796(Ft/s)
Critical depth =      0.211(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        5.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =     8.600(Ft.)
End of street segment elevation =     8.300(Ft.)
Length of street segment  =     4.100(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
```

```
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     18.572(CFS)
Depth of flow =   0.428(Ft.), Average velocity =   7.726(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  15.090(Ft.)
Flow velocity =   7.73(Ft/s)
Travel time =    0.01 min.     TC =   10.75  min.
 Adding area flow to street
Soil group(s) classification and AP  values input by user
USER INPUT of soil data for subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 89.59
Pervious ratio(Ap) = 0.9500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.190(In/Hr)
Rainfall intensity =      3.128(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.859
Subarea runoff =     10.836(CFS) for    4.100(Ac.)
Total runoff =     23.947(CFS)  Total area =        8.91(Ac.)
Area averaged Fm value =    0.142(In/Hr)
Street flow at end of street =     23.947(CFS)
Half street flow at end of street =     23.947(CFS)
Depth of flow =   0.461(Ft.), Average velocity =   8.216(Ft/s)
Flow width (from curb towards crown)=  16.697(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       6.000 to Point/Station       7.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(2 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.7000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.140(In/Hr)
Initial subarea data:
Initial area flow distance =   688.000(Ft.)
Top (of initial area) elevation =    15.700(Ft.)
Bottom (of initial area) elevation =    10.500(Ft.)
Difference in elevation =     5.200(Ft.)
Slope =    0.00756  s(%)=      0.76
TC = k(0.438)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   15.879 min.
NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
for this Development Type
Rainfall intensity =      2.508(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.850
Subarea runoff =      6.095(CFS)
Total initial stream area =        2.860(Ac.)
End of computations, total study area =           11.77 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
```

effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.708
Area averaged SCS curve number (AMC 2) = 81.5

```
                 Orange County Rational Hydrology Program

          (Hydrology Manual Date(s) October 1986 & November 1996)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2004 Version 8.0
        Rational Hydrology Study, Date: 10/28/14  File Name: EXLEB.roc
------------------------------------------------------------------------


PRE-DEVELOPMENT HYDROLOGY
100-YEAR STORM
------------------------------------------------------------------------


Program License Serial Number 6201

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

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

Rational hydrology study storm event year is   100.0

Decimal fraction of study above 2000 ft., 600M  =     0.0000
English Units Used for input data


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   322.000(Ft.)
Top (of initial area) elevation =    13.200(Ft.)
Bottom (of initial area) elevation =    11.800(Ft.)
Difference in elevation =     1.400(Ft.)
Slope =    0.00435  s(%)=       0.43
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.086 min.
Rainfall intensity =      4.394(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.896
Subarea runoff =      3.700(CFS)
Total initial stream area =        0.940(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       2.000 to Point/Station       3.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
Soil group(s) classification and AP  values input by user
USER INPUT of soil data for subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 89.59
Pervious ratio(Ap) = 0.0100  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.002(In/Hr)
```

```
Time of concentration =     9.09 min.
Rainfall intensity =      4.394(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.898
Subarea runoff =      4.467(CFS) for    1.130(Ac.)
Total runoff =      8.167(CFS)  Total area =        2.07(Ac.)
Area averaged Fm value =    0.010(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        4.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    11.800(Ft.)
Downstream point elevation =     8.600(Ft.)
Channel length thru subarea  =   165.000(Ft.)
Channel base width      =   10.000(Ft.)
Slope or 'Z' of left channel bank = 100.000
Slope or 'Z' of right channel bank = 100.000
Estimated mean flow rate at midpoint of channel =     12.590(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     12.590(CFS)
Depth of flow =   0.221(Ft.), Average velocity =   1.777(Ft/s)
Channel flow top width =   54.161(Ft.)
Flow Velocity =    1.78(Ft/s)
Travel time  =    1.55 min.
Time of concentration =   10.63 min.
Critical depth =      0.207(Ft.)
 Adding area flow to channel
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Rainfall intensity =      4.015(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.877
Subarea runoff =      8.777(CFS) for    2.740(Ac.)
Total runoff =     16.945(CFS)  Total area =        4.81(Ac.)
Area averaged Fm value =    0.101(In/Hr)
Depth of flow =   0.251(Ft.), Average velocity =   1.918(Ft/s)
Critical depth =      0.238(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        5.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =     8.600(Ft.)
End of street segment elevation =     8.300(Ft.)
Length of street segment  =     4.100(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
```

```
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     24.038(CFS)
Depth of flow =   0.461(Ft.), Average velocity =   8.224(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  16.722(Ft.)
Flow velocity =   8.22(Ft/s)
Travel time =    0.01 min.     TC =   10.64  min.
 Adding area flow to street
Soil group(s) classification and AP  values input by user
USER INPUT of soil data for subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 89.59
Pervious ratio(Ap) = 0.9500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.190(In/Hr)
Rainfall intensity =      4.014(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.868
Subarea runoff =     14.102(CFS) for    4.100(Ac.)
Total runoff =     31.046(CFS)  Total area =        8.91(Ac.)
Area averaged Fm value =    0.142(In/Hr)
Street flow at end of street =     31.046(CFS)
Half street flow at end of street =     31.046(CFS)
Depth of flow =   0.497(Ft.), Average velocity =   8.753(Ft/s)
Flow width (from curb towards crown)=  18.494(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       6.000 to Point/Station       7.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(2 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.7000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.140(In/Hr)
Initial subarea data:
Initial area flow distance =   688.000(Ft.)
Top (of initial area) elevation =    15.700(Ft.)
Bottom (of initial area) elevation =    10.500(Ft.)
Difference in elevation =     5.200(Ft.)
Slope =    0.00756  s(%)=      0.76
TC = k(0.438)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   15.879 min.
NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
for this Development Type
Rainfall intensity =      3.191(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.861
Subarea runoff =      7.853(CFS)
Total initial stream area =        2.860(Ac.)
End of computations, total study area =          11.77 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
```

effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.708
Area averaged SCS curve number (AMC 2) = 81.5

TTG

Appendix B-Post-Development Hydrology Calculations

(Rational Method-Unmitigated)

100-year, 25-year, 10-year & 2-year

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                  Orange County Rational Hydrology Program

              (Hydrology Manual Date(s) October 1986 & November 1996)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2004 Version 8.0
        Rational Hydrology Study, Date: 10/29/14  File Name: POSTLEBARD.roc
------------------------------------------------------------------------
POST DEVELOPMENT HYDROLOGY
2-YEAR STORM (UNMITIGATED)



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


Program License Serial Number 6201

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

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Rational hydrology study storm event year is     2.0

Decimal fraction of study above 2000 ft., 600M  =     0.0000
English Units Used for input data


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
CONDOMINIUM subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.3500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.070(In/Hr)
Initial subarea data:
Initial area flow distance =   460.000(Ft.)
Top (of initial area) elevation =    12.200(Ft.)
Bottom (of initial area) elevation =    11.300(Ft.)
Difference in elevation =     0.900(Ft.)
Slope =    0.00196  s(%)=       0.20
TC = k(0.360)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   14.558 min.
NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
for this Development Type
Rainfall intensity =      1.226(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.849
Subarea runoff =      3.266(CFS)
Total initial stream area =        3.140(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       2.000 to Point/Station       3.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    11.500(Ft.)
Downstream point elevation =     8.700(Ft.)
```

```
Channel length thru subarea  =   460.000(Ft.)
Channel base width      =    2.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      3.266(CFS)
Depth of flow =   0.498(Ft.), Average velocity =   1.875(Ft/s)
Channel flow top width =    4.990(Ft.)
Flow Velocity =    1.88(Ft/s)
Travel time  =    4.09 min.
Time of concentration =   18.65 min.
Critical depth =      0.359(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       3.000 to Point/Station       3.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      3.140(Ac.)
Runoff from this stream =      3.266(CFS)
Time of concentration =   18.65 min.
Rainfall intensity =     1.063(In/Hr)
Area averaged loss rate (Fm) =    0.0700(In/Hr)
Area averaged Pervious ratio (Ap) = 0.3500
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       4.000 to Point/Station       5.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   160.000(Ft.)
Top (of initial area) elevation =    13.000(Ft.)
Bottom (of initial area) elevation =    10.100(Ft.)
Difference in elevation =     2.900(Ft.)
Slope =    0.01813  s(%)=       1.81
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    5.163 min.
Rainfall intensity =      2.223(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.892
Subarea runoff =      0.991(CFS)
Total initial stream area =       0.500(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       5.000 to Point/Station       6.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    10.100(Ft.)
Downstream point elevation =     8.900(Ft.)
Channel length thru subarea  =   300.000(Ft.)
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```
Channel base width      =    2.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =      1.611(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      1.611(CFS)
Depth of flow =   0.386(Ft.), Average velocity =   1.323(Ft/s)
Channel flow top width =    4.314(Ft.)
Flow Velocity =    1.32(Ft/s)
Travel time  =    3.78 min.
Time of concentration =    8.94 min.
Critical depth =      0.240(Ft.)
 Adding area flow to channel
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Rainfall intensity =      1.621(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.832
Subarea runoff =      1.166(CFS) for    1.100(Ac.)
Total runoff =      2.157(CFS)  Total area =        1.60(Ac.)
Area averaged Fm value =    0.123(In/Hr)
Depth of flow =   0.449(Ft.), Average velocity =   1.436(Ft/s)
Critical depth =      0.285(Ft.)


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Process from Point/Station       6.000 to Point/Station       3.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =     8.900(Ft.)
End of street segment elevation =     8.300(Ft.)
Length of street segment  =   460.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      2.804(CFS)
Depth of flow =   0.444(Ft.), Average velocity =   1.063(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  15.850(Ft.)
Flow velocity =   1.06(Ft/s)
Travel time =    7.21 min.     TC =   16.16  min.
 Adding area flow to street
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
```

```
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Rainfall intensity =      1.155(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.783
Subarea runoff =      1.233(CFS) for    2.150(Ac.)
Total runoff =      3.390(CFS)  Total area =        3.75(Ac.)
Area averaged Fm value =    0.150(In/Hr)
Street flow at end of street =      3.390(CFS)
Half street flow at end of street =      3.390(CFS)
Depth of flow =   0.468(Ft.), Average velocity =   1.113(Ft/s)
Flow width (from curb towards crown)=  17.089(Ft.)


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Process from Point/Station        3.000 to Point/Station        3.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      3.750(Ac.)
Runoff from this stream =      3.390(CFS)
Time of concentration =   16.16 min.
Rainfall intensity =     1.155(In/Hr)
Area averaged loss rate (Fm) =    0.1500(In/Hr)
Area averaged Pervious ratio (Ap) = 0.7500
Summary of stream data:

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


1      3.14     3.266     18.65    0.070      1.063
2      3.75     3.390     16.16    0.150      1.155
Qmax(1) =
           1.000 *    1.000 *     3.266) +
           0.909 *    1.000 *     3.390) + =       6.349
Qmax(2) =
           1.092 *    0.867 *     3.266) +
           1.000 *    1.000 *     3.390) + =       6.480

Total of 2 main streams to confluence:
Flow rates before confluence point:
       4.266       4.390
Maximum flow rates at confluence using above data:
        6.349        6.480
Area of streams before confluence:
        3.140        3.750
Effective area values after confluence:
        6.890        6.471


Results of confluence:
Total flow rate =      6.480(CFS)
Time of concentration =    16.158 min.
Effective stream area after confluence  =      6.471(Ac.)
Study area average Pervious fraction(Ap) =  0.568
Study area average soil loss rate(Fm) =    0.114(In/Hr)
Study area total =       6.89(Ac.)
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Process from Point/Station       3.000 to Point/Station       7.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =     8.300(Ft.)
End of street segment elevation =     7.900(Ft.)
Length of street segment  =   300.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      7.437(CFS)
Depth of flow =   0.589(Ft.), Average velocity =   1.332(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    4.47(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  20.000(Ft.)
Flow velocity =   1.33(Ft/s)
Travel time =    3.75 min.     TC =   19.91  min.
 Adding area flow to street
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Rainfall intensity =      1.024(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.781
Subarea runoff =      1.844(CFS) for    3.930(Ac.)
Total runoff =      8.324(CFS)  Total area =       10.40(Ac.)
Area averaged Fm value =    0.135(In/Hr)
Street flow at end of street =      8.324(CFS)
Half street flow at end of street =      8.324(CFS)
Depth of flow =   0.609(Ft.), Average velocity =   1.372(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    5.44(Ft.)
Flow width (from curb towards crown)=  20.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       8.000 to Point/Station       9.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
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Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   170.000(Ft.)
Top (of initial area) elevation =    13.200(Ft.)
Bottom (of initial area) elevation =    10.300(Ft.)
Difference in elevation =     2.900(Ft.)
Slope =    0.01706  s(%)=       1.71
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    5.354 min.
Rainfall intensity =      2.177(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.892
Subarea runoff =      0.815(CFS)
Total initial stream area =        0.420(Ac.)


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Process from Point/Station        9.000 to Point/Station       10.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    10.300(Ft.)
End of street segment elevation =     9.600(Ft.)
Length of street segment  =   520.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      0.924(CFS)
Depth of flow =   0.326(Ft.), Average velocity =   0.827(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   9.949(Ft.)
Flow velocity =   0.83(Ft/s)
Travel time =   10.48 min.     TC =   15.83  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      1.168(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.885
Subarea runoff =      0.156(CFS) for    0.520(Ac.)
Total runoff =      0.971(CFS)  Total area =        0.94(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Street flow at end of street =      0.971(CFS)
Half street flow at end of street =      0.971(CFS)
Depth of flow =   0.330(Ft.), Average velocity =   0.837(Ft/s)
Flow width (from curb towards crown)=  10.169(Ft.)
End of computations, total study area =          11.76 (Ac.)
The following figures may
```

be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.625
Area averaged SCS curve number (AMC 2) = 75.0

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              Orange County Rational Hydrology Program

          (Hydrology Manual Date(s) October 1986 & November 1996)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2004 Version 8.0
        Rational Hydrology Study, Date: 10/29/14  File Name: POSTLEBARD.roc
------------------------------------------------------------------------
POST DEVELOPMENT HYDROLOGY
10-YEAR STORM (UNMITIGATED)



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Program License Serial Number 6201

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

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Rational hydrology study storm event year is    10.0

Decimal fraction of study above 2000 ft., 600M  =     0.0000
English Units Used for input data


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Process from Point/Station       1.000 to Point/Station       2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
CONDOMINIUM subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.3500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.070(In/Hr)
Initial subarea data:
Initial area flow distance =   460.000(Ft.)
Top (of initial area) elevation =    12.200(Ft.)
Bottom (of initial area) elevation =    11.300(Ft.)
Difference in elevation =     0.900(Ft.)
Slope =    0.00196  s(%)=       0.20
TC = k(0.360)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   14.558 min.
NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
for this Development Type
Rainfall intensity =      2.201(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.871
Subarea runoff =      6.021(CFS)
Total initial stream area =        3.140(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       2.000 to Point/Station       3.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    11.500(Ft.)
Downstream point elevation =     8.700(Ft.)
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Channel length thru subarea  =   460.000(Ft.)
Channel base width      =    2.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      6.021(CFS)
Depth of flow =   0.675(Ft.), Average velocity =   2.214(Ft/s)
Channel flow top width =    6.053(Ft.)
Flow Velocity =    2.21(Ft/s)
Travel time  =    3.46 min.
Time of concentration =   18.02 min.
Critical depth =      0.508(Ft.)


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Process from Point/Station       3.000 to Point/Station       3.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      3.140(Ac.)
Runoff from this stream =      6.021(CFS)
Time of concentration =   18.02 min.
Rainfall intensity =     1.947(In/Hr)
Area averaged loss rate (Fm) =    0.0700(In/Hr)
Area averaged Pervious ratio (Ap) = 0.3500
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       4.000 to Point/Station       5.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   160.000(Ft.)
Top (of initial area) elevation =    13.000(Ft.)
Bottom (of initial area) elevation =    10.100(Ft.)
Difference in elevation =     2.900(Ft.)
Slope =    0.01813  s(%)=       1.81
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    5.163 min.
Rainfall intensity =      3.986(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.895
Subarea runoff =      1.785(CFS)
Total initial stream area =       0.500(Ac.)


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Process from Point/Station       5.000 to Point/Station       6.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    10.100(Ft.)
Downstream point elevation =     8.900(Ft.)
Channel length thru subarea  =   300.000(Ft.)
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Channel base width      =    2.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =      3.012(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      3.012(CFS)
Depth of flow =   0.532(Ft.), Average velocity =   1.575(Ft/s)
Channel flow top width =    5.191(Ft.)
Flow Velocity =    1.58(Ft/s)
Travel time  =    3.17 min.
Time of concentration =    8.34 min.
Critical depth =      0.344(Ft.)
 Adding area flow to channel
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Rainfall intensity =      3.029(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.863
Subarea runoff =      2.399(CFS) for    1.100(Ac.)
Total runoff =      4.184(CFS)  Total area =        1.60(Ac.)
Area averaged Fm value =    0.123(In/Hr)
Depth of flow =   0.626(Ft.), Average velocity =   1.722(Ft/s)
Critical depth =      0.414(Ft.)


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Process from Point/Station       6.000 to Point/Station       3.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =     8.900(Ft.)
End of street segment elevation =     8.300(Ft.)
Length of street segment  =   460.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      5.573(CFS)
Depth of flow =   0.546(Ft.), Average velocity =   1.223(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    2.28(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  20.000(Ft.)
Flow velocity =   1.22(Ft/s)
Travel time =    6.27 min.     TC =   14.60  min.
 Adding area flow to street
PARK subarea
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```
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Rainfall intensity =      2.197(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.839
Subarea runoff =      2.723(CFS) for    2.150(Ac.)
Total runoff =      6.907(CFS)  Total area =        3.75(Ac.)
Area averaged Fm value =    0.150(In/Hr)
Street flow at end of street =      6.907(CFS)
Half street flow at end of street =      6.907(CFS)
Depth of flow =   0.579(Ft.), Average velocity =   1.296(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    3.95(Ft.)
Flow width (from curb towards crown)=  20.000(Ft.)


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Process from Point/Station        3.000 to Point/Station        3.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      3.750(Ac.)
Runoff from this stream =      6.907(CFS)
Time of concentration =   14.60 min.
Rainfall intensity =     2.197(In/Hr)
Area averaged loss rate (Fm) =    0.1500(In/Hr)
Area averaged Pervious ratio (Ap) = 0.7500
Summary of stream data:

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


1      3.14     6.021     18.02    0.070      1.947
2      3.75     6.907     14.60    0.150      2.197
Qmax(1) =
           1.000 *    1.000 *     6.021) +
           0.878 *    1.000 *     6.907) + =      12.086
Qmax(2) =
           1.133 *    0.810 *     6.021) +
           1.000 *    1.000 *     6.907) + =      12.434

Total of 2 main streams to confluence:
Flow rates before confluence point:
       7.021       7.907
Maximum flow rates at confluence using above data:
       12.086       12.434
Area of streams before confluence:
        3.140        3.750
Effective area values after confluence:
        6.890        6.295


Results of confluence:
Total flow rate =     12.434(CFS)
Time of concentration =    14.604 min.
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Effective stream area after confluence  =      6.295(Ac.)
Study area average Pervious fraction(Ap) =  0.568
Study area average soil loss rate(Fm) =    0.114(In/Hr)
Study area total =       6.89(Ac.)


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Process from Point/Station       3.000 to Point/Station       7.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =     8.300(Ft.)
End of street segment elevation =     7.900(Ft.)
Length of street segment  =   300.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     14.676(CFS)
Depth of flow =   0.717(Ft.), Average velocity =   1.614(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =   10.83(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  20.000(Ft.)
Flow velocity =   1.61(Ft/s)
Travel time =    3.10 min.     TC =   17.70  min.
 Adding area flow to street
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Rainfall intensity =      1.967(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.838
Subarea runoff =      4.424(CFS) for    3.930(Ac.)
Total runoff =     16.859(CFS)  Total area =       10.22(Ac.)
Area averaged Fm value =    0.135(In/Hr)
Street flow at end of street =     16.859(CFS)
Half street flow at end of street =     16.859(CFS)
Depth of flow =   0.743(Ft.), Average velocity =   1.706(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =   12.15(Ft.)
Flow width (from curb towards crown)=  20.000(Ft.)


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Process from Point/Station       8.000 to Point/Station       9.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
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COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   170.000(Ft.)
Top (of initial area) elevation =    13.200(Ft.)
Bottom (of initial area) elevation =    10.300(Ft.)
Difference in elevation =     2.900(Ft.)
Slope =    0.01706  s(%)=       1.71
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    5.354 min.
Rainfall intensity =      3.904(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.895
Subarea runoff =      1.468(CFS)
Total initial stream area =        0.420(Ac.)


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Process from Point/Station        9.000 to Point/Station       10.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    10.300(Ft.)
End of street segment elevation =     9.600(Ft.)
Length of street segment  =   520.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      1.687(CFS)
Depth of flow =   0.383(Ft.), Average velocity =   0.952(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  12.826(Ft.)
Flow velocity =   0.95(Ft/s)
Travel time =    9.10 min.     TC =   14.46  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      2.209(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.892
Subarea runoff =      0.384(CFS) for    0.520(Ac.)
Total runoff =      1.852(CFS)  Total area =        0.94(Ac.)
Area averaged Fm value =    0.020(In/Hr)
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Street flow at end of street =      1.852(CFS)
Half street flow at end of street =      1.852(CFS)
Depth of flow =   0.393(Ft.), Average velocity =   0.973(Ft/s)
Flow width (from curb towards crown)=  13.327(Ft.)
End of computations, total study area =           11.76 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.625
Area averaged SCS curve number (AMC 2) =  75.0
```

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              Orange County Rational Hydrology Program

        (Hydrology Manual Date(s) October 1986 & November 1996)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2004 Version 8.0
        Rational Hydrology Study, Date: 10/29/14  File Name: POSTLEBARD.roc
------------------------------------------------------------------------
POST DEVELOPMENT HYDROLOGY
25-YEAR STORM (UNMITIGATED)



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Program License Serial Number 6201

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

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Rational hydrology study storm event year is    25.0

Decimal fraction of study above 2000 ft., 600M  =     0.0000
English Units Used for input data


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
CONDOMINIUM subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.3500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.070(In/Hr)
Initial subarea data:
Initial area flow distance =   460.000(Ft.)
Top (of initial area) elevation =    12.200(Ft.)
Bottom (of initial area) elevation =    11.300(Ft.)
Difference in elevation =     0.900(Ft.)
Slope =    0.00196  s(%)=       0.20
TC = k(0.360)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   14.558 min.
NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
for this Development Type
Rainfall intensity =      2.634(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.876
Subarea runoff =      7.247(CFS)
Total initial stream area =        3.140(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       2.000 to Point/Station       3.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    11.500(Ft.)
Downstream point elevation =     8.700(Ft.)
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```
Channel length thru subarea  =   460.000(Ft.)
Channel base width      =    2.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      7.247(CFS)
Depth of flow =   0.739(Ft.), Average velocity =   2.326(Ft/s)
Channel flow top width =    6.433(Ft.)
Flow Velocity =    2.33(Ft/s)
Travel time  =    3.30 min.
Time of concentration =   17.85 min.
Critical depth =      0.563(Ft.)


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Process from Point/Station       3.000 to Point/Station       3.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      3.140(Ac.)
Runoff from this stream =      7.247(CFS)
Time of concentration =   17.85 min.
Rainfall intensity =     2.347(In/Hr)
Area averaged loss rate (Fm) =    0.0700(In/Hr)
Area averaged Pervious ratio (Ap) = 0.3500
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       4.000 to Point/Station       5.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   160.000(Ft.)
Top (of initial area) elevation =    13.000(Ft.)
Bottom (of initial area) elevation =    10.100(Ft.)
Difference in elevation =     2.900(Ft.)
Slope =    0.01813  s(%)=       1.81
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    5.163 min.
Rainfall intensity =      4.737(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.896
Subarea runoff =      2.123(CFS)
Total initial stream area =        0.500(Ac.)


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Process from Point/Station       5.000 to Point/Station       6.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    10.100(Ft.)
Downstream point elevation =     8.900(Ft.)
Channel length thru subarea  =   300.000(Ft.)
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Channel base width      =    2.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =      3.633(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      3.633(CFS)
Depth of flow =   0.584(Ft.), Average velocity =   1.658(Ft/s)
Channel flow top width =    5.504(Ft.)
Flow Velocity =    1.66(Ft/s)
Travel time  =    3.02 min.
Time of concentration =    8.18 min.
Critical depth =      0.383(Ft.)
 Adding area flow to channel
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Rainfall intensity =      3.651(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.870
Subarea runoff =      2.957(CFS) for    1.100(Ac.)
Total runoff =      5.080(CFS)  Total area =        1.60(Ac.)
Area averaged Fm value =    0.123(In/Hr)
Depth of flow =   0.689(Ft.), Average velocity =   1.814(Ft/s)
Critical depth =      0.461(Ft.)


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Process from Point/Station        6.000 to Point/Station        3.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =     8.900(Ft.)
End of street segment elevation =     8.300(Ft.)
Length of street segment  =   460.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      6.844(CFS)
Depth of flow =   0.578(Ft.), Average velocity =   1.292(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    3.88(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  20.000(Ft.)
Flow velocity =   1.29(Ft/s)
Travel time =    5.93 min.     TC =   14.11  min.
 Adding area flow to street
PARK subarea
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```
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Rainfall intensity =      2.681(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.850
Subarea runoff =      3.463(CFS) for    2.150(Ac.)
Total runoff =      8.543(CFS)  Total area =        3.75(Ac.)
Area averaged Fm value =    0.150(In/Hr)
Street flow at end of street =      8.543(CFS)
Half street flow at end of street =      8.543(CFS)
Depth of flow =   0.615(Ft.), Average velocity =   1.371(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    5.77(Ft.)
Flow width (from curb towards crown)=  20.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        3.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      3.750(Ac.)
Runoff from this stream =      8.543(CFS)
Time of concentration =   14.11 min.
Rainfall intensity =     2.681(In/Hr)
Area averaged loss rate (Fm) =    0.1500(In/Hr)
Area averaged Pervious ratio (Ap) = 0.7500
Summary of stream data:

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


1      3.14     7.247     17.85    0.070      2.347
2      3.75     8.543     14.11    0.150      2.681
Qmax(1) =
           1.000 *    1.000 *     7.247) +
           0.868 *    1.000 *     8.543) + =      14.662
Qmax(2) =
           1.147 *    0.790 *     7.247) +
           1.000 *    1.000 *     8.543) + =      15.112

Total of 2 main streams to confluence:
Flow rates before confluence point:
       8.247       9.543
Maximum flow rates at confluence using above data:
       14.662       15.112
Area of streams before confluence:
        3.140        3.750
Effective area values after confluence:
        6.890        6.232


Results of confluence:
Total flow rate =     15.112(CFS)
Time of concentration =    14.111 min.
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Effective stream area after confluence  =      6.232(Ac.)
Study area average Pervious fraction(Ap) =  0.568
Study area average soil loss rate(Fm) =    0.114(In/Hr)
Study area total =       6.89(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       3.000 to Point/Station       7.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =     8.300(Ft.)
End of street segment elevation =     7.900(Ft.)
Length of street segment  =   300.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     18.017(CFS)
Depth of flow =   0.756(Ft.), Average velocity =   1.752(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =   12.82(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  20.000(Ft.)
Flow velocity =   1.75(Ft/s)
Travel time =    2.85 min.     TC =   16.96  min.
 Adding area flow to street
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Rainfall intensity =      2.416(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.850
Subarea runoff =      5.744(CFS) for    3.930(Ac.)
Total runoff =     20.856(CFS)  Total area =       10.16(Ac.)
Area averaged Fm value =    0.135(In/Hr)
Street flow at end of street =     20.856(CFS)
Half street flow at end of street =     20.856(CFS)
Depth of flow =   0.788(Ft.), Average velocity =   1.858(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =   14.39(Ft.)
Flow width (from curb towards crown)=  20.000(Ft.)


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Process from Point/Station       8.000 to Point/Station       9.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
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COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   170.000(Ft.)
Top (of initial area) elevation =    13.200(Ft.)
Bottom (of initial area) elevation =    10.300(Ft.)
Difference in elevation =     2.900(Ft.)
Slope =    0.01706  s(%)=       1.71
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    5.354 min.
Rainfall intensity =      4.641(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.896
Subarea runoff =      1.747(CFS)
Total initial stream area =        0.420(Ac.)


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Process from Point/Station        9.000 to Point/Station       10.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    10.300(Ft.)
End of street segment elevation =     9.600(Ft.)
Length of street segment  =   520.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      2.032(CFS)
Depth of flow =   0.403(Ft.), Average velocity =   0.995(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  13.839(Ft.)
Flow velocity =   1.00(Ft/s)
Travel time =    8.71 min.     TC =   14.06  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      2.687(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.893
Subarea runoff =      0.509(CFS) for    0.520(Ac.)
Total runoff =      2.256(CFS)  Total area =        0.94(Ac.)
Area averaged Fm value =    0.020(In/Hr)
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```
Street flow at end of street =      2.256(CFS)
Half street flow at end of street =      2.256(CFS)
Depth of flow =   0.415(Ft.), Average velocity =   1.020(Ft/s)
Flow width (from curb towards crown)=  14.436(Ft.)
End of computations, total study area =          11.76 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.625
Area averaged SCS curve number (AMC 2) =  75.0
```

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                  Orange County Rational Hydrology Program

              (Hydrology Manual Date(s) October 1986 & November 1996)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2004 Version 8.0
        Rational Hydrology Study, Date: 10/29/14  File Name: POSTLEBARD.roc
------------------------------------------------------------------------
POST DEVELOPMENT HYDROLOGY
100-YEAR STORM (UNMITIGATED)



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


Program License Serial Number 6201

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

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

Rational hydrology study storm event year is   100.0

Decimal fraction of study above 2000 ft., 600M  =     0.0000
English Units Used for input data


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
CONDOMINIUM subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.3500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.070(In/Hr)
Initial subarea data:
Initial area flow distance =   460.000(Ft.)
Top (of initial area) elevation =    12.200(Ft.)
Bottom (of initial area) elevation =    11.300(Ft.)
Difference in elevation =     0.900(Ft.)
Slope =    0.00196  s(%)=       0.20
TC = k(0.360)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   14.558 min.
NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
for this Development Type
Rainfall intensity =      3.354(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.881
Subarea runoff =      9.280(CFS)
Total initial stream area =        3.140(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       2.000 to Point/Station       3.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    11.500(Ft.)
Downstream point elevation =     8.700(Ft.)
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Channel length thru subarea  =   460.000(Ft.)
Channel base width      =    2.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      9.280(CFS)
Depth of flow =   0.832(Ft.), Average velocity =   2.483(Ft/s)
Channel flow top width =    6.990(Ft.)
Flow Velocity =    2.48(Ft/s)
Travel time  =    3.09 min.
Time of concentration =   17.65 min.
Critical depth =      0.641(Ft.)


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Process from Point/Station        3.000 to Point/Station       3.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      3.140(Ac.)
Runoff from this stream =      9.280(CFS)
Time of concentration =   17.65 min.
Rainfall intensity =     3.004(In/Hr)
Area averaged loss rate (Fm) =    0.0700(In/Hr)
Area averaged Pervious ratio (Ap) = 0.3500
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station       5.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   160.000(Ft.)
Top (of initial area) elevation =    13.000(Ft.)
Bottom (of initial area) elevation =    10.100(Ft.)
Difference in elevation =     2.900(Ft.)
Slope =    0.01813  s(%)=       1.81
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    5.163 min.
Rainfall intensity =      6.075(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      2.725(CFS)
Total initial stream area =       0.500(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.000 to Point/Station       6.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    10.100(Ft.)
Downstream point elevation =     8.900(Ft.)
Channel length thru subarea  =   300.000(Ft.)
```

```
Channel base width      =    2.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =      4.721(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      4.721(CFS)
Depth of flow =   0.665(Ft.), Average velocity =   1.779(Ft/s)
Channel flow top width =    5.987(Ft.)
Flow Velocity =    1.78(Ft/s)
Travel time  =    2.81 min.
Time of concentration =    7.97 min.
Critical depth =      0.445(Ft.)
 Adding area flow to channel
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Rainfall intensity =      4.735(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.877
Subarea runoff =      3.917(CFS) for    1.100(Ac.)
Total runoff =      6.642(CFS)  Total area =        1.60(Ac.)
Area averaged Fm value =    0.123(In/Hr)
Depth of flow =   0.784(Ft.), Average velocity =   1.948(Ft/s)
Critical depth =      0.535(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station        3.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =     8.900(Ft.)
End of street segment elevation =     8.300(Ft.)
Length of street segment  =   460.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      9.021(CFS)
Depth of flow =   0.625(Ft.), Average velocity =   1.391(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    6.25(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  20.000(Ft.)
Flow velocity =   1.39(Ft/s)
Travel time =    5.51 min.     TC =   13.49  min.
 Adding area flow to street
PARK subarea
```

```
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Rainfall intensity =      3.504(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.861
Subarea runoff =      4.678(CFS) for    2.150(Ac.)
Total runoff =     11.320(CFS)  Total area =        3.75(Ac.)
Area averaged Fm value =    0.150(In/Hr)
Street flow at end of street =     11.320(CFS)
Half street flow at end of street =     11.320(CFS)
Depth of flow =   0.668(Ft.), Average velocity =   1.476(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    8.42(Ft.)
Flow width (from curb towards crown)=  20.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       3.000 to Point/Station       3.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      3.750(Ac.)
Runoff from this stream =     11.320(CFS)
Time of concentration =   13.49 min.
Rainfall intensity =     3.504(In/Hr)
Area averaged loss rate (Fm) =    0.1500(In/Hr)
Area averaged Pervious ratio (Ap) = 0.7500
Summary of stream data:

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


1      3.14     9.280     17.65    0.070      3.004
2      3.75    11.320     13.49    0.150      3.504
Qmax(1) =
           1.000 *    1.000 *     9.280) +
           0.851 *    1.000 *    11.320) + =      18.912
Qmax(2) =
           1.171 *    0.764 *     9.280) +
           1.000 *    1.000 *    11.320) + =      19.622

Total of 2 main streams to confluence:
Flow rates before confluence point:
      10.280      12.320
Maximum flow rates at confluence using above data:
       18.912       19.622
Area of streams before confluence:
        3.140        3.750
Effective area values after confluence:
        6.890        6.150


Results of confluence:
Total flow rate =     19.622(CFS)
Time of concentration =    13.486 min.
```

```
Effective stream area after confluence  =       6.150(Ac.)
Study area average Pervious fraction(Ap) =  0.568
Study area average soil loss rate(Fm) =    0.114(In/Hr)
Study area total =       6.89(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       3.000 to Point/Station       7.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =     8.300(Ft.)
End of street segment elevation =     7.900(Ft.)
Length of street segment  =   300.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  10.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     23.624(CFS)
Depth of flow =   0.817(Ft.), Average velocity =   1.952(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =   15.84(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  20.000(Ft.)
Flow velocity =   1.95(Ft/s)
Travel time =    2.56 min.     TC =   16.05  min.
 Adding area flow to street
PARK subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.8500  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.170(In/Hr)
Rainfall intensity =      3.172(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.862
Subarea runoff =      7.923(CFS) for    3.930(Ac.)
Total runoff =     27.545(CFS)  Total area =       10.08(Ac.)
Area averaged Fm value =    0.136(In/Hr)
Street flow at end of street =     27.545(CFS)
Half street flow at end of street =     27.545(CFS)
Depth of flow =   0.856(Ft.), Average velocity =   2.076(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =   17.79(Ft.)
Flow width (from curb towards crown)=  20.000(Ft.)


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Process from Point/Station       8.000 to Point/Station       9.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
```

```
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Initial subarea data:
Initial area flow distance =   170.000(Ft.)
Top (of initial area) elevation =    13.200(Ft.)
Bottom (of initial area) elevation =    10.300(Ft.)
Difference in elevation =     2.900(Ft.)
Slope =    0.01706  s(%)=       1.71
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    5.354 min.
Rainfall intensity =      5.950(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      2.241(CFS)
Total initial stream area =        0.420(Ac.)


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Process from Point/Station        9.000 to Point/Station       10.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    10.300(Ft.)
End of street segment elevation =     9.600(Ft.)
Length of street segment  =   520.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      2.630(CFS)
Depth of flow =   0.434(Ft.), Average velocity =   1.059(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  15.352(Ft.)
Flow velocity =   1.06(Ft/s)
Travel time =    8.19 min.     TC =   13.54  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
SCS curve number for soil(AMC 2)  = 75.00
Pervious ratio(Ap) = 0.1000  Max loss rate(Fp)=     0.200(In/Hr)
Max Catchment Loss (Fm) =     0.020(In/Hr)
Rainfall intensity =      3.496(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.895
Subarea runoff =      0.700(CFS) for    0.520(Ac.)
Total runoff =      2.941(CFS)  Total area =        0.94(Ac.)
Area averaged Fm value =    0.020(In/Hr)
```

```
Street flow at end of street =      2.941(CFS)
Half street flow at end of street =      2.941(CFS)
Depth of flow =   0.448(Ft.), Average velocity =   1.088(Ft/s)
Flow width (from curb towards crown)=  16.052(Ft.)
End of computations, total study area =           11.76 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.625
Area averaged SCS curve number (AMC 2) =  75.0
```

Appendix C-Post-Development Hydrology Calculations

(Unit Hydrograph-Mitigated)

100-year, 25-year, 10-year & 2-year

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 12/04/14   File Name LEBARD2A3A4A2Y.out

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Orange County Unit Hydrograph Hydrology Method
Manual Date(s) - October 1986, November 1996

Program License Serial Number 6201

LEBARD AREA 2A-3A-4A HYDROGRAPH 2 YEAR

Storm Event Year = 2

Antecedent Moisture Condition = 1

English (in-lb) Input Units Used
++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	Area (Ac.)	Area Fraction	Soil Group	Fp (In/Hr)	Ap (dec.)	Fm (In/Hr)
75.0	3.8	1.00	D	0.200	0.850	0.170

Area-averaged adjusted loss rate Fm (In/Hr) = 0.170

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC1)	S	Pervious Yield Fr
3.19	0.850	75.0	57.0	7.54	0.018
0.56	0.150	98.0	98.0	0.20	0.890

Area-averaged catchment yield fraction, Y = 0.148
Area-averaged low loss fraction, Yb = 0.852
++
User entry of time of concentration = 0.269 (hours)
Watershed area = 3.75(Ac.)
Catchment Lag time = 0.215 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 38.6805
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.150(In/Hr)
Average low loss rate fraction (Yb) = 0.852 (decimal)
Note: user entry of the Fm value
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.190(In)
Computed peak 30-minute rainfall = 0.400(In)
Specified peak 1-hour rainfall = 0.530(In)

```
      Computed peak 3-hour rainfall =  0.890(In)
      Specified peak 6-hour rainfall =  1.220(In)
      Specified peak 24-hour rainfall =  2.050(In)


      Rainfall depth area reduction factors:
      Using a total area of       3.75(Ac.) (Ref: fig. E-4)

      5-minute factor = 1.000     Adjusted rainfall =  0.190(In)
      30-minute factor = 1.000    Adjusted rainfall =  0.400(In)
      1-hour factor = 1.000       Adjusted rainfall =  0.530(In)
      3-hour factor = 1.000       Adjusted rainfall =  0.890(In)
      6-hour factor = 1.000       Adjusted rainfall =  1.220(In)
      24-hour factor = 1.000  Adjusted rainfall =  2.050(In)
      ---------------------------------------------------------------------


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - 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   5   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5      5.0      7.5     10.0
----------------------------------------------------------------------
 11+45       0.0240      0.04  Q   V     |         |         |         |
 11+50       0.0243      0.04  Q   V     |         |         |         |
 11+55       0.0245      0.04  Q   V     |         |         |         |
 12+ 0       0.0248      0.04  Q    V    |         |         |         |
 12+ 5       0.0251      0.04  Q    V    |         |         |         |
 12+10       0.0254      0.04  Q    V    |         |         |         |
 12+15       0.0257      0.05  Q    V    |         |         |         |
 12+20       0.0261      0.05  Q    V    |         |         |         |
 12+25       0.0264      0.05  Q    V    |         |         |         |
 12+30       0.0268      0.05  Q    V    |         |         |         |
 12+35       0.0272      0.05  Q    V    |         |         |         |
 12+40       0.0275      0.05  Q    V    |         |         |         |
 12+45       0.0279      0.06  Q    V    |         |         |         |
 12+50       0.0283      0.06  Q    V    |         |         |         |
 12+55       0.0287      0.06  Q    V    |         |         |         |
 13+ 0       0.0291      0.06  Q    V    |         |         |         |
 13+ 5       0.0295      0.06  Q    V    |         |         |         |
 13+10       0.0299      0.06  Q     V   |         |         |         |
 13+15       0.0303      0.06  Q     V   |         |         |         |
 13+20       0.0308      0.06  Q     V   |         |         |         |
 13+25       0.0312      0.06  Q     V   |         |         |         |
 13+30       0.0316      0.06  Q     V   |         |         |         |
 13+35       0.0321      0.06  Q     V   |         |         |         |
 13+40       0.0325      0.07  Q     V   |         |         |         |
 13+45       0.0330      0.07  Q     V   |         |         |         |
 13+50       0.0334      0.07  Q     V   |         |         |         |
 13+55       0.0339      0.07  Q     V   |         |         |         |
 14+ 0       0.0344      0.07  Q     V   |         |         |         |
 14+ 5       0.0349      0.07  Q      V  |         |         |         |
 14+10       0.0354      0.07  Q      V  |         |         |         |
 14+15       0.0359      0.08  Q      V  |         |         |         |
 14+20       0.0365      0.08  Q      V  |         |         |         |
 14+25       0.0370      0.08  Q      V  |         |         |         |
 14+30       0.0376      0.08  Q      V  |         |         |         |
 14+35       0.0382      0.09  Q      V  |         |         |         |
 14+40       0.0388      0.09  Q      V  |         |         |         |
 14+45       0.0394      0.09  Q       V |         |         |         |
```

```
14+50       0.0400      0.09  Q       V |         |         |         |
14+55       0.0407      0.10  Q       V |         |         |         |
15+ 0       0.0415      0.11  Q       V |         |         |         |
15+ 5       0.0424      0.13  Q       V |         |         |         |
15+10       0.0434      0.15  Q       V |         |         |         |
15+15       0.0447      0.18  Q        V|         |         |         |
15+20       0.0462      0.22  Q        V|         |         |         |
15+25       0.0479      0.25  |Q       V|         |         |         |
15+30       0.0498      0.28  |Q        V         |         |         |
15+35       0.0518      0.29  |Q        V         |         |         |
15+40       0.0540      0.32  |Q        V         |         |         |
15+45       0.0566      0.38  |Q        |V        |         |         |
15+50       0.0600      0.49  |Q        | V       |         |         |
15+55       0.0644      0.64  | Q       |  V      |         |         |
16+ 0       0.0706      0.90  |  Q      |   V     |         |         |
16+ 5       0.0805      1.45  |    Q    |     V   |         |         |
16+10       0.0983      2.58  |         Q        V|         |         |
16+15       0.1220      3.45  |         |  Q      |   V     |         |
16+20       0.1442      3.21  |         | Q       |        V|         |
16+25       0.1574      1.92  |      Q  |         |         |V        |
16+30       0.1647      1.07  |   Q     |         |         |  V      |
16+35       0.1690      0.62  | Q       |         |         |   V     |
16+40       0.1718      0.40  |Q        |         |         |   V     |
16+45       0.1739      0.31  |Q        |         |         |    V    |
16+50       0.1754      0.21  Q         |         |         |    V    |
16+55       0.1763      0.14  Q         |         |         |    V    |
17+ 0       0.1771      0.11  Q         |         |         |    V    |
17+ 5       0.1778      0.10  Q         |         |         |     V   |
17+10       0.1784      0.09  Q         |         |         |     V   |
17+15       0.1789      0.08  Q         |         |         |     V   |
17+20       0.1794      0.08  Q         |         |         |     V   |
17+25       0.1799      0.07  Q         |         |         |     V   |
17+30       0.1804      0.07  Q         |         |         |     V   |
17+35       0.1809      0.07  Q         |         |         |     V   |
17+40       0.1813      0.06  Q         |         |         |     V   |
17+45       0.1817      0.06  Q         |         |         |     V   |
17+50       0.1822      0.06  Q         |         |         |      V  |
17+55       0.1826      0.06  Q         |         |         |      V  |
18+ 0       0.1829      0.06  Q         |         |         |      V  |
18+ 5       0.1833      0.06  Q         |         |         |      V  |
18+10       0.1837      0.05  Q         |         |         |      V  |
1
-----------------------------------------------------------------------
```

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 12/04/14   File Name LEBARD2A3A4A10Y.out

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Orange County Unit Hydrograph Hydrology Method
Manual Date(s) - October 1986, November 1996

Program License Serial Number 6201

LEBARD AREA 2A-3A-4A HYDROGRAPH 10 YEAR

Storm Event Year = 10

Antecedent Moisture Condition = 2

English (in-lb) Input Units Used
++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	Area (Ac.)	Area Fraction	Soil Group	Fp (In/Hr)	Ap (dec.)	Fm (In/Hr)
75.0	3.8	1.00	D	0.200	0.850	0.170

Area-averaged adjusted loss rate Fm (In/Hr) = 0.170

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC2)	S	Pervious Yield Fr
3.19	0.850	75.0	75.0	3.33	0.389
0.56	0.150	98.0	98.0	0.20	0.936

Area-averaged catchment yield fraction, Y = 0.471
Area-averaged low loss fraction, Yb = 0.529
++
User entry of time of concentration =   0.243 (hours)
Watershed area =   3.75(Ac.)
Catchment Lag time =   0.195 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 42.8141
Hydrograph baseflow =   0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.170(In/Hr)
Average low loss rate fraction (Yb) = 0.529 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.340(In)
Computed peak 30-minute rainfall = 0.720(In)
Specified peak 1-hour rainfall = 0.950(In)
Computed peak 3-hour rainfall = 1.590(In)

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      Specified peak 6-hour rainfall =  2.200(In)
      Specified peak 24-hour rainfall =  3.680(In)


      Rainfall depth area reduction factors:
      Using a total area of       3.75(Ac.) (Ref: fig. E-4)

      5-minute factor = 1.000     Adjusted rainfall =  0.340(In)
      30-minute factor = 1.000    Adjusted rainfall =  0.720(In)
      1-hour factor = 1.000       Adjusted rainfall =  0.950(In)
      3-hour factor = 1.000       Adjusted rainfall =  1.590(In)
      6-hour factor = 1.000       Adjusted rainfall =  2.200(In)
      24-hour factor = 1.000  Adjusted rainfall =  3.680(In)
      ---------------------------------------------------------------------


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - 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   5   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
 13+25       0.1782      0.37  |Q        V         |         |         |
 13+30       0.1808      0.37  |Q        |V        |         |         |
 13+35       0.1834      0.38  |Q        |V        |         |         |
 13+40       0.1860      0.38  |Q        |V        |         |         |
 13+45       0.1887      0.39  |Q        |V        |         |         |
 13+50       0.1915      0.40  |Q        |V        |         |         |
 13+55       0.1942      0.41  |Q        |V        |         |         |
 14+ 0       0.1971      0.41  |Q        | V       |         |         |
 14+ 5       0.2000      0.42  |Q        | V       |         |         |
 14+10       0.2030      0.43  |Q        | V       |         |         |
 14+15       0.2060      0.44  |Q        | V       |         |         |
 14+20       0.2091      0.45  |Q        | V       |         |         |
 14+25       0.2123      0.46  |Q        |  V      |         |         |
 14+30       0.2155      0.47  |Q        |  V      |         |         |
 14+35       0.2188      0.48  |Q        |  V      |         |         |
 14+40       0.2223      0.50  |Q        |  V      |         |         |
 14+45       0.2258      0.51  | Q       |  V      |         |         |
 14+50       0.2294      0.53  | Q       |   V     |         |         |
 14+55       0.2332      0.55  | Q       |   V     |         |         |
 15+ 0       0.2371      0.57  | Q       |   V     |         |         |
 15+ 5       0.2413      0.61  | Q       |   V     |         |         |
 15+10       0.2457      0.65  | Q       |    V    |         |         |
 15+15       0.2506      0.70  | Q       |    V    |         |         |
 15+20       0.2559      0.77  |  Q      |    V    |         |         |
 15+25       0.2616      0.83  |  Q      |     V   |         |         |
 15+30       0.2676      0.87  |  Q      |     V   |         |         |
 15+35       0.2737      0.89  |  Q      |     V   |         |         |
 15+40       0.2802      0.94  |  Q      |      V  |         |         |
 15+45       0.2875      1.07  |   Q     |      V  |         |         |
 15+50       0.2963      1.28  |    Q    |       V |         |         |
 15+55       0.3074      1.60  |     Q   |       V |         |         |
 16+ 0       0.3219      2.12  |       Q |        V|         |         |
 16+ 5       0.3443      3.24  |         | Q       |V        |         |
 16+10       0.3826      5.56  |         |         | QV      |         |
 16+15       0.4317      7.14  |         |         |     V Q |         |
 16+20       0.4712      5.74  |         |         | Q     V |         |
 16+25       0.4938      3.27  |         |  Q      |         V         |
 16+30       0.5071      1.93  |      Q  |         |         |V        |
```

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   16+35       0.5158      1.26  |    Q    |         |         |V        |
   16+40       0.5229      1.03  |   Q     |         |         | V       |
   16+45       0.5287      0.84  |  Q      |         |         | V       |
   16+50       0.5333      0.67  | Q       |         |         | V       |
   16+55       0.5373      0.59  | Q       |         |         | V       |
   17+ 0       0.5410      0.54  | Q       |         |         |  V      |
   17+ 5       0.5445      0.50  | Q       |         |         |  V      |
   17+10       0.5478      0.47  |Q        |         |         |  V      |
   17+15       0.5509      0.45  |Q        |         |         |  V      |
   17+20       0.5538      0.43  |Q        |         |         |  V      |
   17+25       0.5567      0.41  |Q        |         |         |   V     |
   17+30       0.5594      0.40  |Q        |         |         |   V     |
   17+35       0.5621      0.38  |Q        |         |         |   V     |
   17+40       0.5646      0.37  |Q        |         |         |   V     |
   17+45       0.5671      0.36  |Q        |         |         |   V     |
   17+50       0.5695      0.35  |Q        |         |         |   V     |
   17+55       0.5719      0.34  |Q        |         |         |    V    |
   18+ 0       0.5742      0.33  |Q        |         |         |    V    |
   18+ 5       0.5764      0.32  |Q        |         |         |    V    |
   18+10       0.5784      0.30  |Q        |         |         |    V    |
   18+15       0.5803      0.27  |Q        |         |         |    V    |
   18+20       0.5820      0.25  Q         |         |         |    V    |
   18+25       0.5837      0.24  Q         |         |         |    V    |
   18+30       0.5852      0.23  Q         |         |         |    V    |
   18+35       0.5868      0.22  Q         |         |         |    V    |
   18+40       0.5883      0.22  Q         |         |         |     V   |

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

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 12/04/14 File Name LEBARD2A3A4A25Y.out

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Orange County Unit Hydrograph Hydrology Method
Manual Date(s) - October 1986, November 1996

Program License Serial Number 6201

LEBARD AREA 2A-3A-4A HYDROGRAPH

Storm Event Year = 25

Antecedent Moisture Condition = 2

English (in-lb) Input Units Used
++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	Area (Ac.)	Area Fraction	Soil Group	Fp (In/Hr)	Ap (dec.)	Fm (In/Hr)
75.0	3.8	1.00	D	0.200	0.850	0.170

Area-averaged adjusted loss rate Fm (In/Hr) = 0.170

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC2)	S	Pervious Yield Fr
3.19	0.850	75.0	75.0	3.33	0.455
0.56	0.150	98.0	98.0	0.20	0.947

Area-averaged catchment yield fraction, Y = 0.529
Area-averaged low loss fraction, Yb = 0.471
++
User entry of time of concentration = 0.235 (hours)
Watershed area = 3.75(Ac.)
Catchment Lag time = 0.188 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 44.3262
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.170(In/Hr)
Average low loss rate fraction (Yb) = 0.471 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.400(In)
Computed peak 30-minute rainfall = 0.870(In)
Specified peak 1-hour rainfall = 1.150(In)
Computed peak 3-hour rainfall = 1.940(In)

```
      Specified peak 6-hour rainfall =  2.710(In)
      Specified peak 24-hour rainfall =  4.490(In)


      Rainfall depth area reduction factors:
      Using a total area of       3.75(Ac.) (Ref: fig. E-4)

      5-minute factor = 1.000     Adjusted rainfall =  0.400(In)
      30-minute factor = 1.000    Adjusted rainfall =  0.870(In)
      1-hour factor = 1.000       Adjusted rainfall =  1.150(In)
      3-hour factor = 1.000       Adjusted rainfall =  1.940(In)
      6-hour factor = 1.000       Adjusted rainfall =  2.710(In)
      24-hour factor = 1.000  Adjusted rainfall =  4.490(In)
      ---------------------------------------------------------------------

      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - 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   5   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0         2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
 12+45       0.2150      0.46  |Q       V|         |         |         |
 12+50       0.2182      0.47  |Q        V         |         |         |
 12+55       0.2215      0.47  |Q        V         |         |         |
 13+ 0       0.2248      0.48  |Q        V         |         |         |
 13+ 5       0.2282      0.49  |Q        V         |         |         |
 13+10       0.2316      0.49  |Q        V         |         |         |
 13+15       0.2350      0.50  | Q       V         |         |         |
 13+20       0.2386      0.51  | Q       |V        |         |         |
 13+25       0.2421      0.52  | Q       |V        |         |         |
 13+30       0.2457      0.52  | Q       |V        |         |         |
 13+35       0.2494      0.53  | Q       |V        |         |         |
 13+40       0.2531      0.54  | Q       |V        |         |         |
 13+45       0.2569      0.55  | Q       |V        |         |         |
 13+50       0.2608      0.56  | Q       | V       |         |         |
 13+55       0.2647      0.57  | Q       | V       |         |         |
 14+ 0       0.2687      0.58  | Q       | V       |         |         |
 14+ 5       0.2728      0.59  | Q       | V       |         |         |
 14+10       0.2769      0.60  | Q       | V       |         |         |
 14+15       0.2812      0.61  | Q       | V       |         |         |
 14+20       0.2855      0.62  | Q       |  V      |         |         |
 14+25       0.2899      0.64  | Q       |  V      |         |         |
 14+30       0.2944      0.65  | Q       |  V      |         |         |
 14+35       0.2990      0.67  | Q       |  V      |         |         |
 14+40       0.3037      0.69  | Q       |   V     |         |         |
 14+45       0.3087      0.71  | Q       |   V     |         |         |
 14+50       0.3138      0.75  | Q       |   V     |         |         |
 14+55       0.3192      0.79  |  Q      |   V     |         |         |
 15+ 0       0.3250      0.84  |  Q      |    V    |         |         |
 15+ 5       0.3311      0.89  |  Q      |    V    |         |         |
 15+10       0.3377      0.95  |  Q      |    V    |         |         |
 15+15       0.3447      1.02  |   Q     |    V    |         |         |
 15+20       0.3522      1.10  |   Q     |     V   |         |         |
 15+25       0.3603      1.17  |   Q     |     V   |         |         |
 15+30       0.3686      1.21  |   Q     |      V  |         |         |
 15+35       0.3771      1.22  |   Q     |      V  |         |         |
 15+40       0.3859      1.29  |    Q    |      V  |         |         |
 15+45       0.3959      1.45  |    Q    |       V |         |         |
 15+50       0.4079      1.73  |     Q   |       V |         |         |
 15+55       0.4227      2.16  |       Q |        V|         |         |
```

```
16+ 0       0.4422      2.82  |         |Q        V         |         |
16+ 5       0.4713      4.22  |         |     Q   |V        |         |
16+10       0.5199      7.06  |         |         |   V   Q |         |
16+15       0.5808      8.84  |         |         |     V   |    Q    |
16+20       0.6273      6.76  |         |         |      QV |         |
16+25       0.6540      3.87  |         |    Q    |         V         |
16+30       0.6700      2.32  |        Q|         |         V         |
16+35       0.6811      1.61  |     Q   |         |         |V        |
16+40       0.6901      1.32  |    Q    |         |         |V        |
16+45       0.6976      1.08  |   Q     |         |         | V       |
16+50       0.7040      0.94  |  Q      |         |         | V       |
16+55       0.7098      0.83  |  Q      |         |         | V       |
17+ 0       0.7149      0.75  | Q       |         |         |  V      |
17+ 5       0.7197      0.69  | Q       |         |         |  V      |
17+10       0.7242      0.65  | Q       |         |         |  V      |
17+15       0.7285      0.63  | Q       |         |         |  V      |
17+20       0.7326      0.60  | Q       |         |         |  V      |
17+25       0.7366      0.58  | Q       |         |         |   V     |
17+30       0.7405      0.56  | Q       |         |         |   V     |
17+35       0.7442      0.54  | Q       |         |         |   V     |
17+40       0.7478      0.52  | Q       |         |         |   V     |
17+45       0.7512      0.51  | Q       |         |         |   V     |
17+50       0.7546      0.49  |Q        |         |         |   V     |
17+55       0.7579      0.48  |Q        |         |         |   V     |
18+ 0       0.7611      0.47  |Q        |         |         |    V    |
18+ 5       0.7643      0.45  |Q        |         |         |    V    |
18+10       0.7672      0.42  |Q        |         |         |    V    |
18+15       0.7697      0.37  |Q        |         |         |    V    |
18+20       0.7720      0.34  |Q        |         |         |    V    |
18+25       0.7742      0.32  |Q        |         |         |    V    |
18+30       0.7763      0.31  |Q        |         |         |    V    |
18+35       0.7784      0.30  |Q        |         |         |    V    |
18+40       0.7804      0.29  |Q        |         |         |     V   |

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U n i t   H y d r o g r a p h   A n a l y s i s

Study date 12/04/14 File Name LEBARD2A3A4A100Y.out

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Orange County Unit Hydrograph Hydrology Method
Manual Date(s) - October 1986, November 1996

Program License Serial Number 6201

LEBARD 2A-3A-4A HYDROGRAPH 100Y

Storm Event Year = 100

Antecedent Moisture Condition = 3

English (in-lb) Input Units Used
++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	Area (Ac.)	Area Fraction	Soil Group	Fp (In/Hr)	Ap (dec.)	Fm (In/Hr)
75.0	3.8	1.00	D	0.200	0.850	0.170

Area-averaged adjusted loss rate Fm (In/Hr) = 0.170

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC3)	S	Pervious Yield Fr
3.19	0.850	75.0	91.0	0.99	0.816
0.56	0.150	98.0	98.0	0.20	0.958

Area-averaged catchment yield fraction, Y = 0.837
Area-averaged low loss fraction, Yb = 0.163
++
User entry of time of concentration = 0.225 (hours)
Watershed area = 3.75(Ac.)
Catchment Lag time = 0.180 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 46.2963
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.170(In/Hr)
Average low loss rate fraction (Yb) = 0.163 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.520(In)
Computed peak 30-minute rainfall = 1.090(In)
Specified peak 1-hour rainfall = 1.450(In)
Computed peak 3-hour rainfall = 2.430(In)

```
      Specified peak 6-hour rainfall =  3.360(In)
      Specified peak 24-hour rainfall =  5.630(In)


      Rainfall depth area reduction factors:
      Using a total area of       3.38(Ac.) (Ref: fig. E-4)

      5-minute factor = 1.000     Adjusted rainfall =  0.520(In)
      30-minute factor = 1.000    Adjusted rainfall =  1.090(In)
      1-hour factor = 1.000       Adjusted rainfall =  1.450(In)
      3-hour factor = 1.000       Adjusted rainfall =  2.430(In)
      6-hour factor = 1.000       Adjusted rainfall =  3.360(In)
      24-hour factor = 1.000  Adjusted rainfall =  5.630(In)
      ---------------------------------------------------------------------


      +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - 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   5   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0      10.0      15.0      20.0
-----------------------------------------------------------------------
 13+10       0.4666      0.95  |Q        | V       |         |         |
 13+15       0.4732      0.96  |Q        | V       |         |         |
 13+20       0.4800      0.98  |Q        | V       |         |         |
 13+25       0.4868      0.99  |Q        | V       |         |         |
 13+30       0.4938      1.01  | Q       |  V      |         |         |
 13+35       0.5009      1.03  | Q       |  V      |         |         |
 13+40       0.5081      1.04  | Q       |  V      |         |         |
 13+45       0.5154      1.06  | Q       |  V      |         |         |
 13+50       0.5228      1.08  | Q       |  V      |         |         |
 13+55       0.5304      1.10  | Q       |   V     |         |         |
 14+ 0       0.5382      1.12  | Q       |   V     |         |         |
 14+ 5       0.5461      1.15  | Q       |   V     |         |         |
 14+10       0.5541      1.17  | Q       |   V     |         |         |
 14+15       0.5624      1.20  | Q       |   V     |         |         |
 14+20       0.5709      1.23  | Q       |    V    |         |         |
 14+25       0.5796      1.26  | Q       |    V    |         |         |
 14+30       0.5885      1.29  | Q       |    V    |         |         |
 14+35       0.5976      1.33  | Q       |    V    |         |         |
 14+40       0.6070      1.36  | Q       |     V   |         |         |
 14+45       0.6166      1.40  | Q       |     V   |         |         |
 14+50       0.6266      1.44  | Q       |     V   |         |         |
 14+55       0.6368      1.49  | Q       |     V   |         |         |
 15+ 0       0.6475      1.54  |  Q      |      V  |         |         |
 15+ 5       0.6585      1.60  |  Q      |      V  |         |         |
 15+10       0.6700      1.67  |  Q      |      V  |         |         |
 15+15       0.6819      1.74  |  Q      |       V |         |         |
 15+20       0.6945      1.82  |  Q      |       V |         |         |
 15+25       0.7076      1.91  |  Q      |       V |         |         |
 15+30       0.7211      1.96  |  Q      |        V|         |         |
 15+35       0.7348      1.99  |  Q      |        V|         |         |
 15+40       0.7492      2.09  |   Q     |        V|         |         |
 15+45       0.7648      2.27  |   Q     |         V         |         |
 15+50       0.7822      2.53  |    Q    |         V         |         |
 15+55       0.8025      2.94  |    Q    |         |V        |         |
 16+ 0       0.8279      3.68  |      Q  |         | V       |         |
 16+ 5       0.8660      5.53  |         |Q        |  V      |         |
 16+10       0.9310      9.45  |         |       Q |   V     |         |
 16+15       1.0118     11.73  |         |         |  Q  V   |         |
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   16+20       1.0702      8.48  |         |     Q   |       V |         |
   16+25       1.1039      4.89  |        Q|         |        V|         |
   16+30       1.1253      3.10  |     Q   |         |        V|         |
   16+35       1.1418      2.39  |   Q     |         |         V         |
   16+40       1.1564      2.12  |   Q     |         |         V         |
   16+45       1.1687      1.79  |  Q      |         |         |V        |
   16+50       1.1800      1.64  |  Q      |         |         |V        |
   16+55       1.1905      1.52  |  Q      |         |         |V        |
   17+ 0       1.2003      1.43  | Q       |         |         |V        |
   17+ 5       1.2096      1.35  | Q       |         |         | V       |
   17+10       1.2184      1.27  | Q       |         |         | V       |
   17+15       1.2267      1.21  | Q       |         |         | V       |
   17+20       1.2347      1.16  | Q       |         |         | V       |
   17+25       1.2424      1.11  | Q       |         |         |  V      |
   17+30       1.2498      1.07  | Q       |         |         |  V      |
   17+35       1.2569      1.04  | Q       |         |         |  V      |
   17+40       1.2638      1.00  | Q       |         |         |  V      |
   17+45       1.2705      0.97  |Q        |         |         |  V      |
   17+50       1.2770      0.94  |Q        |         |         |   V     |
   17+55       1.2833      0.92  |Q        |         |         |   V     |
   18+ 0       1.2895      0.89  |Q        |         |         |   V     |
   18+ 5       1.2954      0.86  |Q        |         |         |   V     |
   18+10       1.3010      0.81  |Q        |         |         |   V     |
   18+15       1.3060      0.73  |Q        |         |         |   V     |
   18+20       1.3106      0.67  |Q        |         |         |   V     |
   18+25       1.3150      0.64  |Q        |         |         |    V    |
   18+30       1.3192      0.62  |Q        |         |         |    V    |
   18+35       1.3234      0.60  |Q        |         |         |    V    |
   18+40       1.3274      0.59  |Q        |         |         |    V    |
   18+45       1.3314      0.58  |Q        |         |         |    V    |
   18+50       1.3353      0.56  |Q        |         |         |    V    |

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

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 12/04/14 File Name LEBARD5A2Y.out

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Orange County Unit Hydrograph Hydrology Method
Manual Date(s) - October 1986, November 1996

Program License Serial Number 6201

LEBARD AREA 5A HYDROGRAPH 2 YEAR

Storm Event Year = 2

Antecedent Moisture Condition = 1

English (in-lb) Input Units Used
++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	Area (Ac.)	Area Fraction	Soil Group	Fp (In/Hr)	Ap (dec.)	Fm (In/Hr)
75.0	3.9	1.00	D	0.200	0.850	0.170

Area-averaged adjusted loss rate Fm (In/Hr) = 0.170

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC1)	S	Pervious Yield Fr
3.34	0.850	75.0	57.0	7.54	0.018
0.59	0.150	98.0	98.0	0.20	0.890

Area-averaged catchment yield fraction, Y = 0.148
Area-averaged low loss fraction, Yb = 0.852
++
User entry of time of concentration = 0.296 (hours)
Watershed area = 3.93(Ac.)
Catchment Lag time = 0.237 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 35.1914
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.170(In/Hr)
Average low loss rate fraction (Yb) = 0.852 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.190(In)
Computed peak 30-minute rainfall = 0.400(In)
Specified peak 1-hour rainfall = 0.530(In)
Computed peak 3-hour rainfall = 0.890(In)

```
Specified peak 6-hour rainfall =  1.220(In)
Specified peak 24-hour rainfall =  2.050(In)


Rainfall depth area reduction factors:
Using a total area of       3.93(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000     Adjusted rainfall =  0.190(In)
30-minute factor = 1.000    Adjusted rainfall =  0.400(In)
1-hour factor = 1.000       Adjusted rainfall =  0.530(In)
3-hour factor = 1.000       Adjusted rainfall =  0.890(In)
6-hour factor = 1.000       Adjusted rainfall =  1.220(In)
24-hour factor = 1.000  Adjusted rainfall =  2.050(In)
---------------------------------------------------------------------


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                     24 - 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   5   Minute intervals ((CFS))

--------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0       2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
 12+35       0.0282      0.06  Q    V    |         |         |         |
 12+40       0.0286      0.06  Q    V    |         |         |         |
 12+45       0.0290      0.06  Q    V    |         |         |         |
 12+50       0.0294      0.06  Q     V   |         |         |         |
 12+55       0.0298      0.06  Q     V   |         |         |         |
 13+ 0       0.0302      0.06  Q     V   |         |         |         |
 13+ 5       0.0307      0.06  Q     V   |         |         |         |
 13+10       0.0311      0.06  Q     V   |         |         |         |
 13+15       0.0315      0.06  Q     V   |         |         |         |
 13+20       0.0320      0.06  Q     V   |         |         |         |
 13+25       0.0324      0.06  Q     V   |         |         |         |
 13+30       0.0329      0.07  Q     V   |         |         |         |
 13+35       0.0333      0.07  Q     V   |         |         |         |
 13+40       0.0338      0.07  Q     V   |         |         |         |
 13+45       0.0343      0.07  Q      V  |         |         |         |
 13+50       0.0347      0.07  Q      V  |         |         |         |
 13+55       0.0352      0.07  Q      V  |         |         |         |
 14+ 0       0.0357      0.07  Q      V  |         |         |         |
 14+ 5       0.0363      0.07  Q      V  |         |         |         |
 14+10       0.0368      0.08  Q      V  |         |         |         |
 14+15       0.0373      0.08  Q      V  |         |         |         |
 14+20       0.0379      0.08  Q      V  |         |         |         |
 14+25       0.0385      0.08  Q      V  |         |         |         |
 14+30       0.0391      0.09  Q       V |         |         |         |
 14+35       0.0397      0.09  Q       V |         |         |         |
 14+40       0.0403      0.09  Q       V |         |         |         |
 14+45       0.0409      0.09  Q       V |         |         |         |
 14+50       0.0416      0.10  Q       V |         |         |         |
 14+55       0.0423      0.10  Q       V |         |         |         |
 15+ 0       0.0430      0.10  Q       V |         |         |         |
 15+ 5       0.0437      0.11  Q        V|         |         |         |
 15+10       0.0445      0.11  Q        V|         |         |         |
 15+15       0.0454      0.13  Q        V|         |         |         |
 15+20       0.0464      0.15  Q        V|         |         |         |
 15+25       0.0476      0.18  Q        V|         |         |         |
 15+30       0.0490      0.20  Q         V         |         |         |
 15+35       0.0506      0.22  Q         V         |         |         |
 15+40       0.0523      0.25  Q         V         |         |         |
```

```
   15+45       0.0544      0.30  |Q        |V        |         |         |
   15+50       0.0572      0.40  |Q        |V        |         |         |
   15+55       0.0610      0.55  | Q       |  V      |         |         |
   16+ 0       0.0665      0.80  |  Q      |   V     |         |         |
   16+ 5       0.0755      1.31  |    Q    |     V   |         |         |
   16+10       0.0916      2.34  |        Q|       V |         |         |
   16+15       0.1138      3.22  |         | Q       |  V      |         |
   16+20       0.1369      3.35  |         |  Q      |       V |         |
   16+25       0.1520      2.20  |       Q |         |         |V        |
   16+30       0.1607      1.27  |    Q    |         |         |  V      |
   16+35       0.1658      0.73  | Q       |         |         |   V     |
   16+40       0.1686      0.41  |Q        |         |         |   V     |
   16+45       0.1704      0.27  |Q        |         |         |    V    |
   16+50       0.1717      0.18  Q         |         |         |    V    |
   16+55       0.1726      0.13  Q         |         |         |    V    |
   17+ 0       0.1733      0.11  Q         |         |         |    V    |
   17+ 5       0.1740      0.10  Q         |         |         |    V    |
   17+10       0.1746      0.09  Q         |         |         |    V    |
   17+15       0.1752      0.08  Q         |         |         |     V   |
   17+20       0.1757      0.08  Q         |         |         |     V   |
   17+25       0.1763      0.08  Q         |         |         |     V   |
   17+30       0.1768      0.07  Q         |         |         |     V   |
   17+35       0.1773      0.07  Q         |         |         |     V   |
   17+40       0.1777      0.07  Q         |         |         |     V   |
   17+45       0.1782      0.07  Q         |         |         |     V   |
   17+50       0.1786      0.06  Q         |         |         |     V   |
   17+55       0.1790      0.06  Q         |         |         |     V   |
   18+ 0       0.1794      0.06  Q         |         |         |     V   |
   18+ 5       0.1798      0.06  Q         |         |         |      V  |
   18+10       0.1802      0.06  Q         |         |         |      V  |
   18+15       0.1806      0.05  Q         |         |         |      V  |
   18+20       0.1809      0.05  Q         |         |         |      V  |
   18+25       0.1812      0.04  Q         |         |         |      V  |
   18+30       0.1815      0.04  Q         |         |         |      V  |
   18+35       0.1818      0.04  Q         |         |         |      V  |
   18+40       0.1821      0.04  Q         |         |         |      V  |
   18+45       0.1823      0.04  Q         |         |         |      V  |
-----------------------------------------------------------------------
```

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 12/04/14   File Name LEBARD5A10Y.out

++

Orange County Unit Hydrograph Hydrology Method
Manual Date(s) - October 1986, November 1996

Program License Serial Number 6201

LEBARD AREA 5A HYDROGRAPH 10 YEAR

Storm Event Year = 10

Antecedent Moisture Condition = 2

English (in-lb) Input Units Used
++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	Area (Ac.)	Area Fraction	Soil Group	Fp (In/Hr)	Ap (dec.)	Fm (In/Hr)
75.0	3.9	1.00	D	0.200	0.850	0.170

Area-averaged adjusted loss rate Fm (In/Hr) = 0.170

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC2)	S	Pervious Yield Fr
3.34	0.850	75.0	75.0	3.33	0.389
0.59	0.150	98.0	98.0	0.20	0.936

Area-averaged catchment yield fraction, Y = 0.471
Area-averaged low loss fraction, Yb = 0.529
++
User entry of time of concentration =   0.296 (hours)
Watershed area =   3.93(Ac.)
Catchment Lag time =   0.237 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 35.1914
Hydrograph baseflow =   0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.170(In/Hr)
Average low loss rate fraction (Yb) = 0.529 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.340(In)
Computed peak 30-minute rainfall = 0.720(In)
Specified peak 1-hour rainfall = 0.950(In)
Computed peak 3-hour rainfall = 1.590(In)

```
      Specified peak 6-hour rainfall =  2.200(In)
      Specified peak 24-hour rainfall =  3.680(In)


      Rainfall depth area reduction factors:
      Using a total area of       3.93(Ac.) (Ref: fig. E-4)

      5-minute factor = 1.000     Adjusted rainfall =  0.340(In)
      30-minute factor = 1.000    Adjusted rainfall =  0.720(In)
      1-hour factor = 1.000       Adjusted rainfall =  0.950(In)
      3-hour factor = 1.000       Adjusted rainfall =  1.590(In)
      6-hour factor = 1.000       Adjusted rainfall =  2.200(In)
      24-hour factor = 1.000  Adjusted rainfall =  3.680(In)
      ---------------------------------------------------------------------

      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                    24 - 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   5   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------

 12+20       0.1534      0.30  |Q       V|         |         |         |
 12+25       0.1556      0.31  |Q       V|         |         |         |
 12+30       0.1578      0.32  |Q       V|         |         |         |
 12+35       0.1600      0.33  |Q       V|         |         |         |
 12+40       0.1623      0.33  |Q       V|         |         |         |
 12+45       0.1647      0.34  |Q       V|         |         |         |
 12+50       0.1670      0.34  |Q       V|         |         |         |
 12+55       0.1694      0.35  |Q       V|         |         |         |
 13+ 0       0.1719      0.35  |Q        V         |         |         |
 13+ 5       0.1743      0.36  |Q        V         |         |         |
 13+10       0.1768      0.36  |Q        V         |         |         |
 13+15       0.1794      0.37  |Q        V         |         |         |
 13+20       0.1819      0.37  |Q        V         |         |         |
 13+25       0.1845      0.38  |Q        V         |         |         |
 13+30       0.1872      0.38  |Q        |V        |         |         |
 13+35       0.1899      0.39  |Q        |V        |         |         |
 13+40       0.1926      0.40  |Q        |V        |         |         |
 13+45       0.1954      0.40  |Q        |V        |         |         |
 13+50       0.1982      0.41  |Q        |V        |         |         |
 13+55       0.2011      0.42  |Q        |V        |         |         |
 14+ 0       0.2040      0.43  |Q        |V        |         |         |
 14+ 5       0.2070      0.44  |Q        | V       |         |         |
 14+10       0.2101      0.44  |Q        | V       |         |         |
 14+15       0.2132      0.45  |Q        | V       |         |         |
 14+20       0.2164      0.46  |Q        | V       |         |         |
 14+25       0.2197      0.47  |Q        | V       |         |         |
 14+30       0.2230      0.49  |Q        |  V      |         |         |
 14+35       0.2265      0.50  |Q        |  V      |         |         |
 14+40       0.2300      0.51  | Q       |  V      |         |         |
 14+45       0.2336      0.53  | Q       |  V      |         |         |
 14+50       0.2373      0.54  | Q       |  V      |         |         |
 14+55       0.2412      0.56  | Q       |   V     |         |         |
 15+ 0       0.2452      0.58  | Q       |   V     |         |         |
 15+ 5       0.2494      0.61  | Q       |   V     |         |         |
 15+10       0.2540      0.66  | Q       |   V     |         |         |
 15+15       0.2588      0.71  | Q       |    V    |         |         |
 15+20       0.2641      0.77  |  Q      |    V    |         |         |
 15+25       0.2699      0.83  |  Q      |    V    |         |         |
```

```
   15+30       0.2759      0.88  |  Q      |     V   |         |         |
   15+35       0.2822      0.91  |  Q      |     V   |         |         |
   15+40       0.2888      0.96  |  Q      |     V   |         |         |
   15+45       0.2961      1.06  |   Q     |      V  |         |         |
   15+50       0.3046      1.24  |   Q     |      V  |         |         |
   15+55       0.3151      1.52  |     Q   |       V |         |         |
   16+ 0       0.3287      1.97  |      Q  |        V|         |         |
   16+ 5       0.3487      2.91  |         |Q        V         |         |
   16+10       0.3814      4.75  |         |       Q | V       |         |
   16+15       0.4249      6.32  |         |         |   VQ    |         |
   16+20       0.4700      6.55  |         |         |     QV  |         |
   16+25       0.5008      4.47  |         |      Q  |        V|         |
   16+30       0.5200      2.79  |         |Q        |         V         |
   16+35       0.5326      1.82  |      Q  |         |         |V        |
   16+40       0.5412      1.25  |   Q     |         |         |V        |
   16+45       0.5480      0.99  |  Q      |         |         | V       |
   16+50       0.5535      0.80  |  Q      |         |         | V       |
   16+55       0.5581      0.66  | Q       |         |         | V       |
   17+ 0       0.5622      0.59  | Q       |         |         |  V      |
   17+ 5       0.5659      0.55  | Q       |         |         |  V      |
   17+10       0.5695      0.51  | Q       |         |         |  V      |
   17+15       0.5728      0.48  |Q        |         |         |  V      |
   17+20       0.5760      0.46  |Q        |         |         |  V      |
   17+25       0.5790      0.44  |Q        |         |         |   V     |
   17+30       0.5819      0.42  |Q        |         |         |   V     |
   17+35       0.5847      0.41  |Q        |         |         |   V     |
   17+40       0.5874      0.39  |Q        |         |         |   V     |
   17+45       0.5901      0.38  |Q        |         |         |   V     |
   17+50       0.5926      0.37  |Q        |         |         |   V     |
   17+55       0.5951      0.36  |Q        |         |         |   V     |
   18+ 0       0.5975      0.35  |Q        |         |         |    V    |
   18+ 5       0.5999      0.34  |Q        |         |         |    V    |
   18+10       0.6021      0.32  |Q        |         |         |    V    |
   18+15       0.6041      0.30  |Q        |         |         |    V    |
   18+20       0.6060      0.27  |Q        |         |         |    V    |
   18+25       0.6078      0.25  |Q        |         |         |    V    |
   18+30       0.6094      0.24  Q         |         |         |    V    |
   18+35       0.6111      0.24  Q         |         |         |    V    |
   18+40       0.6126      0.23  Q         |         |         |     V   |
   18+45       0.6142      0.22  Q         |         |         |     V   |
   18+50       0.6157      0.22  Q         |         |         |     V   |
   18+55       0.6172      0.21  Q         |         |         |     V   |
   19+ 0       0.6186      0.21  Q         |         |         |     V   |

-----------------------------------------------------------------------
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U n i t   H y d r o g r a p h   A n a l y s i s

Study date 12/04/14 File Name LEBARD5A25Y.out

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Orange County Unit Hydrograph Hydrology Method
Manual Date(s) - October 1986, November 1996

Program License Serial Number 6201

LEBARD AREA 5A HYDROGRAPH 25Y

Storm Event Year = 25

Antecedent Moisture Condition = 2

English (in-lb) Input Units Used
++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	Area (Ac.)	Area Fraction	Soil Group	Fp (In/Hr)	Ap (dec.)	Fm (In/Hr)
75.0	3.9	1.00	D	0.200	0.850	0.170

Area-averaged adjusted loss rate Fm (In/Hr) = 0.170

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC2)	S	Pervious Yield Fr
3.34	0.850	75.0	75.0	3.33	0.455
0.59	0.150	98.0	98.0	0.20	0.947

Area-averaged catchment yield fraction, Y = 0.529
Area-averaged low loss fraction, Yb = 0.471
++
User entry of time of concentration = 0.296 (hours)
Watershed area = 3.93(Ac.)
Catchment Lag time = 0.237 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 35.1914
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.170(In/Hr)
Average low loss rate fraction (Yb) = 0.471 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.400(In)
Computed peak 30-minute rainfall = 0.870(In)
Specified peak 1-hour rainfall = 1.150(In)
Computed peak 3-hour rainfall = 1.940(In)

```
      Specified peak 6-hour rainfall =  2.710(In)
      Specified peak 24-hour rainfall =  4.490(In)


      Rainfall depth area reduction factors:
      Using a total area of       3.93(Ac.) (Ref: fig. E-4)

      5-minute factor = 1.000     Adjusted rainfall =  0.400(In)
      30-minute factor = 1.000    Adjusted rainfall =  0.870(In)
      1-hour factor = 1.000       Adjusted rainfall =  1.150(In)
      3-hour factor = 1.000       Adjusted rainfall =  1.940(In)
      6-hour factor = 1.000       Adjusted rainfall =  2.710(In)
      24-hour factor = 1.000  Adjusted rainfall =  4.490(In)
      ---------------------------------------------------------------------

      +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - 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   5   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------

 12+20       0.2074      0.42  |Q       V|         |         |         |
 12+25       0.2104      0.44  |Q       V|         |         |         |
 12+30       0.2136      0.46  |Q       V|         |         |         |
 12+35       0.2168      0.47  |Q       V|         |         |         |
 12+40       0.2201      0.48  |Q       V|         |         |         |
 12+45       0.2234      0.48  |Q       V|         |         |         |
 12+50       0.2267      0.49  |Q       V|         |         |         |
 12+55       0.2301      0.49  |Q        V         |         |         |
 13+ 0       0.2336      0.50  | Q       V         |         |         |
 13+ 5       0.2371      0.51  | Q       V         |         |         |
 13+10       0.2406      0.51  | Q       V         |         |         |
 13+15       0.2442      0.52  | Q       V         |         |         |
 13+20       0.2479      0.53  | Q       V         |         |         |
 13+25       0.2516      0.54  | Q       |V        |         |         |
 13+30       0.2553      0.54  | Q       |V        |         |         |
 13+35       0.2591      0.55  | Q       |V        |         |         |
 13+40       0.2630      0.56  | Q       |V        |         |         |
 13+45       0.2669      0.57  | Q       |V        |         |         |
 13+50       0.2709      0.58  | Q       |V        |         |         |
 13+55       0.2750      0.59  | Q       | V       |         |         |
 14+ 0       0.2792      0.60  | Q       | V       |         |         |
 14+ 5       0.2834      0.61  | Q       | V       |         |         |
 14+10       0.2877      0.63  | Q       | V       |         |         |
 14+15       0.2921      0.64  | Q       | V       |         |         |
 14+20       0.2965      0.65  | Q       |  V      |         |         |
 14+25       0.3011      0.66  | Q       |  V      |         |         |
 14+30       0.3058      0.68  | Q       |  V      |         |         |
 14+35       0.3105      0.69  | Q       |  V      |         |         |
 14+40       0.3154      0.71  | Q       |  V      |         |         |
 14+45       0.3205      0.73  | Q       |   V     |         |         |
 14+50       0.3257      0.76  |  Q      |   V     |         |         |
 14+55       0.3313      0.80  |  Q      |   V     |         |         |
 15+ 0       0.3371      0.85  |  Q      |   V     |         |         |
 15+ 5       0.3433      0.90  |  Q      |    V    |         |         |
 15+10       0.3499      0.96  |  Q      |    V    |         |         |
 15+15       0.3570      1.03  |   Q     |    V    |         |         |
 15+20       0.3646      1.10  |   Q     |     V   |         |         |
 15+25       0.3727      1.18  |   Q     |     V   |         |         |
```

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   15+30       0.3812      1.24  |   Q     |     V   |         |         |
   15+35       0.3900      1.27  |    Q    |      V  |         |         |
   15+40       0.3990      1.32  |    Q    |      V  |         |         |
   15+45       0.4089      1.44  |    Q    |       V |         |         |
   15+50       0.4204      1.67  |     Q   |       V |         |         |
   15+55       0.4344      2.02  |       Q |        V|         |         |
   16+ 0       0.4523      2.60  |         Q        V|         |         |
   16+ 5       0.4779      3.73  |         |   Q     |V        |         |
   16+10       0.5185      5.90  |         |         | VQ      |         |
   16+15       0.5718      7.73  |         |         |    V    Q         |
   16+20       0.6266      7.96  |         |         |      V  |Q        |
   16+25       0.6645      5.51  |         |         | Q      V|         |
   16+30       0.6887      3.51  |         |   Q     |         V         |
   16+35       0.7049      2.36  |        Q|         |         |V        |
   16+40       0.7164      1.67  |     Q   |         |         |V        |
   16+45       0.7258      1.36  |    Q    |         |         |V        |
   16+50       0.7336      1.14  |   Q     |         |         | V       |
   16+55       0.7402      0.95  |  Q      |         |         | V       |
   17+ 0       0.7460      0.85  |  Q      |         |         | V       |
   17+ 5       0.7513      0.77  |  Q      |         |         |  V      |
   17+10       0.7562      0.72  | Q       |         |         |  V      |
   17+15       0.7609      0.68  | Q       |         |         |  V      |
   17+20       0.7654      0.65  | Q       |         |         |  V      |
   17+25       0.7697      0.62  | Q       |         |         |  V      |
   17+30       0.7738      0.60  | Q       |         |         |   V     |
   17+35       0.7778      0.58  | Q       |         |         |   V     |
   17+40       0.7816      0.56  | Q       |         |         |   V     |
   17+45       0.7853      0.54  | Q       |         |         |   V     |
   17+50       0.7889      0.53  | Q       |         |         |   V     |
   17+55       0.7925      0.51  | Q       |         |         |   V     |
   18+ 0       0.7959      0.50  |Q        |         |         |    V    |
   18+ 5       0.7992      0.48  |Q        |         |         |    V    |
   18+10       0.8024      0.46  |Q        |         |         |    V    |
   18+15       0.8052      0.42  |Q        |         |         |    V    |
   18+20       0.8078      0.38  |Q        |         |         |    V    |
   18+25       0.8102      0.35  |Q        |         |         |    V    |
   18+30       0.8125      0.33  |Q        |         |         |    V    |
   18+35       0.8147      0.32  |Q        |         |         |    V    |
   18+40       0.8169      0.31  |Q        |         |         |    V    |
   18+45       0.8190      0.30  |Q        |         |         |     V   |
   18+50       0.8210      0.30  |Q        |         |         |     V   |
   18+55       0.8230      0.29  |Q        |         |         |     V   |
   19+ 0       0.8250      0.28  |Q        |         |         |     V   |
   19+ 5       0.8269      0.28  |Q        |         |         |     V   |

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

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 12/04/14 File Name LEBARD5A100Y.out

++

Orange County Unit Hydrograph Hydrology Method
Manual Date(s) - October 1986, November 1996

Program License Serial Number 6201

LEBARD AREA 5A HYDROGRAPH 100Y

Storm Event Year = 100

Antecedent Moisture Condition = 3

English (in-lb) Input Units Used
+++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	Area (Ac.)	Area Fraction	Soil Group	Fp (In/Hr)	Ap (dec.)	Fm (In/Hr)
75.0	3.9	1.00	D	0.200	0.850	0.170

Area-averaged adjusted loss rate Fm (In/Hr) = 0.170

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC3)	S	Pervious Yield Fr
3.34	0.850	75.0	91.0	0.99	0.816
0.59	0.150	98.0	98.0	0.20	0.958

Area-averaged catchment yield fraction, Y = 0.837
Area-averaged low loss fraction, Yb = 0.163
+++
User entry of time of concentration = 0.296 (hours)
Watershed area = 3.93(Ac.)
Catchment Lag time = 0.237 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 35.1914
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.170(In/Hr)
Average low loss rate fraction (Yb) = 0.163 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.520(In)
Computed peak 30-minute rainfall = 1.090(In)
Specified peak 1-hour rainfall = 1.450(In)

```
      Computed peak 3-hour rainfall =  2.430(In)
      Specified peak 6-hour rainfall =  3.360(In)
      Specified peak 24-hour rainfall =  5.630(In)


      Rainfall depth area reduction factors:
      Using a total area of       3.93(Ac.) (Ref: fig. E-4)

      5-minute factor = 1.000     Adjusted rainfall =  0.520(In)
      30-minute factor = 1.000    Adjusted rainfall =  1.090(In)
      1-hour factor = 1.000       Adjusted rainfall =  1.450(In)
      3-hour factor = 1.000       Adjusted rainfall =  2.430(In)
      6-hour factor = 1.000       Adjusted rainfall =  3.360(In)
      24-hour factor = 1.000  Adjusted rainfall =  5.630(In)
      ---------------------------------------------------------------------

      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - 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   5   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0      10.0      15.0      20.0
-----------------------------------------------------------------------
 12+50       0.4554      0.93  |Q        |V        |         |         |
 12+55       0.4619      0.94  |Q        |V        |         |         |
 13+ 0       0.4684      0.96  |Q        |V        |         |         |
 13+ 5       0.4751      0.97  |Q        | V       |         |         |
 13+10       0.4819      0.98  |Q        | V       |         |         |
 13+15       0.4887      1.00  |Q        | V       |         |         |
 13+20       0.4957      1.01  | Q       | V       |         |         |
 13+25       0.5028      1.03  | Q       | V       |         |         |
 13+30       0.5099      1.04  | Q       |  V      |         |         |
 13+35       0.5172      1.06  | Q       |  V      |         |         |
 13+40       0.5247      1.08  | Q       |  V      |         |         |
 13+45       0.5322      1.10  | Q       |  V      |         |         |
 13+50       0.5399      1.11  | Q       |  V      |         |         |
 13+55       0.5477      1.14  | Q       |  V      |         |         |
 14+ 0       0.5557      1.16  | Q       |   V     |         |         |
 14+ 5       0.5638      1.18  | Q       |   V     |         |         |
 14+10       0.5721      1.21  | Q       |   V     |         |         |
 14+15       0.5806      1.23  | Q       |   V     |         |         |
 14+20       0.5893      1.26  | Q       |    V    |         |         |
 14+25       0.5982      1.29  | Q       |    V    |         |         |
 14+30       0.6073      1.32  | Q       |    V    |         |         |
 14+35       0.6167      1.36  | Q       |    V    |         |         |
 14+40       0.6263      1.39  | Q       |    V    |         |         |
 14+45       0.6361      1.43  | Q       |     V   |         |         |
 14+50       0.6463      1.48  | Q       |     V   |         |         |
 14+55       0.6568      1.52  |  Q      |     V   |         |         |
 15+ 0       0.6676      1.57  |  Q      |      V  |         |         |
 15+ 5       0.6789      1.63  |  Q      |      V  |         |         |
 15+10       0.6905      1.69  |  Q      |      V  |         |         |
 15+15       0.7027      1.76  |  Q      |      V  |         |         |
 15+20       0.7153      1.84  |  Q      |       V |         |         |
 15+25       0.7286      1.93  |  Q      |       V |         |         |
 15+30       0.7424      2.00  |  Q      |       V |         |         |
 15+35       0.7565      2.05  |   Q     |        V|         |         |
 15+40       0.7711      2.12  |   Q     |        V|         |         |
 15+45       0.7866      2.26  |   Q     |         V         |         |
 15+50       0.8037      2.48  |   Q     |         V         |         |
 15+55       0.8231      2.81  |    Q    |         |V        |         |
```

```
   16+ 0       0.8465      3.41  |     Q   |         |V        |         |
   16+ 5       0.8793      4.76  |        Q|         | V       |         |
   16+10       0.9313      7.55  |         |    Q    |  V      |         |
   16+15       0.9998      9.96  |         |        Q|    V    |         |
   16+20       1.0711     10.34  |         |         Q      V  |         |
   16+25       1.1209      7.24  |         |   Q     |       V |         |
   16+30       1.1537      4.76  |        Q|         |        V|         |
   16+35       1.1768      3.36  |     Q   |         |         V         |
   16+40       1.1942      2.51  |    Q    |         |         V         |
   16+45       1.2090      2.15  |   Q     |         |         V         |
   16+50       1.2220      1.90  |  Q      |         |         |V        |
   16+55       1.2336      1.68  |  Q      |         |         |V        |
   17+ 0       1.2444      1.56  |  Q      |         |         |V        |
   17+ 5       1.2545      1.47  | Q       |         |         | V       |
   17+10       1.2640      1.38  | Q       |         |         | V       |
   17+15       1.2731      1.31  | Q       |         |         | V       |
   17+20       1.2817      1.25  | Q       |         |         | V       |
   17+25       1.2899      1.20  | Q       |         |         | V       |
   17+30       1.2978      1.15  | Q       |         |         |  V      |
   17+35       1.3055      1.11  | Q       |         |         |  V      |
   17+40       1.3128      1.07  | Q       |         |         |  V      |
   17+45       1.3199      1.04  | Q       |         |         |  V      |
   17+50       1.3269      1.00  | Q       |         |         |  V      |
   17+55       1.3336      0.98  |Q        |         |         |   V     |
   18+ 0       1.3401      0.95  |Q        |         |         |   V     |
   18+ 5       1.3465      0.92  |Q        |         |         |   V     |
   18+10       1.3525      0.88  |Q        |         |         |   V     |
   18+15       1.3581      0.81  |Q        |         |         |   V     |
   18+20       1.3632      0.74  |Q        |         |         |   V     |
   18+25       1.3680      0.69  |Q        |         |         |   V     |
   18+30       1.3725      0.66  |Q        |         |         |    V    |
   18+35       1.3770      0.64  |Q        |         |         |    V    |
   18+40       1.3813      0.62  |Q        |         |         |    V    |
   18+45       1.3855      0.61  |Q        |         |         |    V    |
   18+50       1.3896      0.60  |Q        |         |         |    V    |
   18+55       1.3936      0.58  |Q        |         |         |    V    |
   19+ 0       1.3975      0.57  |Q        |         |         |    V    |

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

```
                FLOOD HYDROGRAPH ROUTING PROGRAM
         Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2005
                     Study date: 12/04/14

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

LEBARD HYDROGRAPH 2 YEAR

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

Program License Serial Number 6201

--------------------------------------------------------------------
********************* HYDROGRAPH INFORMATION **********************

                From study/file name: LEBARD2Y.rte
************************HYDROGRAPH DATA*************************
                Number of intervals =   296
                Time interval =    5.0 (Min.)
                Maximum/Peak flow rate =        3.408 (CFS)
                Total volume =       0.357 (Ac.Ft)
        Status of hydrographs being held in storage
                   Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
        Peak (CFS)      0.000     0.000     0.000     0.000     0.000
        Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
*******************************************************************

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** RETARDING BASIN ROUTING ****
______________________________________________________________________

User entry of depth-outflow-storage data
--------------------------------------------------------------------
Total number of inflow hydrograph intervals = 296
Hydrograph time unit =  5.000 (Min.)
Initial depth in storage basin =   0.00(Ft.)
--------------------------------------------------------------------
--------------------------------------------------------------------
Initial basin depth =   0.00 (Ft.)
Initial basin storage =      0.00 (Ac.Ft)
Initial basin outflow =   0.00 (CFS)
---------------------------------------------------------------------
--------------------------------------------------------------------
Depth vs. Storage and Depth vs. Discharge data:
 Basin Depth  Storage    Outflow   (S-O*dt/2)   (S+O*dt/2)
     (Ft.)    (Ac.Ft)    (CFS)     (Ac.Ft)    (Ac.Ft)
---------------------------------------------------------------------
  0.000      0.000      0.000      0.000        0.000
  0.200      0.037      0.400      0.036        0.038
  0.400      0.074      0.800      0.071        0.077
  0.600      0.111      1.600      0.105        0.117
  0.800      0.148      2.200      0.140        0.156
  1.000      0.185      2.600      0.176        0.194
  1.200      0.222      2.900      0.212        0.232
```

```
         1.400      0.259      3.300      0.248        0.270
         1.600      0.296      3.600      0.284        0.308
         1.800      0.333      3.800      0.320        0.346
       -------------------------------------------------------------------
                       Hydrograph Detention Basin Routing
       --------------------------------------------------------------------

       Graph values: 'I'= unit inflow; 'O'=outflow at time shown
       --------------------------------------------------------------------
13.500    0.21    0.17      0.016  |O      |       |       |       |     0.08
13.583    0.21    0.17      0.016  |O      |       |       |       |     0.09
13.667    0.22    0.17      0.016  |OI     |       |       |       |     0.09
13.750    0.22    0.18      0.016  |OI     |       |       |       |     0.09
13.833    0.22    0.18      0.017  |OI     |       |       |       |     0.09
13.917    0.23    0.18      0.017  |OI     |       |       |       |     0.09
14.000    0.23    0.19      0.017  |OI     |       |       |       |     0.09
14.083    0.24    0.19      0.018  |OI     |       |       |       |     0.10
14.167    0.24    0.19      0.018  |OI     |       |       |       |     0.10
14.250    0.25    0.20      0.018  |OI     |       |       |       |     0.10
14.333    0.26    0.20      0.019  |OI     |       |       |       |     0.10
14.417    0.27    0.21      0.019  |OI     |       |       |       |     0.10
14.500    0.28    0.21      0.020  |OI     |       |       |       |     0.11
14.583    0.28    0.22      0.020  | O     |       |       |       |     0.11
14.667    0.29    0.22      0.021  | O     |       |       |       |     0.11
14.750    0.30    0.23      0.021  | O     |       |       |       |     0.11
14.833    0.31    0.23      0.022  | O     |       |       |       |     0.12
14.917    0.33    0.24      0.022  | OI    |       |       |       |     0.12
15.000    0.34    0.25      0.023  | OI    |       |       |       |     0.12
15.083    0.36    0.25      0.023  | OI    |       |       |       |     0.13
15.167    0.39    0.26      0.024  | OI    |       |       |       |     0.13
15.250    0.41    0.27      0.025  | OI    |       |       |       |     0.14
15.333    0.44    0.28      0.026  | O I   |       |       |       |     0.14
15.417    0.47    0.30      0.027  | O I   |       |       |       |     0.15
15.500    0.49    0.31      0.029  | O I   |       |       |       |     0.15
15.583    0.50    0.32      0.030  |  OI   |       |       |       |     0.16
15.667    0.53    0.34      0.031  |  OI   |       |       |       |     0.17
15.750    0.59    0.35      0.033  |  O I  |       |       |       |     0.18
15.833    0.68    0.37      0.034  |  O  I |       |       |       |     0.19
15.917    0.82    0.40      0.037  |  O   I|       |       |       |     0.20
16.000    1.06    0.44      0.041  |   O   |I      |       |       |     0.22
16.083    1.58    0.50      0.046  |   O   |     I |       |       |     0.25
16.167    2.67    0.62      0.057  |    O  |       |       |I      |     0.31
16.250    3.41    0.79      0.073  |      O|       |       |       I     0.40
16.333    2.76    1.10      0.088  |       | O     |       |I      |     0.48
16.417    1.61    1.25      0.095  |       |  O   I|       |       |     0.51
16.500    0.99    1.26      0.095  |       |I O    |       |       |     0.51
16.583    0.68    1.20      0.092  |     I |  O    |       |       |     0.50
16.667    0.57    1.12      0.089  |    I  | O     |       |       |     0.48
16.750    0.47    1.04      0.085  |   I   |O      |       |       |     0.46
16.833    0.39    0.95      0.081  |  I    O       |       |       |     0.44
16.917    0.35    0.87      0.077  |  I    O       |       |       |     0.42
17.000    0.32    0.80      0.074  | I    O|       |       |       |     0.40
17.083    0.29    0.76      0.071  | I    O|       |       |       |     0.38
17.167    0.28    0.73      0.067  | I   O |       |       |       |     0.36
17.250    0.26    0.70      0.064  | I   O |       |       |       |     0.35
17.333    0.25    0.66      0.061  | I   O |       |       |       |     0.33
17.417    0.23    0.63      0.059  | I  O  |       |       |       |     0.32
17.500    0.22    0.60      0.056  | I  O  |       |       |       |     0.30
17.583    0.22    0.58      0.053  | I  O  |       |       |       |     0.29
17.667    0.21    0.55      0.051  |I   O  |       |       |       |     0.28
17.750    0.20    0.53      0.049  |I  O   |       |       |       |     0.26
17.833    0.20    0.50      0.046  |I  O   |       |       |       |     0.25
17.917    0.19    0.48      0.044  |I  O   |       |       |       |     0.24
```

```
18.000    0.19    0.46      0.042  |I  O    |       |       |       |      0.23
18.083    0.18    0.44      0.041  |I  O    |       |       |       |      0.22
18.167    0.17    0.42      0.039  |I O     |       |       |       |      0.21
18.250    0.16    0.40      0.037  |I O     |       |       |       |      0.20
18.333    0.14    0.38      0.036  |I O     |       |       |       |      0.19
18.417    0.14    0.37      0.034  |I O     |       |       |       |      0.18
18.500    0.13    0.35      0.032  |I O     |       |       |       |      0.17
18.583    0.13    0.33      0.031  |I O     |       |       |       |      0.17
18.667    0.13    0.32      0.030  |IO      |       |       |       |      0.16
18.750    0.12    0.31      0.028  |IO      |       |       |       |      0.15
18.833    0.12    0.29      0.027  |IO      |       |       |       |      0.15
18.917    0.12    0.28      0.026  |IO      |       |       |       |      0.14
19.000    0.12    0.27      0.025  |IO      |       |       |       |      0.13
19.083    0.11    0.26      0.024  |IO      |       |       |       |      0.13
19.167    0.11    0.25      0.023  |IO      |       |       |       |      0.12
19.250    0.11    0.24      0.022  |IO      |       |       |       |      0.12
19.333    0.11    0.23      0.021  |IO      |       |       |       |      0.11
19.417    0.11    0.22      0.020  I O      |       |       |       |      0.11
19.500    0.10    0.21      0.020  IO       |       |       |       |      0.11

       ****************************HYDROGRAPH DATA****************************
                       Number of intervals =   339
                       Time interval =    5.0 (Min.)
                       Maximum/Peak flow rate =        1.258 (CFS)
                       Total volume =       0.356 (Ac.Ft)
               Status of hydrographs being held in storage
                          Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
               Peak (CFS)      0.000     0.000     0.000     0.000     0.000
               Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
       ***********************************************************************

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


       ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
       Process from Point/Station       2.000 to Point/Station       3.000
       **** STREAM ROUTING SCS CONVEX METHOD ****
       ______________________________________________________________________
       HYDROGRAPH STREAM ROUTING DATA:
       Length of stream =    180.00 (Ft.)
       Elevation difference =    0.70 (Ft.)
       Slope of channel =  0.003889 (Vert/Horiz)
       Channel type - Improved Channel


       Channel length =   180.00(Ft.)     Elevation difference =   0.70(Ft.)
       Channel evaluation using mean flow rate of hydrograph
       Channel base width  =   10.000(Ft.)
       Slope or 'Z' of left channel bank =   3.000
       Slope or 'Z' of right channel bank =   3.000
       Manning's 'N'    = 0.200
       Maximum depth of channel  =    1.000(Ft.)
       Flow(q) thru subarea =      0.170(CFS)
       Depth of flow =     0.136(Ft.)
       Average velocity =     0.119(Ft/s)
       Total flow rate =     0.170(CFS)
       Channel flow top width =   10.819(Ft.)
       Depth of flow in channel =   0.14(Ft.)
       Total number of channels (same dimensions) = 1
       Flow Velocity =    0.12(Ft/s)
       Travel time  =   25.13 min.
       Individual channel flow =    0.170(CFS)
       Total capacity of improved channels =      0.170(CFS)
```

```
Critical Depth in Channel =    0.02(Ft.)


Channel evaluation using maximum flow rate of hydrograph
Flow(q) thru subarea =      1.258(CFS)
Depth of flow =     0.446(Ft.)
Average velocity =     0.249(Ft/s)
Total flow rate =     1.258(CFS)
Channel flow top width =   12.673(Ft.)
Depth of flow in channel =   0.45(Ft.)
Total number of channels (same dimensions) = 1
Flow Velocity =    0.25(Ft/s)
Travel time  =   25.13 min.
Individual channel flow =    1.258(CFS)
Total capacity of improved channels =      1.258(CFS)
Critical Depth in Channel =    0.08(Ft.)


*********************** SCS CONVEX CHANNEL ROUTING *********************
Convex method of stream routing  data items:
Using equation: Outflow =
O(t+dt) = (1-c*)O(t+dt-dt*) + Input(c*)
          where c* = 1 - (1-c)^e and dt = c(length)/velocity
          c(v/v+1.7) =   0.1278   Travel time =  12.05 (min.)
        dt*(unit time interval) =   5.00(min.),  e=   2.4989
        dt(routing time-step) =   1.54 (min.),   c* =   0.2894

Output hydrograph delayed by 0  unit time increments


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                  P R I N T  O F  S T O R M
               R u n o f f     H y d r o g r a p h
--------------------------------------------------------------------
            Hydrograph in   5   Minute intervals (CFS)

--------------------------------------------------------------------
Time(h+m) Out = O(CFS) In = I  0        0.3       0.6       0.9       1.3
----------------------------------------------------------------------
 12+ 0       0.1158      0.12  |  O       |         |         |         |
 12+ 5       0.1169      0.12  |  O       |         |         |         |
 12+10       0.1181      0.12  |  O       |         |         |         |
 12+15       0.1196      0.12  |  O       |         |         |         |
 12+20       0.1214      0.13  |  OI      |         |         |         |
 12+25       0.1235      0.13  |  OI      |         |         |         |
 12+30       0.1259      0.13  |   O      |         |         |         |
 12+35       0.1286      0.14  |   O      |         |         |         |
 12+40       0.1314      0.14  |   O      |         |         |         |
 12+45       0.1342      0.14  |   O      |         |         |         |
 12+50       0.1372      0.15  |   O      |         |         |         |
 12+55       0.1401      0.15  |   O      |         |         |         |
 13+ 0       0.1431      0.15  |   O      |         |         |         |
 13+ 5       0.1460      0.15  |   O      |         |         |         |
 13+10       0.1490      0.16  |   O      |         |         |         |
 13+15       0.1519      0.16  |   OI     |         |         |         |
 13+20       0.1549      0.16  |   OI     |         |         |         |
 13+25       0.1578      0.17  |    O     |         |         |         |
 13+30       0.1608      0.17  |    O     |         |         |         |
 13+35       0.1637      0.17  |    O     |         |         |         |
 13+40       0.1667      0.17  |    O     |         |         |         |
 13+45       0.1697      0.18  |    O     |         |         |         |
 13+50       0.1728      0.18  |    O     |         |         |         |
 13+55       0.1759      0.18  |    O     |         |         |         |
```

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14+ 0       0.1790      0.19  |    O    |         |         |         |
14+ 5       0.1822      0.19  |    OI   |         |         |         |
14+10       0.1856      0.19  |    OI   |         |         |         |
14+15       0.1890      0.20  |     O   |         |         |         |
14+20       0.1927      0.20  |     O   |         |         |         |
14+25       0.1965      0.21  |     O   |         |         |         |
14+30       0.2006      0.21  |     O   |         |         |         |
14+35       0.2049      0.22  |     O   |         |         |         |
14+40       0.2094      0.22  |     OI  |         |         |         |
14+45       0.2141      0.23  |     OI  |         |         |         |
14+50       0.2190      0.23  |     OI  |         |         |         |
14+55       0.2242      0.24  |      O  |         |         |         |
15+ 0       0.2299      0.25  |      O  |         |         |         |
15+ 5       0.2360      0.25  |      OI |         |         |         |
15+10       0.2428      0.26  |      OI |         |         |         |
15+15       0.2504      0.27  |      OI |         |         |         |
15+20       0.2588      0.28  |       OI|         |         |         |
15+25       0.2683      0.30  |       OI|         |         |         |
15+30       0.2789      0.31  |       OI|         |         |         |
15+35       0.2902      0.32  |        OI         |         |         |
15+40       0.3022      0.34  |        OI         |         |         |
15+45       0.3152      0.35  |         OI        |         |         |
15+50       0.3299      0.37  |         OI        |         |         |
15+55       0.3476      0.40  |         |OI       |         |         |
16+ 0       0.3704      0.44  |         |O I      |         |         |
16+ 5       0.4027      0.50  |         | O  I    |         |         |
16+10       0.4546      0.62  |         |   O    I|         |         |
16+15       0.5367      0.79  |         |      O  |    I    |         |
16+20       0.6725      1.10  |         |         |O        |    I    |
16+25       0.8266      1.25  |         |         |     O   |        I|
16+30       0.9508      1.26  |         |         |         O         I
16+35       1.0278      1.20  |         |         |         | O     I |
16+40       1.0612      1.12  |         |         |         |  O I    |
16+45       1.0612      1.04  |         |         |         | IO      |
16+50       1.0370      0.95  |         |         |         I O       |
16+55       0.9963      0.87  |         |         |      I  |O        |
17+ 0       0.9455      0.80  |         |         |    I    O         |
17+ 5       0.8959      0.76  |         |         |   I   O |         |
17+10       0.8505      0.73  |         |         |  I   O  |         |
17+15       0.8087      0.70  |         |         | I  O    |         |
17+20       0.7696      0.66  |         |         |I  O     |         |
17+25       0.7329      0.63  |         |         I  O      |         |
17+30       0.6983      0.60  |         |        I| O       |         |
17+35       0.6656      0.58  |         |       I |O        |         |
17+40       0.6346      0.55  |         |      I  O         |         |
17+45       0.6054      0.53  |         |     I  O|         |         |
17+50       0.5777      0.50  |         |    I  O |         |         |
17+55       0.5515      0.48  |         |    I O  |         |         |
18+ 0       0.5267      0.46  |         |   I O   |         |         |
18+ 5       0.5032      0.44  |         |  I  O   |         |         |
18+10       0.4810      0.42  |         |  I O    |         |         |
18+15       0.4598      0.40  |         | I O     |         |         |
18+20       0.4395      0.38  |         | IO      |         |         |
18+25       0.4199      0.37  |         |I O      |         |         |
18+30       0.4011      0.35  |         |IO       |         |         |
18+35       0.3831      0.33  |         I O       |         |         |
18+40       0.3660      0.32  |         IO        |         |         |
18+45       0.3497      0.31  |        I|O        |         |         |
18+50       0.3342      0.29  |        IO         |         |         |
18+55       0.3196      0.28  |       I O         |         |         |
19+ 0       0.3057      0.27  |       IO|         |         |         |
19+ 5       0.2926      0.26  |       IO|         |         |         |
19+10       0.2803      0.25  |      IO |         |         |         |
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   19+15       0.2687      0.24  |      IO |         |         |         |
   19+20       0.2577      0.23  |      IO |         |         |         |
   19+25       0.2473      0.22  |     IO  |         |         |         |
   19+30       0.2375      0.21  |     IO  |         |         |         |
   19+35       0.2283      0.20  |     IO  |         |         |         |
   19+40       0.2196      0.20  |     O   |         |         |         |
   19+45       0.2114      0.19  |     O   |         |         |         |
   19+50       0.2037      0.18  |    IO   |         |         |         |
   19+55       0.1964      0.18  |    IO   |         |         |         |
   20+ 0       0.1895      0.17  |    IO   |         |         |         |
   20+ 5       0.1830      0.17  |    O    |         |         |         |
   20+10       0.1769      0.16  |    O    |         |         |         |
   20+15       0.1711      0.16  |   IO    |         |         |         |
   20+20       0.1656      0.15  |   IO    |         |         |         |
   20+25       0.1604      0.15  |   IO    |         |         |         |
   20+30       0.1555      0.14  |   O     |         |         |         |
   20+35       0.1509      0.14  |   O     |         |         |         |
   20+40       0.1465      0.13  |   O     |         |         |         |
   20+45       0.1423      0.13  |   O     |         |         |         |
   20+50       0.1384      0.13  |   O     |         |         |         |
   20+55       0.1347      0.12  |  IO     |         |         |         |
   21+ 0       0.1312      0.12  |  IO     |         |         |         |
   21+ 5       0.1278      0.12  |  IO     |         |         |         |
   21+10       0.1246      0.12  |  O      |         |         |         |
   21+15       0.1216      0.11  |  O      |         |         |         |
   21+20       0.1188      0.11  |  O      |         |         |         |
   21+25       0.1160      0.11  |  O      |         |         |         |
   21+30       0.1134      0.11  |  O      |         |         |         |
   21+35       0.1110      0.10  |  O      |         |         |         |
   21+40       0.1086      0.10  |  O      |         |         |         |
   21+45       0.1064      0.10  |  O      |         |         |         |
   21+50       0.1043      0.10  |  O      |         |         |         |
   21+55       0.1023      0.10  |  O      |         |         |         |
   22+ 0       0.1003      0.10  |  O      |         |         |         |
   22+ 5       0.0985      0.09  | IO      |         |         |         |
   22+10       0.0967      0.09  | IO      |         |         |         |
   22+15       0.0950      0.09  | IO      |         |         |         |
   22+20       0.0934      0.09  | O       |         |         |         |
   22+25       0.0919      0.09  | O       |         |         |         |
   22+30       0.0904      0.09  | O       |         |         |         |

-----------------------------------------------------------------------
       ****************************HYDROGRAPH DATA****************************
                    Number of intervals =   342
                    Time interval =    5.0 (Min.)
                    Maximum/Peak flow rate =       1.061 (CFS)
                    Total volume =       0.356 (Ac.Ft)
               Status of hydrographs being held in storage
                       Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
               Peak (CFS)      0.000     0.000     0.000     0.000     0.000
               Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
       ***********************************************************************

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


       ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
       Process from Point/Station       4.000 to Point/Station       3.000
       **** ADD/COMBINE/RECOVER HYDROGRAPHS ****
       ______________________________________________________________________
       ********************* HYDROGRAPH INFORMATION *********************

                       From study/file name: LEBARD2A3A4A2Y.rte
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      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                        P R I N T   O F   S T O R M
                     R u n o f f     H y d r o g r a p h
      --------------------------------------------------------------------
                  Hydrograph in   5   Minute intervals (CFS)

      --------------------------------------------------------------------
Time(h+m) Add q(CFS)  Tot. Q   0        1.0       2.0       3.0       4.0
-----------------------------------------------------------------------
 12+ 0      0.0409      0.16  qQ        |         |         |         |
 12+ 5      0.0416      0.16  qQ        |         |         |         |
 12+10      0.0436      0.16  qQ        |         |         |         |
 12+15      0.0467      0.17  qQ        |         |         |         |
 12+20      0.0500      0.17  qQ        |         |         |         |
 12+25      0.0519      0.18  qQ        |         |         |         |
 12+30      0.0531      0.18  qQ        |         |         |         |
 12+35      0.0539      0.18  qQ        |         |         |         |
 12+40      0.0547      0.19  qQ        |         |         |         |
 12+45      0.0554      0.19  qQ        |         |         |         |
 12+50      0.0562      0.19  qQ        |         |         |         |
 12+55      0.0569      0.20  qQ        |         |         |         |
 13+ 0      0.0577      0.20  q Q       |         |         |         |
 13+ 5      0.0585      0.20  q Q       |         |         |         |
 13+10      0.0594      0.21  q Q       |         |         |         |
 13+15      0.0602      0.21  q Q       |         |         |         |
 13+20      0.0612      0.22  q Q       |         |         |         |
 13+25      0.0621      0.22  q Q       |         |         |         |
 13+30      0.0631      0.22  q Q       |         |         |         |
 13+35      0.0642      0.23  q Q       |         |         |         |
 13+40      0.0653      0.23  q Q       |         |         |         |
 13+45      0.0664      0.24  q Q       |         |         |         |
 13+50      0.0677      0.24  q Q       |         |         |         |
 13+55      0.0690      0.24  q Q       |         |         |         |
 14+ 0      0.0703      0.25  q Q       |         |         |         |
 14+ 5      0.0718      0.25  q Q       |         |         |         |
 14+10      0.0738      0.26  q Q       |         |         |         |
 14+15      0.0762      0.27  q Q       |         |         |         |
 14+20      0.0788      0.27  q Q       |         |         |         |
 14+25      0.0810      0.28  q Q       |         |         |         |
 14+30      0.0832      0.28  q Q       |         |         |         |
 14+35      0.0853      0.29  q Q       |         |         |         |
 14+40      0.0877      0.30  q Q       |         |         |         |
 14+45      0.0902      0.30  q  Q      |         |         |         |
 14+50      0.0932      0.31  q  Q      |         |         |         |
 14+55      0.0986      0.32  q  Q      |         |         |         |
 15+ 0      0.1099      0.34  |q Q      |         |         |         |
 15+ 5      0.1283      0.36  |q Q      |         |         |         |
 15+10      0.1532      0.40  |q Q      |         |         |         |
 15+15      0.1821      0.43  |q  Q     |         |         |         |
 15+20      0.2163      0.48  | q Q     |         |         |         |
 15+25      0.2512      0.52  | q  Q    |         |         |         |
 15+30      0.2767      0.56  | q  Q    |         |         |         |
 15+35      0.2923      0.58  | q  Q    |         |         |         |
 15+40      0.3196      0.62  |  q  Q   |         |         |         |
 15+45      0.3815      0.70  |  q  Q   |         |         |         |
 15+50      0.4854      0.82  |   q   Q |         |         |         |
 15+55      0.6406      0.99  |     q  Q|         |         |         |
 16+ 0      0.8963      1.27  |       q | Q       |         |         |
 16+ 5      1.4466      1.85  |         |   q   Q |         |         |
 16+10      2.5751      3.03  |         |         |    q    Q         |
 16+15      3.4494      3.99  |         |         |         |   q     Q
 16+20      3.2142      3.89  |         |         |         | q      Q|
 16+25      1.9173      2.74  |         |        q|      Q  |         |
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   16+30       1.0698      2.02  |         q         Q         |         |
   16+35       0.6210      1.65  |     q   |     Q   |         |         |
   16+40       0.4034      1.46  |   q     |   Q     |         |         |
   16+45       0.3076      1.37  |  q      |  Q      |         |         |
   16+50       0.2103      1.25  | q       | Q       |         |         |
   16+55       0.1413      1.14  |q        |Q        |         |         |
   17+ 0       0.1114      1.06  |q        Q         |         |         |
   17+ 5       0.0965      0.99  q        Q|         |         |         |
   17+10       0.0875      0.94  q        Q|         |         |         |
   17+15       0.0810      0.89  q       Q |         |         |         |
   17+20       0.0759      0.85  q       Q |         |         |         |
   17+25       0.0720      0.80  q       Q |         |         |         |
   17+30       0.0689      0.77  q      Q  |         |         |         |
   17+35       0.0664      0.73  q      Q  |         |         |         |
   17+40       0.0641      0.70  q      Q  |         |         |         |
   17+45       0.0620      0.67  q     Q   |         |         |         |
   17+50       0.0601      0.64  q     Q   |         |         |         |
   17+55       0.0584      0.61  q     Q   |         |         |         |
   18+ 0       0.0568      0.58  q    Q    |         |         |         |
   18+ 5       0.0551      0.56  q    Q    |         |         |         |
   18+10       0.0523      0.53  q    Q    |         |         |         |
   18+15       0.0484      0.51  q    Q    |         |         |         |
   18+20       0.0446      0.48  q   Q     |         |         |         |
   18+25       0.0422      0.46  q   Q     |         |         |         |
   18+30       0.0406      0.44  q   Q     |         |         |         |
   18+35       0.0395      0.42  q   Q     |         |         |         |
   18+40       0.0386      0.40  q   Q     |         |         |         |
   18+45       0.0377      0.39  q  Q      |         |         |         |
   18+50       0.0369      0.37  q  Q      |         |         |         |
   18+55       0.0361      0.36  q  Q      |         |         |         |
   19+ 0       0.0354      0.34  q  Q      |         |         |         |
   19+ 5       0.0347      0.33  q  Q      |         |         |         |
   19+10       0.0341      0.31  q  Q      |         |         |         |
   19+15       0.0335      0.30  q  Q      |         |         |         |
   19+20       0.0329      0.29  q Q       |         |         |         |
   19+25       0.0324      0.28  q Q       |         |         |         |
   19+30       0.0318      0.27  q Q       |         |         |         |
   19+35       0.0313      0.26  q Q       |         |         |         |
   19+40       0.0308      0.25  q Q       |         |         |         |
   19+45       0.0304      0.24  q Q       |         |         |         |
   19+50       0.0299      0.23  q Q       |         |         |         |
   19+55       0.0295      0.23  q Q       |         |         |         |
   20+ 0       0.0291      0.22  q Q       |         |         |         |
   20+ 5       0.0287      0.21  q Q       |         |         |         |
   20+10       0.0283      0.21  q Q       |         |         |         |
   20+15       0.0279      0.20  qQ        |         |         |         |
   20+20       0.0275      0.19  qQ        |         |         |         |
   20+25       0.0272      0.19  qQ        |         |         |         |
-----------------------------------------------------------------------
        ****************************HYDROGRAPH DATA****************************
                        Number of intervals =   342
                        Time interval =    5.0 (Min.)
                        Maximum/Peak flow rate =        3.986 (CFS)
                        Total volume =       0.553 (Ac.Ft)
                Status of hydrographs being held in storage
                           Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
                Peak (CFS)      0.000     0.000     0.000     0.000     0.000
                Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
        ***********************************************************************

        --------------------------------------------------------------------
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      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      11.000 to Point/Station       7.000
      **** ADD/COMBINE/RECOVER HYDROGRAPHS ****
      ______________________________________________________________________
      ******************** HYDROGRAPH INFORMATION *********************

                      From study/file name: LEBARD5A2Y.rte
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                        P R I N T   O F   S T O R M
                     R u n o f f     H y d r o g r a p h
      --------------------------------------------------------------------
                   Hydrograph in   5   Minute intervals (CFS)

      --------------------------------------------------------------------
Time(h+m) Add q(CFS)  Tot. Q   0        1.8       3.6       5.4       7.2
---------------------------------------------------------------------------
 13+50       0.0703      0.31  qQ        |         |         |         |
 13+55       0.0716      0.32  qQ        |         |         |         |
 14+ 0       0.0730      0.32  qQ        |         |         |         |
 14+ 5       0.0745      0.33  qQ        |         |         |         |
 14+10       0.0765      0.34  qQ        |         |         |         |
 14+15       0.0789      0.34  qQ        |         |         |         |
 14+20       0.0815      0.35  qQ        |         |         |         |
 14+25       0.0839      0.36  qQ        |         |         |         |
 14+30       0.0862      0.37  q Q       |         |         |         |
 14+35       0.0885      0.38  q Q       |         |         |         |
 14+40       0.0909      0.39  q Q       |         |         |         |
 14+45       0.0934      0.40  q Q       |         |         |         |
 14+50       0.0962      0.41  q Q       |         |         |         |
 14+55       0.0992      0.42  q Q       |         |         |         |
 15+ 0       0.1025      0.44  q Q       |         |         |         |
 15+ 5       0.1066      0.47  q Q       |         |         |         |
 15+10       0.1135      0.51  q Q       |         |         |         |
 15+15       0.1264      0.56  q  Q      |         |         |         |
 15+20       0.1492      0.62  q  Q      |         |         |         |
 15+25       0.1786      0.70  q  Q      |         |         |         |
 15+30       0.2046      0.76  |q  Q     |         |         |         |
 15+35       0.2234      0.81  |q  Q     |         |         |         |
 15+40       0.2484      0.87  |q  Q     |         |         |         |
 15+45       0.3049      1.00  |q   Q    |         |         |         |
 15+50       0.4037      1.22  | q   Q   |         |         |         |
 15+55       0.5517      1.54  |  q    Q |         |         |         |
 16+ 0       0.7973      2.06  |   q     |Q        |         |         |
 16+ 5       1.3113      3.16  |      q  |      Q  |         |         |
 16+10       2.3405      5.37  |         | q       |        Q|         |
 16+15       3.2209      7.21  |         |      q  |         |        Q|
 16+20       3.3521      7.24  |         |       q |         |         Q
 16+25       2.1987      4.94  |         | q       |      Q  |         |
 16+30       1.2656      3.29  |     q   |       Q |         |         |
 16+35       0.7290      2.38  |   q     |  Q      |         |         |
 16+40       0.4078      1.87  | q       Q         |         |         |
 16+45       0.2703      1.64  |q       Q|         |         |         |
 16+50       0.1839      1.43  |q     Q  |         |         |         |
 16+55       0.1275      1.27  q     Q   |         |         |         |
 17+ 0       0.1082      1.17  q     Q   |         |         |         |
 17+ 5       0.0976      1.09  q     Q   |         |         |         |
 17+10       0.0907      1.03  q    Q    |         |         |         |
 17+15       0.0848      0.97  q    Q    |         |         |         |
 17+20       0.0798      0.93  q    Q    |         |         |         |
 17+25       0.0759      0.88  q   Q     |         |         |         |
 17+30       0.0726      0.84  q   Q     |         |         |         |
 17+35       0.0698      0.80  q   Q     |         |         |         |
 17+40       0.0674      0.77  q   Q     |         |         |         |
```

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 17+45        0.0652       0.73  q   Q      |         |         |         |
 17+50        0.0632       0.70  q  Q       |         |         |         |
 17+55        0.0613       0.67  q  Q       |         |         |         |
 18+ 0        0.0596       0.64  q  Q       |         |         |         |
 18+ 5        0.0578       0.62  q  Q       |         |         |         |
 18+10        0.0551       0.59  q  Q       |         |         |         |
 18+15        0.0515       0.56  q  Q       |         |         |         |
 18+20        0.0474       0.53  q Q        |         |         |         |
 18+25        0.0447       0.51  q Q        |         |         |         |
 18+30        0.0428       0.48  q Q        |         |         |         |
 18+35        0.0415       0.46  q Q        |         |         |         |
 18+40        0.0404       0.44  q Q        |         |         |         |
 18+45        0.0395       0.43  q Q        |         |         |         |
 18+50        0.0386       0.41  q Q        |         |         |         |
 18+55        0.0379       0.39  q Q        |         |         |         |
 19+ 0        0.0371       0.38  q Q        |         |         |         |
 19+ 5        0.0364       0.36  q Q        |         |         |         |
 19+10        0.0357       0.35  qQ         |         |         |         |
 19+15        0.0351       0.34  qQ         |         |         |         |
 19+20        0.0345       0.33  qQ         |         |         |         |
-----------------------------------------------------------------------
        ****************************HYDROGRAPH DATA****************************
                        Number of intervals =   342
                        Time interval =    5.0 (Min.)
                        Maximum/Peak flow rate =         7.239 (CFS)
                        Total volume =       0.747 (Ac.Ft)
                Status of hydrographs being held in storage
                           Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
                Peak (CFS)      0.000     0.000     0.000     0.000     0.000
                Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
        ***********************************************************************

        --------------------------------------------------------------------
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FLOOD HYDROGRAPH ROUTING PROGRAM

Study date: 12/04/14

LEBARD 10Y HYDROGRAPH

Program License Serial Number 6201

********************* HYDROGRAPH INFORMATION *********************

From study/file name: LEBARD10Y.rte
****************************HYDROGRAPH DATA****************************
Number of intervals = 296
Time interval = 5.0 (Min.)
Maximum/Peak flow rate = 6.308 (CFS)
Total volume = 0.768 (Ac.Ft)
Status of hydrographs being held in storage

	Stream 1	Stream 2	Stream 3	Stream 4	Stream 5
Peak (CFS)	0.000	0.000	0.000	0.000	0.000
Vol (Ac.Ft)	0.000	0.000	0.000	0.000	0.000

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Process from Point/Station 1.000 to Point/Station 2.000
**** RETARDING BASIN ROUTING ****

User entry of depth-outflow-storage data

Total number of inflow hydrograph intervals = 296
Hydrograph time unit = 5.000 (Min.)
Initial depth in storage basin = 0.00(Ft.)

Initial basin depth = 0.00 (Ft.)
Initial basin storage = 0.00 (Ac.Ft)
Initial basin outflow = 0.00 (CFS)

Depth vs. Storage and Depth vs. Discharge data:

Basin Depth (Ft.)	Storage (Ac.Ft)	Outflow (CFS)	(S-O*dt/2) (Ac.Ft)	(S+O*dt/2) (Ac.Ft)
0.000	0.000	0.000	0.000	0.000
0.200	0.037	0.400	0.036	0.038
0.400	0.074	0.800	0.071	0.077
0.600	0.111	1.600	0.105	0.117
0.800	0.148	2.200	0.140	0.156
1.000	0.185	2.600	0.176	0.194
1.200	0.222	2.900	0.212	0.232

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         1.400      0.259      3.300      0.248        0.270
         1.600      0.296      3.600      0.284        0.308
         1.800      0.333      3.800      0.320        0.346
       --------------------------------------------------------------------
                       Hydrograph Detention Basin Routing
       ---------------------------------------------------------------------

       Graph values: 'I'= unit inflow; 'O'=outflow at time shown
       ---------------------------------------------------------------------
 Time   Inflow  Outflow    Storage                                     Depth
(Hours)  (CFS)   (CFS)     (Ac.Ft) .0      1.6    3.15    4.73    6.31 (Ft.)
12.000    0.31    0.27      0.025  |O      |       |       |       |     0.14
12.083    0.31    0.27      0.025  |O      |       |       |       |     0.14
12.167    0.33    0.28      0.026  |O      |       |       |       |     0.14
12.250    0.37    0.28      0.026  |O      |       |       |       |     0.14
12.333    0.39    0.29      0.027  |O      |       |       |       |     0.14
12.417    0.41    0.30      0.028  |OI     |       |       |       |     0.15
12.500    0.42    0.31      0.028  |OI     |       |       |       |     0.15
12.583    0.42    0.31      0.029  |OI     |       |       |       |     0.16
12.667    0.43    0.32      0.030  |OI     |       |       |       |     0.16
12.750    0.43    0.33      0.030  |OI     |       |       |       |     0.16
12.833    0.44    0.34      0.031  |OI     |       |       |       |     0.17
12.917    0.44    0.34      0.032  |OI     |       |       |       |     0.17
13.000    0.45    0.35      0.033  |OI     |       |       |       |     0.18
13.083    0.46    0.36      0.033  |OI     |       |       |       |     0.18
13.167    0.46    0.37      0.034  |OI     |       |       |       |     0.18
13.250    0.47    0.37      0.035  |OI     |       |       |       |     0.19
13.333    0.48    0.38      0.035  |OI     |       |       |       |     0.19
13.417    0.48    0.39      0.036  |OI     |       |       |       |     0.19
13.500    0.49    0.40      0.037  | O     |       |       |       |     0.20
13.583    0.50    0.40      0.037  | O     |       |       |       |     0.20
13.667    0.51    0.41      0.038  | O     |       |       |       |     0.20
13.750    0.52    0.42      0.039  | O     |       |       |       |     0.21
13.833    0.53    0.42      0.039  | O     |       |       |       |     0.21
13.917    0.54    0.43      0.040  | O     |       |       |       |     0.22
14.000    0.55    0.44      0.041  | O     |       |       |       |     0.22
14.083    0.56    0.45      0.041  | O     |       |       |       |     0.22
14.167    0.57    0.46      0.042  | O     |       |       |       |     0.23
14.250    0.58    0.47      0.043  | O     |       |       |       |     0.23
14.333    0.60    0.47      0.044  | OI    |       |       |       |     0.24
14.417    0.61    0.48      0.045  | OI    |       |       |       |     0.24
14.500    0.63    0.49      0.046  | OI    |       |       |       |     0.25
14.583    0.64    0.50      0.047  | OI    |       |       |       |     0.25
14.667    0.66    0.51      0.048  | OI    |       |       |       |     0.26
14.750    0.69    0.53      0.049  | OI    |       |       |       |     0.26
14.833    0.72    0.54      0.050  | OI    |       |       |       |     0.27
14.917    0.75    0.55      0.051  | OI    |       |       |       |     0.28
15.000    0.78    0.57      0.052  | OI    |       |       |       |     0.28
15.083    0.82    0.58      0.054  | O I   |       |       |       |     0.29
15.167    0.86    0.60      0.056  |  OI   |       |       |       |     0.30
15.250    0.91    0.62      0.058  |  OI   |       |       |       |     0.31
15.333    0.96    0.64      0.060  |  OI   |       |       |       |     0.32
15.417    1.01    0.67      0.062  |  O I  |       |       |       |     0.33
15.500    1.04    0.69      0.064  |  O I  |       |       |       |     0.35
15.583    1.06    0.72      0.067  |  O I  |       |       |       |     0.36
15.667    1.10    0.75      0.069  |  O I  |       |       |       |     0.37
15.750    1.21    0.78      0.072  |  O  I |       |       |       |     0.39
15.833    1.39    0.83      0.075  |   O  I|       |       |       |     0.41
15.917    1.66    0.92      0.080  |   O   I       |       |       |     0.43
16.000    2.09    1.06      0.086  |    O  | I     |       |       |     0.46
16.083    3.04    1.26      0.095  |     O |      I|       |       |     0.52
16.167    4.99    1.63      0.113  |       O       |       |I      |     0.61
16.250    6.31    2.06      0.139  |       | O     |       |       I     0.75
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16.333    5.11    2.37      0.163  |       |   O   |       |I      |     0.88
16.417    3.04    2.49      0.175  |       |   O  I|       |       |     0.94
16.500    1.93    2.49      0.175  |       |I  O   |       |       |     0.94
16.583    1.37    2.43      0.169  |     I |   O   |       |       |     0.91
16.667    1.18    2.35      0.161  |    I  |  O    |       |       |     0.87
16.750    1.01    2.26      0.153  |    I  |  O    |       |       |     0.83
16.833    0.87    2.14      0.144  |   I   | O     |       |       |     0.78
16.917    0.79    2.00      0.136  |  I    | O     |       |       |     0.73
17.000    0.72    1.87      0.128  |  I    |O      |       |       |     0.69
17.083    0.67    1.75      0.120  |  I    O       |       |       |     0.65
17.167    0.63    1.63      0.113  |  I    O       |       |       |     0.61
17.250    0.60    1.50      0.106  |  I   O|       |       |       |     0.58
17.333    0.57    1.37      0.101  | I   O |       |       |       |     0.54
17.417    0.55    1.26      0.095  | I   O |       |       |       |     0.52
17.500    0.53    1.16      0.091  | I  O  |       |       |       |     0.49
17.583    0.51    1.07      0.087  | I  O  |       |       |       |     0.47
17.667    0.49    0.99      0.083  | I  O  |       |       |       |     0.45
17.750    0.48    0.92      0.080  | I O   |       |       |       |     0.43
17.833    0.46    0.86      0.077  | I O   |       |       |       |     0.41
17.917    0.45    0.80      0.074  | I O   |       |       |       |     0.40
18.000    0.44    0.78      0.072  | IO    |       |       |       |     0.39
18.083    0.42    0.75      0.069  | IO    |       |       |       |     0.38
18.167    0.40    0.73      0.067  | IO    |       |       |       |     0.36
18.250    0.36    0.70      0.065  |I O    |       |       |       |     0.35
18.333    0.33    0.68      0.063  |I O    |       |       |       |     0.34
18.417    0.31    0.65      0.060  |I O    |       |       |       |     0.33
18.500    0.30    0.63      0.058  |I O    |       |       |       |     0.31
18.583    0.29    0.60      0.056  |I O    |       |       |       |     0.30
18.667    0.29    0.58      0.054  |IO     |       |       |       |     0.29
18.750    0.28    0.56      0.052  |IO     |       |       |       |     0.28
18.833    0.27    0.54      0.050  |IO     |       |       |       |     0.27
18.917    0.27    0.52      0.048  |IO     |       |       |       |     0.26
19.000    0.26    0.50      0.046  |IO     |       |       |       |     0.25


***************************HYDROGRAPH DATA****************************
                Number of intervals =   350
                Time interval =    5.0 (Min.)
                Maximum/Peak flow rate =       2.489 (CFS)
                Total volume =       0.768 (Ac.Ft)
        Status of hydrographs being held in storage
                   Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
        Peak (CFS)      0.000     0.000     0.000     0.000     0.000
        Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
**********************************************************************

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Process from Point/Station       2.000 to Point/Station       3.000
**** STREAM ROUTING SCS CONVEX METHOD ****

HYDROGRAPH STREAM ROUTING DATA:
Length of stream =    180.00 (Ft.)
Elevation difference =    0.70 (Ft.)
Slope of channel =  0.003889 (Vert/Horiz)
Channel type - Improved Channel


Channel length =   180.00(Ft.)     Elevation difference =   0.70(Ft.)
Channel evaluation using mean flow rate of hydrograph
Channel base width  =   10.000(Ft.)
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Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Manning's 'N'    = 0.200
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      0.381(CFS)
Depth of flow =     0.221(Ft.)
Average velocity =     0.162(Ft/s)
Total flow rate =     0.381(CFS)
Channel flow top width =   11.325(Ft.)
Depth of flow in channel =   0.22(Ft.)
Total number of channels (same dimensions) = 1
Flow Velocity =    0.16(Ft/s)
Travel time  =   18.53 min.
Individual channel flow =    0.381(CFS)
Total capacity of improved channels =      0.381(CFS)
Critical Depth in Channel =    0.04(Ft.)


Channel evaluation using maximum flow rate of hydrograph
Flow(q) thru subarea =      2.489(CFS)
Depth of flow =     0.661(Ft.)
Average velocity =     0.314(Ft/s)
Total flow rate =     2.489(CFS)
Channel flow top width =   13.966(Ft.)
Depth of flow in channel =   0.66(Ft.)
Total number of channels (same dimensions) = 1
Flow Velocity =    0.31(Ft/s)
Travel time  =   18.53 min.
Individual channel flow =    2.489(CFS)
Total capacity of improved channels =      2.489(CFS)
Critical Depth in Channel =    0.12(Ft.)


*********************** SCS CONVEX CHANNEL ROUTING *********************
Convex method of stream routing  data items:
Using equation: Outflow =
O(t+dt) = (1-c*)O(t+dt-dt*) + Input(c*)
          where c* = 1 - (1-c)^e and dt = c(length)/velocity
          c(v/v+1.7) =   0.1560   Travel time =   9.55 (min.)
        dt*(unit time interval) =   5.00(min.),  e=   2.5714
        dt(routing time-step) =   1.49 (min.),   c* =   0.3535

Output hydrograph delayed by 0  unit time increments


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                  P R I N T  O F  S T O R M
               R u n o f f     H y d r o g r a p h
--------------------------------------------------------------------
            Hydrograph in   5   Minute intervals (CFS)

--------------------------------------------------------------------
Time(h+m) Out = O(CFS) In = I  0        0.6       1.2       1.9       2.5
-----------------------------------------------------------------------
 10+55      0.2358      0.24  |  O       |         |         |         |
 11+ 0      0.2377      0.24  |  O       |         |         |         |
 11+ 5      0.2397      0.24  |  O       |         |         |         |
 11+10      0.2417      0.25  |  O       |         |         |         |
 11+15      0.2438      0.25  |  O       |         |         |         |
 11+20      0.2459      0.25  |  OI      |         |         |         |
 11+25      0.2481      0.25  |  OI      |         |         |         |
 11+30      0.2504      0.26  |   O      |         |         |         |
 11+35      0.2526      0.26  |   O      |         |         |         |
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11+40       0.2550      0.26  |   O     |         |         |         |
11+45       0.2574      0.26  |   O     |         |         |         |
11+50       0.2598      0.27  |   O     |         |         |         |
11+55       0.2624      0.27  |   O     |         |         |         |
12+ 0       0.2649      0.27  |   O     |         |         |         |
12+ 5       0.2676      0.27  |   O     |         |         |         |
12+10       0.2706      0.28  |   O     |         |         |         |
12+15       0.2742      0.28  |   O     |         |         |         |
12+20       0.2788      0.29  |   O     |         |         |         |
12+25       0.2845      0.30  |   O     |         |         |         |
12+30       0.2911      0.31  |   O     |         |         |         |
12+35       0.2982      0.31  |   OI    |         |         |         |
12+40       0.3056      0.32  |   OI    |         |         |         |
12+45       0.3132      0.33  |    O    |         |         |         |
12+50       0.3208      0.34  |    O    |         |         |         |
12+55       0.3284      0.34  |    O    |         |         |         |
13+ 0       0.3360      0.35  |    O    |         |         |         |
13+ 5       0.3434      0.36  |    O    |         |         |         |
13+10       0.3508      0.37  |    O    |         |         |         |
13+15       0.3581      0.37  |    OI   |         |         |         |
13+20       0.3654      0.38  |    OI   |         |         |         |
13+25       0.3726      0.39  |    OI   |         |         |         |
13+30       0.3798      0.40  |     O   |         |         |         |
13+35       0.3871      0.40  |     O   |         |         |         |
13+40       0.3943      0.41  |     O   |         |         |         |
13+45       0.4016      0.42  |     O   |         |         |         |
13+50       0.4090      0.42  |     O   |         |         |         |
13+55       0.4164      0.43  |     O   |         |         |         |
14+ 0       0.4240      0.44  |     OI  |         |         |         |
14+ 5       0.4317      0.45  |     OI  |         |         |         |
14+10       0.4396      0.46  |      O  |         |         |         |
14+15       0.4478      0.47  |      O  |         |         |         |
14+20       0.4561      0.47  |      O  |         |         |         |
14+25       0.4648      0.48  |      O  |         |         |         |
14+30       0.4737      0.49  |      O  |         |         |         |
14+35       0.4830      0.50  |      OI |         |         |         |
14+40       0.4928      0.51  |      OI |         |         |         |
14+45       0.5032      0.53  |       O |         |         |         |
14+50       0.5143      0.54  |       O |         |         |         |
14+55       0.5263      0.55  |       O |         |         |         |
15+ 0       0.5392      0.57  |       OI|         |         |         |
15+ 5       0.5533      0.58  |       OI|         |         |         |
15+10       0.5687      0.60  |        O|         |         |         |
15+15       0.5856      0.62  |        OI         |         |         |
15+20       0.6041      0.64  |        OI         |         |         |
15+25       0.6245      0.67  |         O         |         |         |
15+30       0.6467      0.69  |         OI        |         |         |
15+35       0.6700      0.72  |         OI        |         |         |
15+40       0.6943      0.75  |         |O        |         |         |
15+45       0.7200      0.78  |         |OI       |         |         |
15+50       0.7522      0.83  |         | OI      |         |         |
15+55       0.8024      0.92  |         | O I     |         |         |
16+ 0       0.8778      1.06  |         |   O I   |         |         |
16+ 5       0.9924      1.26  |         |    O    I         |         |
16+10       1.1805      1.63  |         |       O |     I   |         |
16+15       1.4464      2.06  |         |         |  O      |  I      |
16+20       1.7393      2.37  |         |         |      O  |       I |
16+25       1.9914      2.49  |         |         |         | O       I
16+30       2.1672      2.49  |         |         |         |   O    I|
16+35       2.2659      2.43  |         |         |         |     O  I|
16+40       2.3027      2.35  |         |         |         |      O  |
16+45       2.2956      2.26  |         |         |         |     O   |
16+50       2.2535      2.14  |         |         |         |   I O   |
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```
16+55       2.1799      2.00  |         |         |         | I  O    |
17+ 0       2.0849      1.87  |         |         |         I  O      |
17+ 5       1.9787      1.75  |         |         |       I |O        |
17+10       1.8682      1.63  |         |         |     I   O         |
17+15       1.7519      1.50  |         |         |   I   O |         |
17+20       1.6314      1.37  |         |         | I   O   |         |
17+25       1.5121      1.26  |         |         I   O     |         |
17+30       1.3983      1.16  |         |       I | O       |         |
17+35       1.2921      1.07  |         |      I  O         |         |
17+40       1.1944      0.99  |         |    I   O|         |         |
17+45       1.1054      0.92  |         |   I  O  |         |         |
17+50       1.0250      0.86  |         |  I  O   |         |         |
17+55       0.9525      0.80  |         | I  O    |         |         |
18+ 0       0.8930      0.78  |         | I O     |         |         |
18+ 5       0.8455      0.75  |         | IO      |         |         |
18+10       0.8062      0.73  |         |IO       |         |         |
18+15       0.7720      0.70  |         |IO       |         |         |
18+20       0.7409      0.68  |         IO        |         |         |
18+25       0.7118      0.65  |         IO        |         |         |
18+30       0.6842      0.63  |         O         |         |         |
18+35       0.6579      0.60  |        IO         |         |         |
18+40       0.6329      0.58  |        IO         |         |         |
18+45       0.6090      0.56  |       IO|         |         |         |
18+50       0.5864      0.54  |       IO|         |         |         |
18+55       0.5648      0.52  |       IO|         |         |         |
19+ 0       0.5444      0.50  |       O |         |         |         |
19+ 5       0.5250      0.48  |      IO |         |         |         |
19+10       0.5066      0.47  |      IO |         |         |         |
19+15       0.4891      0.45  |      O  |         |         |         |
19+20       0.4726      0.44  |      O  |         |         |         |
19+25       0.4568      0.42  |     IO  |         |         |         |
19+30       0.4419      0.41  |     IO  |         |         |         |
19+35       0.4278      0.40  |     O   |         |         |         |
19+40       0.4143      0.39  |     O   |         |         |         |
19+45       0.4016      0.37  |     O   |         |         |         |
19+50       0.3895      0.36  |    IO   |         |         |         |
19+55       0.3780      0.35  |    IO   |         |         |         |
20+ 0       0.3670      0.34  |    O    |         |         |         |
20+ 5       0.3567      0.33  |    O    |         |         |         |
20+10       0.3468      0.33  |    O    |         |         |         |
20+15       0.3374      0.32  |    O    |         |         |         |
20+20       0.3285      0.31  |   IO    |         |         |         |
20+25       0.3200      0.30  |   IO    |         |         |         |
20+30       0.3119      0.30  |   IO    |         |         |         |
20+35       0.3043      0.29  |   O     |         |         |         |
20+40       0.2969      0.28  |   O     |         |         |         |
20+45       0.2900      0.28  |   O     |         |         |         |
20+50       0.2833      0.27  |   O     |         |         |         |
20+55       0.2770      0.26  |   O     |         |         |         |
21+ 0       0.2709      0.26  |   O     |         |         |         |
21+ 5       0.2651      0.25  |   O     |         |         |         |
21+10       0.2596      0.25  |  IO     |         |         |         |
21+15       0.2544      0.24  |  IO     |         |         |         |
21+20       0.2493      0.24  |  IO     |         |         |         |
21+25       0.2445      0.23  |  O      |         |         |         |
21+30       0.2399      0.23  |  O      |         |         |         |
21+35       0.2355      0.23  |  O      |         |         |         |
21+40       0.2312      0.22  |  O      |         |         |         |
21+45       0.2272      0.22  |  O      |         |         |         |
21+50       0.2233      0.22  |  O      |         |         |         |
21+55       0.2196      0.21  |  O      |         |         |         |
22+ 0       0.2160      0.21  |  O      |         |         |         |
22+ 5       0.2126      0.21  |  O      |         |         |         |
```

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 22+10       0.2093      0.20  |  O       |         |         |         |
 22+15       0.2061      0.20  |  O       |         |         |         |
 22+20       0.2031      0.20  |  O       |         |         |         |
 22+25       0.2001      0.19  |  O       |         |         |         |
 22+30       0.1973      0.19  |  O       |         |         |         |
 22+35       0.1946      0.19  |  O       |         |         |         |
 22+40       0.1919      0.19  | IO       |         |         |         |
 22+45       0.1894      0.18  | IO       |         |         |         |
 22+50       0.1870      0.18  | IO       |         |         |         |
 22+55       0.1846      0.18  | O        |         |         |         |

----------------------------------------------------------------------
        ****************************HYDROGRAPH DATA****************************
                        Number of intervals =   353
                        Time interval =    5.0 (Min.)
                        Maximum/Peak flow rate =        2.303 (CFS)
                        Total volume =       0.768 (Ac.Ft)
                Status of hydrographs being held in storage
                           Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
                Peak (CFS)      0.000     0.000     0.000     0.000     0.000
                Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
        ***********************************************************************

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


        ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
        Process from Point/Station        4.000 to Point/Station        3.000
        **** ADD/COMBINE/RECOVER HYDROGRAPHS ****
        ______________________________________________________________________
        ********************* HYDROGRAPH INFORMATION *********************

                        From study/file name: LEBARD2A3A4A10Y.rte
        ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          P R I N T   O F   S T O R M
                       R u n o f f     H y d r o g r a p h
        --------------------------------------------------------------------
                    Hydrograph in   5   Minute intervals (CFS)

        --------------------------------------------------------------------
  Time(h+m) Add q(CFS)  Tot. Q   0        2.1       4.3       6.4       8.6
  -----------------------------------------------------------------------
 12+35       0.3184      0.62  |qQ        |         |         |         |
 12+40       0.3228      0.63  |qQ        |         |         |         |
 12+45       0.3271      0.64  |qQ        |         |         |         |
 12+50       0.3313      0.65  |q Q       |         |         |         |
 12+55       0.3356      0.66  |q Q       |         |         |         |
 13+ 0       0.3402      0.68  |q Q       |         |         |         |
 13+ 5       0.3448      0.69  |q Q       |         |         |         |
 13+10       0.3497      0.70  |q Q       |         |         |         |
 13+15       0.3548      0.71  |q Q       |         |         |         |
 13+20       0.3602      0.73  |q Q       |         |         |         |
 13+25       0.3657      0.74  |q Q       |         |         |         |
 13+30       0.3715      0.75  |q Q       |         |         |         |
 13+35       0.3776      0.76  |q Q       |         |         |         |
 13+40       0.3840      0.78  |q Q       |         |         |         |
 13+45       0.3907      0.79  |q Q       |         |         |         |
 13+50       0.3978      0.81  |q Q       |         |         |         |
 13+55       0.4052      0.82  |q Q       |         |         |         |
 14+ 0       0.4130      0.84  |q Q       |         |         |         |
 14+ 5       0.4213      0.85  |q Q       |         |         |         |
 14+10       0.4302      0.87  | q Q      |         |         |         |
 14+15       0.4397      0.89  | q Q      |         |         |         |
```

```
14+20       0.4498      0.91   | q Q     |         |         |         |
14+25       0.4605      0.93   | q Q     |         |         |         |
14+30       0.4720      0.95   | q Q     |         |         |         |
14+35       0.4842      0.97   | q Q     |         |         |         |
14+40       0.4975      0.99   | q Q     |         |         |         |
14+45       0.5118      1.02   | q Q     |         |         |         |
14+50       0.5275      1.04   | q Q     |         |         |         |
14+55       0.5455      1.07   | q Q     |         |         |         |
15+ 0       0.5702      1.11   | q  Q    |         |         |         |
15+ 5       0.6051      1.16   | q  Q    |         |         |         |
15+10       0.6502      1.22   |  q Q    |         |         |         |
15+15       0.7040      1.29   |  q  Q   |         |         |         |
15+20       0.7667      1.37   |  q  Q   |         |         |         |
15+25       0.8304      1.45   |  q  Q   |         |         |         |
15+30       0.8684      1.52   |   q  Q  |         |         |         |
15+35       0.8851      1.56   |   q  Q  |         |         |         |
15+40       0.9407      1.63   |   q  Q  |         |         |         |
15+45       1.0682      1.79   |   q   Q |         |         |         |
15+50       1.2799      2.03   |    q   Q|         |         |         |
15+55       1.6032      2.41   |      q  |Q        |         |         |
16+ 0       2.1163      2.99   |        q|  Q      |         |         |
16+ 5       3.2419      4.23   |         |    q   Q|         |         |
16+10       5.5621      6.74   |         |         |    q    |Q        |
16+15       7.1389      8.59   |         |         |         |  q      Q
16+20       5.7363      7.48   |         |         |     q   |   Q     |
16+25       3.2726      5.26   |         |    q    |   Q     |         |
16+30       1.9336      4.10   |        q|         Q|         |         |
16+35       1.2641      3.53   |    q    |     Q   |         |         |
16+40       1.0295      3.33   |   q     |    Q    |         |         |
16+45       0.8353      3.13   |  q      |   Q     |         |         |
16+50       0.6707      2.92   |  q      |  Q      |         |         |
16+55       0.5896      2.77   | q       | Q       |         |         |
17+ 0       0.5387      2.62   | q       | Q       |         |         |
17+ 5       0.5030      2.48   | q       |Q        |         |         |
17+10       0.4746      2.34   | q       Q         |         |         |
17+15       0.4511      2.20   | q       Q         |         |         |
17+20       0.4311      2.06   | q      Q|         |         |         |
17+25       0.4137      1.93   |q      Q |         |         |         |
17+30       0.3982      1.80   |q      Q |         |         |         |
17+35       0.3843      1.68   |q     Q  |         |         |         |
17+40       0.3718      1.57   |q     Q  |         |         |         |
17+45       0.3603      1.47   |q    Q   |         |         |         |
17+50       0.3499      1.37   |q    Q   |         |         |         |
17+55       0.3402      1.29   |q    Q   |         |         |         |
18+ 0       0.3313      1.22   |q   Q    |         |         |         |
18+ 5       0.3209      1.17   |q   Q    |         |         |         |
18+10       0.3013      1.11   |q   Q    |         |         |         |
18+15       0.2730      1.04   |q  Q     |         |         |         |
18+20       0.2497      0.99   |q  Q     |         |         |         |
18+25       0.2366      0.95   |q  Q     |         |         |         |
18+30       0.2283      0.91   |q  Q     |         |         |         |
18+35       0.2223      0.88   |q  Q     |         |         |         |
18+40       0.2169      0.85   |q Q      |         |         |         |
18+45       0.2120      0.82   q  Q      |         |         |         |
18+50       0.2076      0.79   q  Q      |         |         |         |
18+55       0.2035      0.77   q  Q      |         |         |         |
19+ 0       0.1995      0.74   q  Q      |         |         |         |
19+ 5       0.1958      0.72   q  Q      |         |         |         |
19+10       0.1922      0.70   q  Q      |         |         |         |
19+15       0.1888      0.68   q  Q      |         |         |         |
19+20       0.1855      0.66   q  Q      |         |         |         |
19+25       0.1824      0.64   q Q       |         |         |         |
19+30       0.1794      0.62   q Q       |         |         |         |
```

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  19+35       0.1766      0.60  q Q         |         |         |         |
  19+40       0.1738      0.59  q Q         |         |         |         |
  19+45       0.1712      0.57  q Q         |         |         |         |
  19+50       0.1687      0.56  q Q         |         |         |         |
  19+55       0.1662      0.54  q Q         |         |         |         |
  20+ 0       0.1639      0.53  q Q         |         |         |         |
  20+ 5       0.1616      0.52  q Q         |         |         |         |
  20+10       0.1594      0.51  q Q         |         |         |         |
  20+15       0.1573      0.49  q Q         |         |         |         |
  20+20       0.1553      0.48  q Q         |         |         |         |
  20+25       0.1533      0.47  q Q         |         |         |         |
  20+30       0.1514      0.46  q Q         |         |         |         |
  20+35       0.1495      0.45  q Q         |         |         |         |
  20+40       0.1477      0.44  q Q         |         |         |         |
  20+45       0.1460      0.44  q Q         |         |         |         |
  20+50       0.1443      0.43  qQ          |         |         |         |
  20+55       0.1427      0.42  qQ          |         |         |         |
  21+ 0       0.1411      0.41  qQ          |         |         |         |
  21+ 5       0.1395      0.40  qQ          |         |         |         |
  21+10       0.1380      0.40  qQ          |         |         |         |
-----------------------------------------------------------------------
        ****************************HYDROGRAPH DATA****************************
                        Number of intervals =   353
                        Time interval =    5.0 (Min.)
                        Maximum/Peak flow rate =        8.585 (CFS)
                        Total volume =       1.421 (Ac.Ft)
                Status of hydrographs being held in storage
                           Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
                Peak (CFS)      0.000     0.000     0.000     0.000     0.000
                Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
        ***********************************************************************

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


        ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
        Process from Point/Station       11.000 to Point/Station        7.000
        **** ADD/COMBINE/RECOVER HYDROGRAPHS ****
        ______________________________________________________________________
        ********************* HYDROGRAPH INFORMATION *********************

                        From study/file name: LEBARD5A10Y.rte
        ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          P R I N T  O F  S T O R M
                       R u n o f f     H y d r o g r a p h
        --------------------------------------------------------------------
                    Hydrograph in   5   Minute intervals (CFS)

        --------------------------------------------------------------------
 Time(h+m) Add q(CFS)  Tot. Q   0         3.7       7.5      11.2      14.9
 -----------------------------------------------------------------
  11+50       0.2351      0.72  qQ          |         |         |         |
  11+55       0.2379      0.73  qQ          |         |         |         |
  12+ 0       0.2408      0.74  qQ          |         |         |         |
  12+ 5       0.2454      0.75  q Q         |         |         |         |
  12+10       0.2571      0.78  q Q         |         |         |         |
  12+15       0.2763      0.83  q Q         |         |         |         |
  12+20       0.2991      0.87  q Q         |         |         |         |
  12+25       0.3139      0.91  q Q         |         |         |         |
  12+30       0.3231      0.93  q Q         |         |         |         |
  12+35       0.3294      0.95  q Q         |         |         |         |
  12+40       0.3342      0.96  q Q         |         |         |         |
  12+45       0.3387      0.98  q Q         |         |         |         |
```

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12+50       0.3433      1.00  q Q       |         |         |         |
12+55       0.3477      1.01  q Q       |         |         |         |
13+ 0       0.3524      1.03  q Q       |         |         |         |
13+ 5       0.3571      1.05  q Q       |         |         |         |
13+10       0.3622      1.06  q Q       |         |         |         |
13+15       0.3673      1.08  q Q       |         |         |         |
13+20       0.3728      1.10  |qQ       |         |         |         |
13+25       0.3784      1.12  |qQ       |         |         |         |
13+30       0.3844      1.14  |q Q      |         |         |         |
13+35       0.3906      1.16  |q Q      |         |         |         |
13+40       0.3972      1.18  |q Q      |         |         |         |
13+45       0.4039      1.20  |q Q      |         |         |         |
13+50       0.4112      1.22  |q Q      |         |         |         |
13+55       0.4186      1.24  |q Q      |         |         |         |
14+ 0       0.4267      1.26  |q Q      |         |         |         |
14+ 5       0.4350      1.29  |q Q      |         |         |         |
14+10       0.4441      1.31  |q Q      |         |         |         |
14+15       0.4536      1.34  |q Q      |         |         |         |
14+20       0.4639      1.37  |q Q      |         |         |         |
14+25       0.4746      1.40  |q Q      |         |         |         |
14+30       0.4863      1.43  |q Q      |         |         |         |
14+35       0.4986      1.47  |q Q      |         |         |         |
14+40       0.5121      1.50  |q  Q     |         |         |         |
14+45       0.5263      1.54  |q  Q     |         |         |         |
14+50       0.5422      1.58  |q  Q     |         |         |         |
14+55       0.5598      1.63  |q  Q     |         |         |         |
15+ 0       0.5829      1.69  |q  Q     |         |         |         |
15+ 5       0.6139      1.77  |q  Q     |         |         |         |
15+10       0.6563      1.88  |q   Q    |         |         |         |
15+15       0.7070      2.00  |q   Q    |         |         |         |
15+20       0.7685      2.14  | q  Q    |         |         |         |
15+25       0.8316      2.29  | q   Q   |         |         |         |
15+30       0.8815      2.40  | q   Q   |         |         |         |
15+35       0.9143      2.47  | q   Q   |         |         |         |
15+40       0.9562      2.59  | q   Q   |         |         |         |
15+45       1.0567      2.84  | q    Q  |         |         |         |
15+50       1.2396      3.27  |  q    Q |         |         |         |
15+55       1.5175      3.92  |   q     Q         |         |         |
16+ 0       1.9743      4.97  |    q    |  Q      |         |         |
16+ 5       2.9053      7.14  |      q  |        Q|         |         |
16+10       4.7499     11.49  |         | q       |         Q         |
16+15       6.3224     14.91  |         |     q   |         |         Q
16+20       6.5469     14.02  |         |      q  |         |      Q  |
16+25       4.4730      9.74  |         | q       |     Q   |         |
16+30       2.7906      6.89  |      q  |       Q |         |         |
16+35       1.8245      5.35  |   q     |   Q     |         |         |
16+40       1.2466      4.58  |  q      | Q       |         |         |
16+45       0.9870      4.12  | q       |Q        |         |         |
16+50       0.8039      3.73  | q       Q         |         |         |
16+55       0.6631      3.43  |q       Q|         |         |         |
17+ 0       0.5925      3.22  |q      Q |         |         |         |
17+ 5       0.5456      3.03  |q      Q |         |         |         |
17+10       0.5111      2.85  |q     Q  |         |         |         |
17+15       0.4835      2.69  |q     Q  |         |         |         |
17+20       0.4606      2.52  |q    Q   |         |         |         |
17+25       0.4409      2.37  |q    Q   |         |         |         |
17+30       0.4236      2.22  |q   Q    |         |         |         |
17+35       0.4083      2.08  |q   Q    |         |         |         |
17+40       0.3945      1.96  |q   Q    |         |         |         |
17+45       0.3819      1.85  |q  Q     |         |         |         |
17+50       0.3705      1.75  q   Q     |         |         |         |
17+55       0.3600      1.65  q   Q     |         |         |         |
18+ 0       0.3503      1.57  q   Q     |         |         |         |
```

```
  18+ 5        0.3397       1.51  q   Q      |         |         |         |
  18+10        0.3229       1.43  q  Q       |         |         |         |
  18+15        0.2991       1.34  q  Q       |         |         |         |
  18+20        0.2727       1.26  q  Q       |         |         |         |
  18+25        0.2548       1.20  q  Q       |         |         |         |
  18+30        0.2434       1.16  q  Q       |         |         |         |
  18+35        0.2353       1.12  q Q        |         |         |         |
  18+40        0.2292       1.08  q Q        |         |         |         |
  18+45        0.2238       1.04  q Q        |         |         |         |
  18+50        0.2189       1.01  q Q        |         |         |         |
  18+55        0.2144       0.98  q Q        |         |         |         |
  19+ 0        0.2102       0.95  q Q        |         |         |         |
  19+ 5        0.2062       0.93  q Q        |         |         |         |
  19+10        0.2023       0.90  q Q        |         |         |         |
  19+15        0.1987       0.88  q Q        |         |         |         |
  19+20        0.1952       0.85  q Q        |         |         |         |
  19+25        0.1919       0.83  q Q        |         |         |         |
  19+30        0.1887       0.81  q Q        |         |         |         |
  19+35        0.1856       0.79  q Q        |         |         |         |
  19+40        0.1827       0.77  q Q        |         |         |         |
  19+45        0.1799       0.75  q Q        |         |         |         |
  19+50        0.1772       0.74  qQ         |         |         |         |
  19+55        0.1746       0.72  qQ         |         |         |         |
  20+ 0        0.1721       0.70  qQ         |         |         |         |

-----------------------------------------------------------------------
        ****************************HYDROGRAPH DATA****************************
                        Number of intervals =   353
                        Time interval =    5.0 (Min.)
                        Maximum/Peak flow rate =       14.908 (CFS)
                        Total volume =      2.101 (Ac.Ft)
                Status of hydrographs being held in storage
                           Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
                Peak (CFS)      0.000     0.000     0.000     0.000     0.000
                Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
        ***********************************************************************

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

FLOOD HYDROGRAPH ROUTING PROGRAM

Study date: 12/04/14

LEBARD 25 YEAR HYDROGRAPH

Program License Serial Number 6201

******************** HYDROGRAPH INFORMATION ********************

From study/file name: LEBARD25Y.rte
***************************HYDROGRAPH DATA***************************
Number of intervals = 296
Time interval = 5.0 (Min.)
Maximum/Peak flow rate = 7.581 (CFS)
Total volume = 0.969 (Ac.Ft)
Status of hydrographs being held in storage

	Stream 1	Stream 2	Stream 3	Stream 4	Stream 5
Peak (CFS)	0.000	0.000	0.000	0.000	0.000
Vol (Ac.Ft)	0.000	0.000	0.000	0.000	0.000

****

+++
Process from Point/Station 1.000 to Point/Station 2.000
**** RETARDING BASIN ROUTING ****

User entry of depth-outflow-storage data

Total number of inflow hydrograph intervals = 296
Hydrograph time unit = 5.000 (Min.)
Initial depth in storage basin = 0.00(Ft.)

Initial basin depth = 0.00 (Ft.)
Initial basin storage = 0.00 (Ac.Ft)
Initial basin outflow = 0.00 (CFS)

Depth vs. Storage and Depth vs. Discharge data:

Basin Depth (Ft.)	Storage (Ac.Ft)	Outflow (CFS)	(S-O*dt/2) (Ac.Ft)	(S+O*dt/2) (Ac.Ft)
0.000	0.000	0.000	0.000	0.000
0.200	0.037	0.400	0.036	0.038
0.400	0.074	0.800	0.071	0.077
0.600	0.111	1.600	0.105	0.117
0.800	0.148	2.200	0.140	0.156
1.000	0.185	2.600	0.176	0.194
1.200	0.222	2.900	0.212	0.232

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         1.400      0.259      3.300      0.248        0.270
         1.600      0.296      3.600      0.284        0.308
         1.800      0.333      3.800      0.320        0.346
       --------------------------------------------------------------------
                       Hydrograph Detention Basin Routing
       ---------------------------------------------------------------------

       Graph values: 'I'= unit inflow; 'O'=outflow at time shown
       ---------------------------------------------------------------------
 Time   Inflow  Outflow    Storage                                 Depth
(Hours)  (CFS)   (CFS)     (Ac.Ft) .0       1.9    3.79    5.69    7.58
12.917    0.59    0.44      0.041  |OI     |       |       |       |     0.22
13.000    0.59    0.45      0.042  |OI     |       |       |       |     0.23
13.083    0.60    0.47      0.043  |OI     |       |       |       |     0.23
13.167    0.61    0.48      0.044  | O     |       |       |       |     0.24
13.250    0.62    0.49      0.045  | O     |       |       |       |     0.24
13.333    0.63    0.49      0.046  | O     |       |       |       |     0.25
13.417    0.64    0.50      0.047  | O     |       |       |       |     0.25
13.500    0.65    0.51      0.048  | O     |       |       |       |     0.26
13.583    0.66    0.52      0.049  | O     |       |       |       |     0.26
13.667    0.67    0.53      0.049  | O     |       |       |       |     0.27
13.750    0.68    0.54      0.050  | O     |       |       |       |     0.27
13.833    0.69    0.55      0.051  | O     |       |       |       |     0.28
13.917    0.70    0.56      0.052  | O     |       |       |       |     0.28
14.000    0.72    0.57      0.053  | OI    |       |       |       |     0.29
14.083    0.73    0.59      0.054  | OI    |       |       |       |     0.29
14.167    0.74    0.60      0.055  | OI    |       |       |       |     0.30
14.250    0.76    0.61      0.056  | OI    |       |       |       |     0.30
14.333    0.77    0.62      0.057  | OI    |       |       |       |     0.31
14.417    0.79    0.63      0.058  | OI    |       |       |       |     0.32
14.500    0.82    0.64      0.059  | OI    |       |       |       |     0.32
14.583    0.84    0.66      0.061  | OI    |       |       |       |     0.33
14.667    0.87    0.67      0.062  | OI    |       |       |       |     0.34
14.750    0.90    0.69      0.064  | OI    |       |       |       |     0.34
14.833    0.94    0.70      0.065  | OI    |       |       |       |     0.35
14.917    0.97    0.72      0.067  |  OI   |       |       |       |     0.36
15.000    1.02    0.74      0.069  |  OI   |       |       |       |     0.37
15.083    1.06    0.76      0.071  |  OI   |       |       |       |     0.38
15.167    1.11    0.79      0.073  |  OI   |       |       |       |     0.39
15.250    1.17    0.82      0.075  |  OI   |       |       |       |     0.41
15.333    1.23    0.87      0.077  |  O I  |       |       |       |     0.42
15.417    1.30    0.93      0.080  |  O I  |       |       |       |     0.43
15.500    1.33    0.98      0.082  |   OI  |       |       |       |     0.45
15.583    1.34    1.03      0.085  |   OI  |       |       |       |     0.46
15.667    1.40    1.08      0.087  |   OI  |       |       |       |     0.47
15.750    1.53    1.13      0.089  |   O I |       |       |       |     0.48
15.833    1.75    1.20      0.093  |    O I|       |       |       |     0.50
15.917    2.11    1.30      0.097  |    O  I       |       |       |     0.53
16.000    2.65    1.45      0.104  |     O |  I    |       |       |     0.56
16.083    3.78    1.67      0.115  |      O|      I|       |       |     0.62
16.167    6.06    2.02      0.137  |       O       |       |I      |     0.74
16.250    7.58    2.42      0.168  |       | O     |       |       I     0.91
16.333    6.15    2.71      0.198  |       |  O    |       |I      |     1.07
16.417    3.71    2.83      0.213  |       |  O   I|       |       |     1.15
16.500    2.38    2.84      0.214  |       | IO    |       |       |     1.16
16.583    1.72    2.80      0.209  |      I|  O    |       |       |     1.13
16.667    1.49    2.73      0.201  |     I |  O    |       |       |     1.09
16.750    1.29    2.66      0.192  |    I  |  O    |       |       |     1.04
16.833    1.12    2.57      0.183  |   I   | O     |       |       |     0.99
16.917    1.02    2.47      0.173  |   I   | O     |       |       |     0.93
17.000    0.94    2.36      0.163  |  I    |O      |       |       |     0.88
17.083    0.88    2.26      0.153  |  I    |O      |       |       |     0.83
17.167    0.82    2.13      0.144  |  I    |O      |       |       |     0.78
```

```
17.250    0.78    1.99      0.135  |  I    O       |       |       |      0.73
17.333    0.75    1.86      0.127  |  I   O|       |       |       |      0.69
17.417    0.72    1.74      0.120  |  I   O|       |       |       |      0.65
17.500    0.69    1.63      0.113  | I   O |       |       |       |      0.61
17.583    0.67    1.51      0.107  | I   O |       |       |       |      0.58
17.667    0.65    1.39      0.101  | I  O  |       |       |       |      0.55
17.750    0.63    1.29      0.097  | I  O  |       |       |       |      0.52
17.833    0.61    1.19      0.092  | I  O  |       |       |       |      0.50
17.917    0.59    1.11      0.088  | I O   |       |       |       |      0.48
18.000    0.58    1.04      0.085  | I O   |       |       |       |      0.46
18.083    0.56    0.97      0.082  | I O   |       |       |       |      0.44
18.167    0.52    0.91      0.079  | IO    |       |       |       |      0.43
18.250    0.47    0.86      0.077  |I O    |       |       |       |      0.41
18.333    0.42    0.80      0.074  |I O    |       |       |       |      0.40
18.417    0.40    0.77      0.071  |I O    |       |       |       |      0.39
18.500    0.38    0.74      0.069  |I O    |       |       |       |      0.37
18.583    0.37    0.72      0.066  |I O    |       |       |       |      0.36
18.667    0.36    0.69      0.064  |IO     |       |       |       |      0.35
18.750    0.35    0.67      0.062  |IO     |       |       |       |      0.33
18.833    0.35    0.64      0.060  |IO     |       |       |       |      0.32
18.917    0.34    0.62      0.058  |IO     |       |       |       |      0.31
19.000    0.33    0.60      0.056  |IO     |       |       |       |      0.30

       ****************************HYDROGRAPH DATA****************************
                Number of intervals =   353
                Time interval =    5.0 (Min.)
                Maximum/Peak flow rate =        2.838 (CFS)
                Total volume =       0.969 (Ac.Ft)
        Status of hydrographs being held in storage
                   Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
        Peak (CFS)      0.000     0.000     0.000     0.000     0.000
        Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
       ***********************************************************************

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


       ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
       Process from Point/Station       2.000 to Point/Station       3.000
       **** STREAM ROUTING SCS CONVEX METHOD ****
       ______________________________________________________________________
       HYDROGRAPH STREAM ROUTING DATA:
       Length of stream =    180.00 (Ft.)
       Elevation difference =    0.70 (Ft.)
       Slope of channel =  0.003889 (Vert/Horiz)
       Channel type - Improved Channel


       Channel length =   180.00(Ft.)     Elevation difference =   0.70(Ft.)
       Channel evaluation using mean flow rate of hydrograph
       Channel base width  =   10.000(Ft.)
       Slope or 'Z' of left channel bank =   3.000
       Slope or 'Z' of right channel bank =   3.000
       Manning's 'N'    = 0.200
       Maximum depth of channel  =    1.000(Ft.)
       Flow(q) thru subarea =      0.491(CFS)
       Depth of flow =     0.257(Ft.)
       Average velocity =     0.178(Ft/s)
       Total flow rate =     0.491(CFS)
       Channel flow top width =   11.540(Ft.)
       Depth of flow in channel =   0.26(Ft.)
       Total number of channels (same dimensions) = 1
       Flow Velocity =    0.18(Ft/s)
```

```
Travel time  =    0.00 min.
Individual channel flow =    0.491(CFS)
Total capacity of improved channels =      0.491(CFS)
Critical Depth in Channel =    0.04(Ft.)


Channel evaluation using maximum flow rate of hydrograph
Flow(q) thru subarea =      2.838(CFS)
Depth of flow =     0.713(Ft.)
Average velocity =     0.328(Ft/s)
Total flow rate =     2.838(CFS)
Channel flow top width =   14.275(Ft.)
Depth of flow in channel =   0.71(Ft.)
Total number of channels (same dimensions) = 1
Flow Velocity =    0.33(Ft/s)
Travel time  =    0.00 min.
Individual channel flow =    2.838(CFS)
Total capacity of improved channels =      2.838(CFS)
Critical Depth in Channel =    0.13(Ft.)


*********************** SCS CONVEX CHANNEL ROUTING *********************
Convex method of stream routing  data items:
Using equation: Outflow =
O(t+dt) = (1-c*)O(t+dt-dt*) + Input(c*)
          where c* = 1 - (1-c)^e and dt = c(length)/velocity
          c(v/v+1.7) =   0.1618   Travel time =   9.14 (min.)
        dt*(unit time interval) =   5.00(min.),  e=   2.5869
        dt(routing time-step) =   1.48 (min.),   c* =   0.3666

Output hydrograph delayed by 0  unit time increments


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                  P R I N T  O F  S T O R M
               R u n o f f     H y d r o g r a p h
--------------------------------------------------------------------
            Hydrograph in   5   Minute intervals (CFS)

--------------------------------------------------------------------
Time(h+m) Out = O(CFS) In = I  0        0.7       1.4       2.1       2.8
-----------------------------------------------------------------------
 12+ 0       0.3330      0.34  |   O      |         |         |         |
 12+ 5       0.3364      0.34  |   O      |         |         |         |
 12+10       0.3403      0.35  |   O      |         |         |         |
 12+15       0.3451      0.36  |   OI     |         |         |         |
 12+20       0.3516      0.37  |   OI     |         |         |         |
 12+25       0.3597      0.38  |    O     |         |         |         |
 12+30       0.3692      0.39  |    O     |         |         |         |
 12+35       0.3795      0.40  |    O     |         |         |         |
 12+40       0.3902      0.41  |    O     |         |         |         |
 12+45       0.4011      0.42  |    O     |         |         |         |
 12+50       0.4120      0.43  |    OI    |         |         |         |
 12+55       0.4228      0.44  |    OI    |         |         |         |
 13+ 0       0.4335      0.45  |     O    |         |         |         |
 13+ 5       0.4440      0.47  |     O    |         |         |         |
 13+10       0.4543      0.48  |     O    |         |         |         |
 13+15       0.4646      0.49  |     O    |         |         |         |
 13+20       0.4746      0.49  |     O    |         |         |         |
 13+25       0.4846      0.50  |     OI   |         |         |         |
 13+30       0.4945      0.51  |     OI   |         |         |         |
 13+35       0.5044      0.52  |      O   |         |         |         |
 13+40       0.5143      0.53  |      O   |         |         |         |
```

```
13+45       0.5241      0.54  |      O  |         |         |         |
13+50       0.5341      0.55  |      O  |         |         |         |
13+55       0.5441      0.56  |      O  |         |         |         |
14+ 0       0.5543      0.57  |      OI |         |         |         |
14+ 5       0.5646      0.59  |      OI |         |         |         |
14+10       0.5750      0.60  |       O |         |         |         |
14+15       0.5857      0.61  |       O |         |         |         |
14+20       0.5966      0.62  |       O |         |         |         |
14+25       0.6077      0.63  |       O |         |         |         |
14+30       0.6193      0.64  |       OI|         |         |         |
14+35       0.6315      0.66  |       OI|         |         |         |
14+40       0.6444      0.67  |        O|         |         |         |
14+45       0.6582      0.69  |        O|         |         |         |
14+50       0.6730      0.70  |        O|         |         |         |
14+55       0.6888      0.72  |        OI         |         |         |
15+ 0       0.7059      0.74  |        OI         |         |         |
15+ 5       0.7244      0.76  |         O         |         |         |
15+10       0.7444      0.79  |         OI        |         |         |
15+15       0.7688      0.82  |         OI        |         |         |
15+20       0.8017      0.87  |         |OI       |         |         |
15+25       0.8422      0.93  |         |O I      |         |         |
15+30       0.8876      0.98  |         | OI      |         |         |
15+35       0.9348      1.03  |         |  OI     |         |         |
15+40       0.9823      1.08  |         |  O I    |         |         |
15+45       1.0311      1.13  |         |   OI    |         |         |
15+50       1.0861      1.20  |         |    OI   |         |         |
15+55       1.1546      1.30  |         |     O I |         |         |
16+ 0       1.2473      1.45  |         |      O  I         |         |
16+ 5       1.3793      1.67  |         |        O|  I      |         |
16+10       1.5756      2.02  |         |         | O     I |         |
16+15       1.8414      2.42  |         |         |    O    |   I     |
16+20       2.1272      2.71  |         |         |        O|       I |
16+25       2.3704      2.83  |         |         |         |  O     I|
16+30       2.5407      2.84  |         |         |         |    O    I
16+35       2.6388      2.80  |         |         |         |      O I|
16+40       2.6797      2.73  |         |         |         |      OI |
16+45       2.6799      2.66  |         |         |         |      O  |
16+50       2.6501      2.57  |         |         |         |     IO  |
16+55       2.5942      2.47  |         |         |         |   I O   |
17+ 0       2.5196      2.36  |         |         |         |  I O    |
17+ 5       2.4340      2.26  |         |         |         |I  O     |
17+10       2.3369      2.13  |         |         |         I O       |
17+15       2.2257      1.99  |         |         |       I |O        |
17+20       2.1066      1.86  |         |         |     I  O|         |
17+25       1.9861      1.74  |         |         |   I  O  |         |
17+30       1.8685      1.63  |         |         |  I  O   |         |
17+35       1.7506      1.51  |         |         |I  O     |         |
17+40       1.6321      1.39  |         |        I|  O      |         |
17+45       1.5172      1.29  |         |       I |O        |         |
17+50       1.4091      1.19  |         |     I  O|         |         |
17+55       1.3093      1.11  |         |    I  O |         |         |
18+ 0       1.2183      1.04  |         |   I  O  |         |         |
18+ 5       1.1359      0.97  |         |  I  O   |         |         |
18+10       1.0611      0.91  |         | I O     |         |         |
18+15       0.9921      0.86  |         | IO      |         |         |
18+20       0.9275      0.80  |         |I O      |         |         |
18+25       0.8732      0.77  |         I O       |         |         |
18+30       0.8287      0.74  |         IO        |         |         |
18+35       0.7907      0.72  |         IO        |         |         |
18+40       0.7572      0.69  |        IO         |         |         |
18+45       0.7271      0.67  |        IO         |         |         |
18+50       0.6995      0.64  |        O|         |         |         |
18+55       0.6739      0.62  |       IO|         |         |         |
```

```
   19+ 0       0.6500      0.60  |       IO|         |         |         |
   19+ 5       0.6275      0.58  |       O |         |         |         |
   19+10       0.6063      0.56  |      IO |         |         |         |
   19+15       0.5863      0.55  |      IO |         |         |         |
   19+20       0.5673      0.53  |      O  |         |         |         |
   19+25       0.5493      0.51  |      O  |         |         |         |
   19+30       0.5322      0.50  |      O  |         |         |         |
   19+35       0.5160      0.48  |     IO  |         |         |         |
   19+40       0.5005      0.47  |     IO  |         |         |         |
   19+45       0.4858      0.46  |     O   |         |         |         |
   19+50       0.4719      0.44  |     O   |         |         |         |
   19+55       0.4586      0.43  |     O   |         |         |         |
   20+ 0       0.4460      0.42  |    IO   |         |         |         |
   20+ 5       0.4339      0.41  |    IO   |         |         |         |
   20+10       0.4225      0.40  |    O    |         |         |         |
   20+15       0.4115      0.39  |    O    |         |         |         |
   20+20       0.4011      0.38  |    O    |         |         |         |
   20+25       0.3912      0.37  |    O    |         |         |         |
   20+30       0.3818      0.36  |    O    |         |         |         |
   20+35       0.3727      0.35  |   IO    |         |         |         |
   20+40       0.3641      0.35  |   IO    |         |         |         |
   20+45       0.3559      0.34  |   IO    |         |         |         |
   20+50       0.3481      0.33  |   O     |         |         |         |
   20+55       0.3406      0.33  |   O     |         |         |         |
   21+ 0       0.3334      0.32  |   O     |         |         |         |
   21+ 5       0.3266      0.31  |   O     |         |         |         |
   21+10       0.3200      0.31  |   O     |         |         |         |
   21+15       0.3137      0.30  |   O     |         |         |         |
   21+20       0.3077      0.30  |   O     |         |         |         |
   21+25       0.3020      0.29  |   O     |         |         |         |
   21+30       0.2964      0.29  |   O     |         |         |         |
   21+35       0.2912      0.28  |  IO     |         |         |         |
   21+40       0.2861      0.28  |  IO     |         |         |         |
-----------------------------------------------------------------------
        ****************************HYDROGRAPH DATA****************************
                        Number of intervals =   356
                        Time interval =    5.0 (Min.)
                        Maximum/Peak flow rate =       2.680 (CFS)
                        Total volume =       0.969 (Ac.Ft)
                Status of hydrographs being held in storage
                           Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
                Peak (CFS)      0.000     0.000     0.000     0.000     0.000
                Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
        ***********************************************************************

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


        ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
        Process from Point/Station       4.000 to Point/Station       3.000
        **** ADD/COMBINE/RECOVER HYDROGRAPHS ****
        ______________________________________________________________________
        ********************* HYDROGRAPH INFORMATION *********************

                        From study/file name: lebard2a3a4a25y.rte
        ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          P R I N T   O F   S T O R M
                       R u n o f f     H y d r o g r a p h
        --------------------------------------------------------------------
                    Hydrograph in   5   Minute intervals (CFS)

        --------------------------------------------------------------------
  Time(h+m) Add q(CFS)  Tot. Q   0         2.7       5.3       8.0      10.7
```

```
-----------------------------------------------------------------------
12+ 0       0.3140      0.65  |qQ       |         |         |         |
12+ 5       0.3218      0.66  |qQ       |         |         |         |
12+10       0.3474      0.69  |qQ       |         |         |         |
12+15       0.3890      0.73  |qQ       |         |         |         |
12+20       0.4206      0.77  |qQ       |         |         |         |
12+25       0.4364      0.80  |qQ       |         |         |         |
12+30       0.4453      0.81  |q Q      |         |         |         |
12+35       0.4515      0.83  |q Q      |         |         |         |
12+40       0.4574      0.85  |q Q      |         |         |         |
12+45       0.4630      0.86  |q Q      |         |         |         |
12+50       0.4688      0.88  |q Q      |         |         |         |
12+55       0.4748      0.90  |q Q      |         |         |         |
13+ 0       0.4811      0.91  |q Q      |         |         |         |
13+ 5       0.4876      0.93  |q Q      |         |         |         |
13+10       0.4943      0.95  |q Q      |         |         |         |
13+15       0.5014      0.97  |q Q      |         |         |         |
13+20       0.5087      0.98  |q Q      |         |         |         |
13+25       0.5164      1.00  |q Q      |         |         |         |
13+30       0.5244      1.02  |q Q      |         |         |         |
13+35       0.5328      1.04  |q Q      |         |         |         |
13+40       0.5415      1.06  | qQ      |         |         |         |
13+45       0.5508      1.07  | q Q     |         |         |         |
13+50       0.5605      1.09  | q Q     |         |         |         |
13+55       0.5707      1.11  | q Q     |         |         |         |
14+ 0       0.5815      1.14  | q Q     |         |         |         |
14+ 5       0.5927      1.16  | q Q     |         |         |         |
14+10       0.6032      1.18  | q Q     |         |         |         |
14+15       0.6133      1.20  | q Q     |         |         |         |
14+20       0.6250      1.22  | q Q     |         |         |         |
14+25       0.6388      1.25  | q Q     |         |         |         |
14+30       0.6542      1.27  | q Q     |         |         |         |
14+35       0.6711      1.30  | q Q     |         |         |         |
14+40       0.6900      1.33  | q Q     |         |         |         |
14+45       0.7139      1.37  | q  Q    |         |         |         |
14+50       0.7466      1.42  | q  Q    |         |         |         |
14+55       0.7881      1.48  | q  Q    |         |         |         |
15+ 0       0.8358      1.54  |  q Q    |         |         |         |
15+ 5       0.8898      1.61  |  q  Q   |         |         |         |
15+10       0.9500      1.69  |  q  Q   |         |         |         |
15+15       1.0180      1.79  |  q  Q   |         |         |         |
15+20       1.0952      1.90  |   q  Q  |         |         |         |
15+25       1.1726      2.01  |   q  Q  |         |         |         |
15+30       1.2117      2.10  |   q  Q  |         |         |         |
15+35       1.2222      2.16  |   q   Q |         |         |         |
15+40       1.2895      2.27  |   q   Q |         |         |         |
15+45       1.4513      2.48  |    q   Q|         |         |         |
15+50       1.7309      2.82  |     q   Q         |         |         |
15+55       2.1628      3.32  |       q | Q       |         |         |
16+ 0       2.8202      4.07  |         q    Q    |         |         |
16+ 5       4.2248      5.60  |         |    q    Q         |         |
16+10       7.0581      8.63  |         |         |     q   | Q       |
16+15       8.8411     10.68  |         |         |         |  q      Q
16+20       6.7630      8.89  |         |         |    q    |  Q      |
16+25       3.8712      6.24  |         |   q     |  Q      |         |
16+30       2.3204      4.86  |       q |       Q |         |         |
16+35       1.6083      4.25  |     q   |    Q    |         |         |
16+40       1.3173      4.00  |   q     |   Q     |         |         |
16+45       1.0797      3.76  |   q     |   Q     |         |         |
16+50       0.9393      3.59  |  q      |  Q      |         |         |
16+55       0.8297      3.42  |  q      | Q       |         |         |
17+ 0       0.7494      3.27  | q       | Q       |         |         |
17+ 5       0.6932      3.13  | q       |Q        |         |         |
```

```
17+10       0.6544      2.99  | q       |Q        |         |         |
17+15       0.6253      2.85  | q       Q         |         |         |
17+20       0.6005      2.71  | q       Q         |         |         |
17+25       0.5779      2.56  | q      Q|         |         |         |
17+30       0.5574      2.43  | q      Q|         |         |         |
17+35       0.5387      2.29  | q     Q |         |         |         |
17+40       0.5218      2.15  |q      Q |         |         |         |
17+45       0.5063      2.02  |q     Q  |         |         |         |
17+50       0.4920      1.90  |q     Q  |         |         |         |
17+55       0.4789      1.79  |q    Q   |         |         |         |
18+ 0       0.4668      1.69  |q    Q   |         |         |         |
18+ 5       0.4517      1.59  |q   Q    |         |         |         |
18+10       0.4198      1.48  |q   Q    |         |         |         |
18+15       0.3729      1.36  |q   Q    |         |         |         |
18+20       0.3371      1.26  |q  Q     |         |         |         |
18+25       0.3180      1.19  |q  Q     |         |         |         |
18+30       0.3066      1.14  |q  Q     |         |         |         |
18+35       0.2986      1.09  |q  Q     |         |         |         |
18+40       0.2914      1.05  |q Q      |         |         |         |
18+45       0.2852      1.01  |q Q      |         |         |         |
18+50       0.2792      0.98  |q Q      |         |         |         |
18+55       0.2736      0.95  |q Q      |         |         |         |
19+ 0       0.2682      0.92  |q Q      |         |         |         |
19+ 5       0.2632      0.89  q  Q      |         |         |         |
19+10       0.2583      0.86  q  Q      |         |         |         |
19+15       0.2537      0.84  q  Q      |         |         |         |
19+20       0.2493      0.82  q  Q      |         |         |         |
19+25       0.2451      0.79  q Q       |         |         |         |
19+30       0.2410      0.77  q Q       |         |         |         |
19+35       0.2372      0.75  q Q       |         |         |         |
19+40       0.2334      0.73  q Q       |         |         |         |
19+45       0.2299      0.72  q Q       |         |         |         |
19+50       0.2264      0.70  q Q       |         |         |         |
19+55       0.2231      0.68  q Q       |         |         |         |
20+ 0       0.2199      0.67  q Q       |         |         |         |

-----------------------------------------------------------------------
        ****************************HYDROGRAPH DATA****************************
                        Number of intervals =   356
                        Time interval =    5.0 (Min.)
                        Maximum/Peak flow rate =       10.682 (CFS)
                        Total volume =       1.836 (Ac.Ft)
                Status of hydrographs being held in storage
                           Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
                Peak (CFS)      0.000     0.000     0.000     0.000     0.000
                Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
        ***********************************************************************

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


        ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
        Process from Point/Station       11.000 to Point/Station        3.000
        **** ADD/COMBINE/RECOVER HYDROGRAPHS ****
        ______________________________________________________________________
        ******************** HYDROGRAPH INFORMATION ********************

                        From study/file name: lebard5a25y.rte
        ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          P R I N T   O F   S T O R M
                       R u n o f f     H y d r o g r a p h
        --------------------------------------------------------------------
                    Hydrograph in   5   Minute intervals (CFS)
```

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      --------------------------------------------------------------------
Time(h+m) Add q(CFS)  Tot. Q   0        4.6       9.2      13.8      18.4
-----------------------------------------------------------------------
 12+ 0       0.3267      0.97  q Q       |         |         |         |
 12+ 5       0.3335      0.99  q Q       |         |         |         |
 12+10       0.3521      1.04  q Q       |         |         |         |
 12+15       0.3834      1.12  q Q       |         |         |         |
 12+20       0.4206      1.19  q Q       |         |         |         |
 12+25       0.4444      1.24  q Q       |         |         |         |
 12+30       0.4587      1.27  q Q       |         |         |         |
 12+35       0.4682      1.30  |qQ       |         |         |         |
 12+40       0.4751      1.32  |qQ       |         |         |         |
 12+45       0.4815      1.35  |qQ       |         |         |         |
 12+50       0.4879      1.37  |qQ       |         |         |         |
 12+55       0.4940      1.39  |q Q      |         |         |         |
 13+ 0       0.5004      1.41  |q Q      |         |         |         |
 13+ 5       0.5070      1.44  |q Q      |         |         |         |
 13+10       0.5140      1.46  |q Q      |         |         |         |
 13+15       0.5211      1.49  |q Q      |         |         |         |
 13+20       0.5287      1.51  |q Q      |         |         |         |
 13+25       0.5364      1.54  |q Q      |         |         |         |
 13+30       0.5447      1.56  |q Q      |         |         |         |
 13+35       0.5532      1.59  |q Q      |         |         |         |
 13+40       0.5623      1.62  |q Q      |         |         |         |
 13+45       0.5716      1.65  |q Q      |         |         |         |
 13+50       0.5816      1.68  |q Q      |         |         |         |
 13+55       0.5918      1.71  |q Q      |         |         |         |
 14+ 0       0.6030      1.74  |q Q      |         |         |         |
 14+ 5       0.6142      1.77  |q Q      |         |         |         |
 14+10       0.6256      1.80  |q Q      |         |         |         |
 14+15       0.6364      1.84  |q Q      |         |         |         |
 14+20       0.6481      1.87  |q  Q     |         |         |         |
 14+25       0.6612      1.91  |q  Q     |         |         |         |
 14+30       0.6766      1.95  |q  Q     |         |         |         |
 14+35       0.6930      2.00  |q  Q     |         |         |         |
 14+40       0.7119      2.05  |q  Q     |         |         |         |
 14+45       0.7342      2.11  |q  Q     |         |         |         |
 14+50       0.7639      2.18  |q  Q     |         |         |         |
 14+55       0.8015      2.28  |q  Q     |         |         |         |
 15+ 0       0.8479      2.39  |q   Q    |         |         |         |
 15+ 5       0.8996      2.51  |q   Q    |         |         |         |
 15+10       0.9595      2.65  | q  Q    |         |         |         |
 15+15       1.0252      2.81  | q   Q   |         |         |         |
 15+20       1.1016      3.00  | q   Q   |         |         |         |
 15+25       1.1786      3.19  | q   Q   |         |         |         |
 15+30       1.2369      3.34  | q    Q  |         |         |         |
 15+35       1.2720      3.43  | q    Q  |         |         |         |
 15+40       1.3169      3.59  | q    Q  |         |         |         |
 15+45       1.4375      3.92  |  q    Q |         |         |         |
 15+50       1.6684      4.49  |  q     Q|         |         |         |
 15+55       2.0249      5.34  |   q     |Q        |         |         |
 16+ 0       2.6022      6.67  |    q    |   Q     |         |         |
 16+ 5       3.7256      9.33  |       q |         Q         |         |
 16+10       5.8961     14.53  |         | q       |         |Q        |
 16+15       7.7268     18.41  |         |     q   |         |         Q
 16+20       7.9588     16.85  |         |      q  |         |     Q   |
 16+25       5.5086     11.75  |         |q        |    Q    |         |
 16+30       3.5082      8.37  |      q  |       Q |         |         |
 16+35       2.3576      6.60  |    q    |   Q     |         |         |
 16+40       1.6734      5.67  |  q      | Q       |         |         |
 16+45       1.3614      5.12  | q       |Q        |         |         |
 16+50       1.1358      4.73  | q       Q         |         |         |
```

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   16+55       0.9524      4.38  | q      Q|         |         |         |
   17+ 0       0.8453      4.11  |q      Q |         |         |         |
   17+ 5       0.7696      3.90  |q      Q |         |         |         |
   17+10       0.7169      3.71  |q      Q |         |         |         |
   17+15       0.6779      3.53  |q     Q  |         |         |         |
   17+20       0.6476      3.35  |q     Q  |         |         |         |
   17+25       0.6216      3.19  |q    Q   |         |         |         |
   17+30       0.5983      3.02  |q    Q   |         |         |         |
   17+35       0.5774      2.87  |q    Q   |         |         |         |
   17+40       0.5584      2.71  |q   Q    |         |         |         |
   17+45       0.5412      2.56  |q   Q    |         |         |         |
   17+50       0.5254      2.43  |q   Q    |         |         |         |
   17+55       0.5109      2.30  |q  Q     |         |         |         |
   18+ 0       0.4975      2.18  |q  Q     |         |         |         |
   18+ 5       0.4824      2.07  |q  Q     |         |         |         |
   18+10       0.4566      1.94  q   Q     |         |         |         |
   18+15       0.4191      1.78  q  Q      |         |         |         |
   18+20       0.3768      1.64  q  Q      |         |         |         |
   18+25       0.3489      1.54  q  Q      |         |         |         |
   18+30       0.3315      1.47  q  Q      |         |         |         |
   18+35       0.3196      1.41  q  Q      |         |         |         |
   18+40       0.3110      1.36  q Q       |         |         |         |
   18+45       0.3035      1.32  q Q       |         |         |         |
   18+50       0.2967      1.28  q Q       |         |         |         |
   18+55       0.2905      1.24  q Q       |         |         |         |
   19+ 0       0.2848      1.20  q Q       |         |         |         |
   19+ 5       0.2793      1.17  q Q       |         |         |         |
   19+10       0.2740      1.14  q Q       |         |         |         |
   19+15       0.2690      1.11  q Q       |         |         |         |
   19+20       0.2643      1.08  q Q       |         |         |         |
   19+25       0.2597      1.05  q Q       |         |         |         |
   19+30       0.2553      1.03  q Q       |         |         |         |
   19+35       0.2512      1.00  q Q       |         |         |         |
   19+40       0.2472      0.98  q Q       |         |         |         |
   19+45       0.2433      0.96  q Q       |         |         |         |
   19+50       0.2396      0.94  q Q       |         |         |         |
   19+55       0.2361      0.92  qQ        |         |         |         |
   20+ 0       0.2327      0.90  qQ        |         |         |         |

-----------------------------------------------------------------------
        ****************************HYDROGRAPH DATA****************************
                        Number of intervals =   356
                        Time interval =    5.0 (Min.)
                        Maximum/Peak flow rate =       18.409 (CFS)
                        Total volume =       2.744 (Ac.Ft)
                Status of hydrographs being held in storage
                           Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
                Peak (CFS)      0.000     0.000     0.000     0.000     0.000
                Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
        ***********************************************************************

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

FLOOD HYDROGRAPH ROUTING PROGRAM

Study date: 12/04/14

LEBARD 100Y PROPOSED HYDROGRAPH

Program License Serial Number 6201

```
******************** HYDROGRAPH INFORMATION ********************

                From study/file name: LEBARD100Y.rte
************************HYDROGRAPH DATA**************************
                Number of intervals =   296
                Time interval =    5.0 (Min.)
                Maximum/Peak flow rate =        9.689 (CFS)
                Total volume =       1.355 (Ac.Ft)
        Status of hydrographs being held in storage
                   Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
        Peak (CFS)      0.000     0.000     0.000     0.000     0.000
        Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
*****************************************************************
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** RETARDING BASIN ROUTING ****
```

User entry of depth-outflow-storage data

Total number of inflow hydrograph intervals = 296
Hydrograph time unit = 5.000 (Min.)
Initial depth in storage basin =   0.00(Ft.)

Initial basin depth =   0.00 (Ft.)
Initial basin storage =   0.00 (Ac.Ft)
Initial basin outflow =   0.00 (CFS)

Depth vs. Storage and Depth vs. Discharge data:

Basin Depth (Ft.)	Storage (Ac.Ft)	Outflow (CFS)	(S-O*dt/2) (Ac.Ft)	(S+O*dt/2) (Ac.Ft)
0.000	0.000	0.000	0.000	0.000
0.200	0.037	0.400	0.036	0.038
0.400	0.074	0.800	0.071	0.077
0.600	0.111	1.600	0.105	0.117
0.800	0.148	2.200	0.140	0.156
1.000	0.185	2.600	0.176	0.194
1.200	0.222	2.900	0.212	0.232

```
         1.400      0.259      3.300      0.248        0.270
       --------------------------------------------------------------------
                       Hydrograph Detention Basin Routing
       --------------------------------------------------------------------

       Graph values: 'I'= unit inflow; 'O'=outflow at time shown
       --------------------------------------------------------------------
 Time   Inflow  Outflow    Storage                                   Depth
(Hours)  (CFS)   (CFS)     (Ac.Ft) .0       2.4    4.84    7.27    9.69 (Ft.)
12.500    0.77    0.57      0.053  |OI     |       |       |       |      0.29
12.583    0.78    0.59      0.054  |OI     |       |       |       |      0.29
12.667    0.79    0.60      0.055  |OI     |       |       |       |      0.30
12.750    0.81    0.61      0.057  | O     |       |       |       |      0.31
12.833    0.82    0.63      0.058  | O     |       |       |       |      0.31
12.917    0.83    0.64      0.059  | O     |       |       |       |      0.32
13.000    0.84    0.66      0.061  | O     |       |       |       |      0.33
13.083    0.85    0.67      0.062  | O     |       |       |       |      0.33
13.167    0.86    0.68      0.063  | O     |       |       |       |      0.34
13.250    0.87    0.70      0.064  | O     |       |       |       |      0.35
13.333    0.89    0.71      0.066  | O     |       |       |       |      0.35
13.417    0.90    0.72      0.067  | O     |       |       |       |      0.36
13.500    0.91    0.74      0.068  | OI    |       |       |       |      0.37
13.583    0.93    0.75      0.069  | OI    |       |       |       |      0.37
13.667    0.95    0.76      0.071  | OI    |       |       |       |      0.38
13.750    0.96    0.78      0.072  | OI    |       |       |       |      0.39
13.833    0.98    0.79      0.073  | OI    |       |       |       |      0.40
13.917    1.00    0.81      0.074  | OI    |       |       |       |      0.40
14.000    1.02    0.84      0.076  | OI    |       |       |       |      0.41
14.083    1.04    0.86      0.077  | OI    |       |       |       |      0.42
14.167    1.06    0.89      0.078  | OI    |       |       |       |      0.42
14.250    1.09    0.91      0.079  |  O    |       |       |       |      0.43
14.333    1.11    0.94      0.080  |  O    |       |       |       |      0.43
14.417    1.14    0.97      0.082  |  O    |       |       |       |      0.44
14.500    1.17    0.99      0.083  |  O    |       |       |       |      0.45
14.583    1.20    1.02      0.084  |  O    |       |       |       |      0.45
14.667    1.23    1.05      0.085  |  OI   |       |       |       |      0.46
14.750    1.27    1.07      0.087  |  OI   |       |       |       |      0.47
14.833    1.30    1.10      0.088  |  OI   |       |       |       |      0.48
14.917    1.35    1.13      0.089  |  OI   |       |       |       |      0.48
15.000    1.39    1.17      0.091  |  OI   |       |       |       |      0.49
15.083    1.44    1.20      0.093  |  OI   |       |       |       |      0.50
15.167    1.50    1.24      0.094  |   O   |       |       |       |      0.51
15.250    1.57    1.28      0.096  |   OI  |       |       |       |      0.52
15.333    1.64    1.32      0.098  |   OI  |       |       |       |      0.53
15.417    1.72    1.37      0.101  |   OI  |       |       |       |      0.54
15.500    1.77    1.42      0.103  |   OI  |       |       |       |      0.56
15.583    1.80    1.47      0.105  |   OI  |       |       |       |      0.57
15.667    1.88    1.53      0.108  |    OI |       |       |       |      0.58
15.750    2.03    1.59      0.110  |    OI |       |       |       |      0.60
15.833    2.27    1.65      0.114  |    O I|       |       |       |      0.62
15.917    2.64    1.73      0.119  |    O  I       |       |       |      0.64
16.000    3.26    1.86      0.127  |     O | I     |       |       |      0.69
16.083    4.68    2.09      0.141  |     O |      I|       |       |      0.76
16.167    7.65    2.42      0.168  |      O|       |       |I      |      0.91
16.250    9.69    2.80      0.210  |       |O      |       |       I      1.13
16.333    7.92    3.20      0.250  |       | O     |       | I     |      1.35
16.417    4.80    3.39      0.271  |       |  O   I|       |       |      1.46
16.500    3.11    3.43      0.274  |       | IO    |       |       |      1.48
16.583    2.26    3.39      0.270  |      I|  O    |       |       |      1.46
16.667    1.97    3.32      0.261  |     I | O     |       |       |      1.41
16.750    1.73    3.22      0.251  |    I  | O     |       |       |      1.36
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16.833    1.52    3.10      0.241  |    I  | O     |       |       |     1.30
16.917    1.40    2.98      0.230  |   I   |O      |       |       |     1.24
17.000    1.31    2.88      0.219  |   I   |O      |       |       |     1.18
17.083    1.24    2.79      0.208  |   I   |O      |       |       |     1.13
17.167    1.17    2.70      0.198  |  I    O       |       |       |     1.07
17.250    1.11    2.62      0.187  |  I    O       |       |       |     1.01
17.333    1.06    2.51      0.177  |  I    O       |       |       |     0.96
17.417    1.02    2.41      0.167  |  I   O|       |       |       |     0.90
17.500    0.98    2.31      0.158  |  I   O|       |       |       |     0.85
17.583    0.95    2.21      0.149  |  I   O|       |       |       |     0.81
17.667    0.92    2.08      0.141  |  I  O |       |       |       |     0.76
17.750    0.89    1.95      0.133  | I   O |       |       |       |     0.72
17.833    0.86    1.84      0.126  | I   O |       |       |       |     0.68
17.917    0.84    1.74      0.119  | I  O  |       |       |       |     0.65
18.000    0.82    1.64      0.113  | I  O  |       |       |       |     0.61
18.083    0.79    1.54      0.108  | I  O  |       |       |       |     0.58
18.167    0.74    1.43      0.103  | I O   |       |       |       |     0.56
18.250    0.67    1.33      0.098  | I O   |       |       |       |     0.53
18.333    0.62    1.23      0.094  | I O   |       |       |       |     0.51
18.417    0.59    1.15      0.090  |I O    |       |       |       |     0.49
18.500    0.56    1.07      0.086  |I O    |       |       |       |     0.47
18.583    0.55    1.00      0.083  |I O    |       |       |       |     0.45
18.667    0.54    0.93      0.080  |I O    |       |       |       |     0.43
18.750    0.52    0.88      0.078  |IO     |       |       |       |     0.42
18.833    0.51    0.83      0.075  |IO     |       |       |       |     0.41
18.917    0.50    0.79      0.073  |IO     |       |       |       |     0.40
19.000    0.49    0.77      0.071  |IO     |       |       |       |     0.39
19.083    0.48    0.75      0.069  |IO     |       |       |       |     0.38
19.167    0.48    0.73      0.068  |IO     |       |       |       |     0.37
19.250    0.47    0.71      0.066  |IO     |       |       |       |     0.36
19.333    0.46    0.69      0.064  |IO     |       |       |       |     0.35
19.417    0.45    0.68      0.063  |IO     |       |       |       |     0.34
19.500    0.44    0.66      0.061  |IO     |       |       |       |     0.33


       ****************************HYDROGRAPH DATA****************************
                       Number of intervals =   358
                       Time interval =    5.0 (Min.)
                       Maximum/Peak flow rate =       3.425 (CFS)
                       Total volume =       1.354 (Ac.Ft)
               Status of hydrographs being held in storage
                          Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
               Peak (CFS)      0.000     0.000     0.000     0.000     0.000
               Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
       ***********************************************************************

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


       ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
       Process from Point/Station       2.000 to Point/Station       3.000
       **** STREAM ROUTING SCS CONVEX METHOD ****
       ______________________________________________________________________
       HYDROGRAPH STREAM ROUTING DATA:
       Length of stream =    180.00 (Ft.)
       Elevation difference =    0.70 (Ft.)
       Slope of channel =  0.003889 (Vert/Horiz)
       Channel type - Improved Channel


       Channel length =   180.00(Ft.)     Elevation difference =   0.70(Ft.)
       Channel evaluation using mean flow rate of hydrograph
       Channel base width  =   10.000(Ft.)
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```
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Manning's 'N'    = 0.200
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      0.702(CFS)
Depth of flow =     0.317(Ft.)
Average velocity =     0.202(Ft/s)
Total flow rate =     0.702(CFS)
Channel flow top width =   11.899(Ft.)
Depth of flow in channel =   0.32(Ft.)
Total number of channels (same dimensions) = 1
Flow Velocity =    0.20(Ft/s)
Travel time  =    0.00 min.
Individual channel flow =    0.702(CFS)
Total capacity of improved channels =      0.702(CFS)
Critical Depth in Channel =    0.05(Ft.)


Channel evaluation using maximum flow rate of hydrograph
Flow(q) thru subarea =      3.425(CFS)
Depth of flow =     0.793(Ft.)
Average velocity =     0.349(Ft/s)
Total flow rate =     3.425(CFS)
Channel flow top width =   14.757(Ft.)
Depth of flow in channel =   0.79(Ft.)
Total number of channels (same dimensions) = 1
Flow Velocity =    0.35(Ft/s)
Travel time  =    0.00 min.
Individual channel flow =    3.425(CFS)
Total capacity of improved channels =      3.425(CFS)
Critical Depth in Channel =    0.15(Ft.)


*********************** SCS CONVEX CHANNEL ROUTING *********************
Convex method of stream routing  data items:
Using equation: Outflow =
O(t+dt) = (1-c*)O(t+dt-dt*) + Input(c*)
          where c* = 1 - (1-c)^e and dt = c(length)/velocity
          c(v/v+1.7) =   0.1703   Travel time =   8.60 (min.)
        dt*(unit time interval) =   5.00(min.),  e=   2.6100
        dt(routing time-step) =   1.46 (min.),   c* =   0.3857

Output hydrograph delayed by 0  unit time increments


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                  P R I N T  O F  S T O R M
               R u n o f f     H y d r o g r a p h
--------------------------------------------------------------------
            Hydrograph in   5   Minute intervals (CFS)

--------------------------------------------------------------------
Time(h+m) Out = O(CFS) In = I  0        0.9       1.7       2.6       3.4
-----------------------------------------------------------------------
 12+ 0       0.4964      0.51  |    O    |         |         |         |
 12+ 5       0.5014      0.51  |    O    |         |         |         |
 12+10       0.5070      0.52  |    OI   |         |         |         |
 12+15       0.5138      0.53  |     O   |         |         |         |
 12+20       0.5226      0.54  |     O   |         |         |         |
 12+25       0.5335      0.56  |     O   |         |         |         |
 12+30       0.5459      0.57  |     O   |         |         |         |
 12+35       0.5593      0.59  |     O   |         |         |         |
 12+40       0.5733      0.60  |     OI  |         |         |         |
```

```
12+45       0.5874      0.61  |     OI  |         |         |         |
12+50       0.6015      0.63  |      O  |         |         |         |
12+55       0.6156      0.64  |      O  |         |         |         |
13+ 0       0.6295      0.66  |      O  |         |         |         |
13+ 5       0.6433      0.67  |      O  |         |         |         |
13+10       0.6569      0.68  |      O  |         |         |         |
13+15       0.6703      0.70  |      OI |         |         |         |
13+20       0.6837      0.71  |      OI |         |         |         |
13+25       0.6971      0.72  |       O |         |         |         |
13+30       0.7104      0.74  |       O |         |         |         |
13+35       0.7237      0.75  |       O |         |         |         |
13+40       0.7372      0.76  |       O |         |         |         |
13+45       0.7507      0.78  |       OI|         |         |         |
13+50       0.7643      0.79  |       OI|         |         |         |
13+55       0.7793      0.81  |        O|         |         |         |
14+ 0       0.7981      0.84  |        O|         |         |         |
14+ 5       0.8200      0.86  |        OI         |         |         |
14+10       0.8435      0.89  |        OI         |         |         |
14+15       0.8678      0.91  |         O         |         |         |
14+20       0.8927      0.94  |         O         |         |         |
14+25       0.9178      0.97  |         OI        |         |         |
14+30       0.9433      0.99  |         |O        |         |         |
14+35       0.9691      1.02  |         |O        |         |         |
14+40       0.9954      1.05  |         |OI       |         |         |
14+45       1.0223      1.07  |         |OI       |         |         |
14+50       1.0500      1.10  |         | O       |         |         |
14+55       1.0787      1.13  |         | OI      |         |         |
15+ 0       1.1088      1.17  |         | OI      |         |         |
15+ 5       1.1406      1.20  |         |  OI     |         |         |
15+10       1.1743      1.24  |         |  OI     |         |         |
15+15       1.2105      1.28  |         |   O     |         |         |
15+20       1.2495      1.32  |         |   OI    |         |         |
15+25       1.2919      1.37  |         |    OI   |         |         |
15+30       1.3374      1.42  |         |    OI   |         |         |
15+35       1.3848      1.47  |         |     OI  |         |         |
15+40       1.4334      1.53  |         |     OI  |         |         |
15+45       1.4853      1.59  |         |      OI |         |         |
15+50       1.5412      1.65  |         |      O I|         |         |
15+55       1.6061      1.73  |         |       O I         |         |
16+ 0       1.6906      1.86  |         |        O|I        |         |
16+ 5       1.8177      2.09  |         |         |O  I     |         |
16+10       2.0109      2.42  |         |         |  O    I |         |
16+15       2.2718      2.80  |         |         |     O   | I       |
16+20       2.5843      3.20  |         |         |         O      I  |
16+25       2.8748      3.39  |         |         |         |  O     I|
16+30       3.0837      3.43  |         |         |         |     O   I
16+35       3.2045      3.39  |         |         |         |      O I|
16+40       3.2554      3.32  |         |         |         |       O |
16+45       3.2515      3.22  |         |         |         |      O  |
16+50       3.2067      3.10  |         |         |         |     IO  |
16+55       3.1341      2.98  |         |         |         |   I O   |
17+ 0       3.0466      2.88  |         |         |         |  I O    |
17+ 5       2.9568      2.79  |         |         |         | I O     |
17+10       2.8683      2.70  |         |         |         |I O      |
17+15       2.7811      2.62  |         |         |         I O       |
17+20       2.6895      2.51  |         |         |        I|O        |
17+25       2.5927      2.41  |         |         |       I O         |
17+30       2.4937      2.31  |         |         |     I  O|         |
17+35       2.3952      2.21  |         |         |    I O  |         |
17+40       2.2881      2.08  |         |         |   I O   |         |
17+45       2.1737      1.95  |         |         | I  O    |         |
17+50       2.0581      1.84  |         |         |I  O     |         |
17+55       1.9456      1.74  |         |         I O       |         |
```

```
   18+ 0       1.8384      1.64  |         |        I|O        |         |
   18+ 5       1.7334      1.54  |         |      I  O         |         |
   18+10       1.6281      1.43  |         |     I  O|         |         |
   18+15       1.5241      1.33  |         |    I O  |         |         |
   18+20       1.4231      1.23  |         |   I O   |         |         |
   18+25       1.3264      1.15  |         |  I O    |         |         |
   18+30       1.2355      1.07  |         | I O     |         |         |
   18+35       1.1514      1.00  |         |I O      |         |         |
   18+40       1.0746      0.93  |         I O       |         |         |
   18+45       1.0051      0.88  |         IO        |         |         |
   18+50       0.9426      0.83  |        I|O        |         |         |
   18+55       0.8885      0.79  |        IO         |         |         |
   19+ 0       0.8455      0.77  |        O|         |         |         |
   19+ 5       0.8111      0.75  |       IO|         |         |         |
   19+10       0.7825      0.73  |       IO|         |         |         |
   19+15       0.7576      0.71  |       O |         |         |         |
   19+20       0.7353      0.69  |       O |         |         |         |
   19+25       0.7150      0.68  |      IO |         |         |         |
   19+30       0.6960      0.66  |      IO |         |         |         |
   19+35       0.6782      0.65  |      O  |         |         |         |
   19+40       0.6613      0.63  |      O  |         |         |         |
   19+45       0.6453      0.62  |      O  |         |         |         |
   19+50       0.6300      0.60  |      O  |         |         |         |
   19+55       0.6153      0.59  |     IO  |         |         |         |
   20+ 0       0.6013      0.58  |     IO  |         |         |         |
   20+ 5       0.5879      0.56  |     O   |         |         |         |
   20+10       0.5750      0.55  |     O   |         |         |         |
   20+15       0.5626      0.54  |     O   |         |         |         |
   20+20       0.5507      0.53  |     O   |         |         |         |
   20+25       0.5393      0.52  |     O   |         |         |         |
   20+30       0.5284      0.51  |    IO   |         |         |         |
   20+35       0.5179      0.50  |    IO   |         |         |         |
   20+40       0.5078      0.49  |    O    |         |         |         |
   20+45       0.4981      0.48  |    O    |         |         |         |
   20+50       0.4887      0.47  |    O    |         |         |         |
   20+55       0.4797      0.46  |    O    |         |         |         |
   21+ 0       0.4711      0.45  |    O    |         |         |         |
   21+ 5       0.4628      0.45  |    O    |         |         |         |
   21+10       0.4548      0.44  |    O    |         |         |         |
   21+15       0.4471      0.43  |    O    |         |         |         |
   21+20       0.4396      0.43  |   IO    |         |         |         |
   21+25       0.4325      0.42  |   IO    |         |         |         |
   21+30       0.4256      0.41  |   O     |         |         |         |
   21+35       0.4189      0.41  |   O     |         |         |         |
   21+40       0.4125      0.40  |   O     |         |         |         |
   21+45       0.4063      0.39  |   O     |         |         |         |
   21+50       0.4004      0.39  |   O     |         |         |         |

-----------------------------------------------------------------------
        ****************************HYDROGRAPH DATA****************************
                        Number of intervals =   360
                        Time interval =    5.0 (Min.)
                        Maximum/Peak flow rate =        3.255 (CFS)
                        Total volume =      1.354 (Ac.Ft)
                Status of hydrographs being held in storage
                           Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
                Peak (CFS)      0.000     0.000     0.000     0.000     0.000
                Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
        ***********************************************************************

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

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      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station       4.000 to Point/Station       3.000
      **** ADD/COMBINE/RECOVER HYDROGRAPHS ****
      ______________________________________________________________________
      ******************** HYDROGRAPH INFORMATION *********************
                      From study/file name: LEBARD2A3A4A100Y.rte
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                        P R I N T   O F   S T O R M
                     R u n o f f     H y d r o g r a p h
      --------------------------------------------------------------------
                   Hydrograph in   5   Minute intervals (CFS)

      --------------------------------------------------------------------
Time(h+m) Add q(CFS)  Tot. Q   0        3.5       7.0      10.5      14.0
-----------------------------------------------------------------------
 12+ 0       0.6346      1.13  |q Q      |         |         |         |
 12+ 5       0.6492      1.15  |q Q      |         |         |         |
 12+10       0.6942      1.20  |q Q      |         |         |         |
 12+15       0.7649      1.28  | qQ      |         |         |         |
 12+20       0.8142      1.34  | qQ      |         |         |         |
 12+25       0.8392      1.37  | qQ      |         |         |         |
 12+30       0.8539      1.40  | qQ      |         |         |         |
 12+35       0.8657      1.43  | q Q     |         |         |         |
 12+40       0.8776      1.45  | q Q     |         |         |         |
 12+45       0.8887      1.48  | q Q     |         |         |         |
 12+50       0.9001      1.50  | q Q     |         |         |         |
 12+55       0.9121      1.53  | q Q     |         |         |         |
 13+ 0       0.9244      1.55  | q Q     |         |         |         |
 13+ 5       0.9373      1.58  | q Q     |         |         |         |
 13+10       0.9506      1.61  | q Q     |         |         |         |
 13+15       0.9647      1.64  | q Q     |         |         |         |
 13+20       0.9791      1.66  | q Q     |         |         |         |
 13+25       0.9944      1.69  | q Q     |         |         |         |
 13+30       1.0103      1.72  | q Q     |         |         |         |
 13+35       1.0270      1.75  | q  Q    |         |         |         |
 13+40       1.0444      1.78  | q  Q    |         |         |         |
 13+45       1.0629      1.81  |  q Q    |         |         |         |
 13+50       1.0821      1.85  |  q Q    |         |         |         |
 13+55       1.1026      1.88  |  q Q    |         |         |         |
 14+ 0       1.1240      1.92  |  q Q    |         |         |         |
 14+ 5       1.1472      1.97  |  q Q    |         |         |         |
 14+10       1.1727      2.02  |  q Q    |         |         |         |
 14+15       1.2010      2.07  |  q Q    |         |         |         |
 14+20       1.2298      2.12  |  q  Q   |         |         |         |
 14+25       1.2599      2.18  |  q  Q   |         |         |         |
 14+30       1.2914      2.23  |  q  Q   |         |         |         |
 14+35       1.3254      2.29  |  q  Q   |         |         |         |
 14+40       1.3618      2.36  |  q  Q   |         |         |         |
 14+45       1.4016      2.42  |   q Q   |         |         |         |
 14+50       1.4445      2.49  |   q  Q  |         |         |         |
 14+55       1.4919      2.57  |   q  Q  |         |         |         |
 15+ 0       1.5437      2.65  |   q  Q  |         |         |         |
 15+ 5       1.6016      2.74  |   q  Q  |         |         |         |
 15+10       1.6657      2.84  |   q   Q |         |         |         |
 15+15       1.7385      2.95  |   q   Q |         |         |         |
 15+20       1.8208      3.07  |    q  Q |         |         |         |
 15+25       1.9057      3.20  |    q   Q|         |         |         |
 15+30       1.9578      3.30  |    q   Q|         |         |         |
 15+35       1.9916      3.38  |    q   Q|         |         |         |
 15+40       2.0876      3.52  |    q    Q         |         |         |
 15+45       2.2669      3.75  |     q   Q         |         |         |
 15+50       2.5323      4.07  |      q  |Q        |         |         |
```

```
   15+55       2.9417      4.55  |       q | Q       |         |         |
   16+ 0       3.6823      5.37  |         q    Q    |         |         |
   16+ 5       5.5307      7.35  |         |    q    Q         |         |
   16+10       9.4487     11.46  |         |         |     q   | Q       |
   16+15      11.7316     14.00  |         |         |         |  q      Q
   16+20       8.4823     11.07  |         |         |   q     |Q        |
   16+25       4.8927      7.77  |         |  q      | Q       |         |
   16+30       3.1037      6.19  |       q |      Q  |         |         |
   16+35       2.3885      5.59  |     q   |    Q    |         |         |
   16+40       2.1226      5.38  |     q   |    Q    |         |         |
   16+45       1.7934      5.04  |    q    |   Q     |         |         |
   16+50       1.6408      4.85  |   q     |  Q      |         |         |
   16+55       1.5218      4.66  |   q     |  Q      |         |         |
   17+ 0       1.4263      4.47  |   q     | Q       |         |         |
   17+ 5       1.3451      4.30  |  q      | Q       |         |         |
   17+10       1.2749      4.14  |  q      |Q        |         |         |
   17+15       1.2131      3.99  |  q      |Q        |         |         |
   17+20       1.1597      3.85  |  q      Q         |         |         |
   17+25       1.1132      3.71  |  q      Q         |         |         |
   17+30       1.0720      3.57  |  q      Q         |         |         |
   17+35       1.0351      3.43  | q      Q|         |         |         |
   17+40       1.0016      3.29  | q      Q|         |         |         |
   17+45       0.9711      3.14  | q     Q |         |         |         |
   17+50       0.9432      3.00  | q     Q |         |         |         |
   17+55       0.9175      2.86  | q     Q |         |         |         |
   18+ 0       0.8937      2.73  | q    Q  |         |         |         |
   18+ 5       0.8649      2.60  | q    Q  |         |         |         |
   18+10       0.8076      2.44  | q   Q   |         |         |         |
   18+15       0.7267      2.25  | q   Q   |         |         |         |
   18+20       0.6692      2.09  |q   Q    |         |         |         |
   18+25       0.6378      1.96  |q   Q    |         |         |         |
   18+30       0.6181      1.85  |q   Q    |         |         |         |
   18+35       0.6026      1.75  |q   Q    |         |         |         |
   18+40       0.5881      1.66  |q  Q     |         |         |         |
   18+45       0.5756      1.58  |q  Q     |         |         |         |
   18+50       0.5638      1.51  |q  Q     |         |         |         |
   18+55       0.5526      1.44  |q  Q     |         |         |         |
   19+ 0       0.5420      1.39  |q Q      |         |         |         |
   19+ 5       0.5319      1.34  |q Q      |         |         |         |
   19+10       0.5222      1.30  |q Q      |         |         |         |
   19+15       0.5130      1.27  |q Q      |         |         |         |
   19+20       0.5042      1.24  |q Q      |         |         |         |
   19+25       0.4958      1.21  |q Q      |         |         |         |
   19+30       0.4878      1.18  |q Q      |         |         |         |

-----------------------------------------------------------------------
        ****************************HYDROGRAPH DATA****************************
                        Number of intervals =   360
                        Time interval =    5.0 (Min.)
                        Maximum/Peak flow rate =       14.003 (CFS)
                        Total volume =       2.856 (Ac.Ft)
                Status of hydrographs being held in storage
                           Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
                Peak (CFS)      0.000     0.000     0.000     0.000     0.000
                Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
        ***********************************************************************

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


        ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
        Process from Point/Station       11.000 to Point/Station        7.000
        **** ADD/COMBINE/RECOVER HYDROGRAPHS ****
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******************** HYDROGRAPH INFORMATION *********************

          From study/file name: LEBARD5A100Y.rte
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                  P R I N T  O F  S T O R M
               R u n o f f     H y d r o g r a p h
-------------------------------------------------------------------
            Hydrograph in   5   Minute intervals (CFS)

-------------------------------------------------------------------
Time(h+m) Add q(CFS)  Tot. Q   0        6.0      12.0      18.0      24.0
-------------------------------------------------------------------------
 12+ 0       0.6563      1.79   |qQ       |         |         |         |
 12+ 5       0.6687      1.82   |q Q      |         |         |         |
 12+10       0.6998      1.90   |q Q      |         |         |         |
 12+15       0.7510      2.03   |q Q      |         |         |         |
 12+20       0.8117      2.15   |q Q      |         |         |         |
 12+25       0.8514      2.22   |q Q      |         |         |         |
 12+30       0.8760      2.28   |q Q      |         |         |         |
 12+35       0.8930      2.32   |q Q      |         |         |         |
 12+40       0.9060      2.36   |q Q      |         |         |         |
 12+45       0.9183      2.39   |q Q      |         |         |         |
 12+50       0.9306      2.43   |q  Q     |         |         |         |
 12+55       0.9426      2.47   |q  Q     |         |         |         |
 13+ 0       0.9553      2.51   |q  Q     |         |         |         |
 13+ 5       0.9682      2.55   |q  Q     |         |         |         |
 13+10       0.9820      2.59   |q  Q     |         |         |         |
 13+15       0.9959      2.63   |q  Q     |         |         |         |
 13+20       1.0109      2.67   |q  Q     |         |         |         |
 13+25       1.0261      2.72   |q  Q     |         |         |         |
 13+30       1.0424      2.76   |q  Q     |         |         |         |
 13+35       1.0590      2.81   |q  Q     |         |         |         |
 13+40       1.0769      2.86   |q  Q     |         |         |         |
 13+45       1.0952      2.91   |q  Q     |         |         |         |
 13+50       1.1149      2.96   |q  Q     |         |         |         |
 13+55       1.1352      3.02   |q   Q    |         |         |         |
 14+ 0       1.1571      3.08   |q   Q    |         |         |         |
 14+ 5       1.1799      3.15   |q   Q    |         |         |         |
 14+10       1.2054      3.22   | q  Q    |         |         |         |
 14+15       1.2325      3.30   | q  Q    |         |         |         |
 14+20       1.2623      3.38   | q  Q    |         |         |         |
 14+25       1.2924      3.47   | q  Q    |         |         |         |
 14+30       1.3247      3.56   | q  Q    |         |         |         |
 14+35       1.3581      3.65   | q   Q   |         |         |         |
 14+40       1.3949      3.75   | q   Q   |         |         |         |
 14+45       1.4336      3.86   | q   Q   |         |         |         |
 14+50       1.4767      3.97   | q   Q   |         |         |         |
 14+55       1.5226      4.09   | q   Q   |         |         |         |
 15+ 0       1.5742      4.23   | q    Q  |         |         |         |
 15+ 5       1.6298      4.37   | q    Q  |         |         |         |
 15+10       1.6932      4.53   | q    Q  |         |         |         |
 15+15       1.7625      4.71   | q    Q  |         |         |         |
 15+20       1.8430      4.91   |  q    Q |         |         |         |
 15+25       1.9258      5.12   |  q    Q |         |         |         |
 15+30       1.9965      5.29   |  q    Q |         |         |         |
 15+35       2.0511      5.43   |  q     Q|         |         |         |
 15+40       2.1202      5.64   |  q     Q|         |         |         |
 15+45       2.2551      6.01   |  q      Q         |         |         |
 15+50       2.4777      6.55   |   q     Q         |         |         |
 15+55       2.8125      7.36   |   q     | Q       |         |         |
 16+ 0       3.4060      8.78   |    q    |   Q     |         |         |
 16+ 5       4.7577     12.11   |      q  |         Q         |         |
```

```
   16+10       7.5489     19.01  |         | q       |         |Q        |
   16+15       9.9551     23.96  |         |     q   |         |        Q
   16+20      10.3412     21.41  |         |      q  |         |    Q    |
   16+25       7.2397     15.01  |         | q       |    Q    |         |
   16+30       4.7631     10.95  |      q  |       Q |         |         |
   16+35       3.3573      8.95  |    q    |   Q     |         |         |
   16+40       2.5145      7.89  |   q     |  Q      |         |         |
   16+45       2.1526      7.20  |  q      | Q       |         |         |
   16+50       1.8952      6.74  |  q      |Q        |         |         |
   16+55       1.6847      6.34  | q       Q         |         |         |
   17+ 0       1.5631      6.04  | q       Q         |         |         |
   17+ 5       1.4657      5.77  | q      Q|         |         |         |
   17+10       1.3837      5.53  | q      Q|         |         |         |
   17+15       1.3124      5.31  | q     Q |         |         |         |
   17+20       1.2502      5.10  | q     Q |         |         |         |
   17+25       1.1964      4.90  |q      Q |         |         |         |
   17+30       1.1492      4.71  |q     Q  |         |         |         |
   17+35       1.1073      4.54  |q     Q  |         |         |         |
   17+40       1.0696      4.36  |q     Q  |         |         |         |
   17+45       1.0355      4.18  |q    Q   |         |         |         |
   17+50       1.0044      4.01  |q    Q   |         |         |         |
   17+55       0.9759      3.84  |q    Q   |         |         |         |
   18+ 0       0.9496      3.68  |q    Q   |         |         |         |
   18+ 5       0.9209      3.52  |q   Q    |         |         |         |
   18+10       0.8757      3.31  |q   Q    |         |         |         |
   18+15       0.8123      3.06  |q   Q    |         |         |         |
   18+20       0.7417      2.83  |q  Q     |         |         |         |
   18+25       0.6939      2.66  |q  Q     |         |         |         |
   18+30       0.6631      2.52  |q  Q     |         |         |         |
   18+35       0.6411      2.40  |q Q      |         |         |         |
   18+40       0.6247      2.29  |q Q      |         |         |         |
   18+45       0.6100      2.19  |q Q      |         |         |         |
   18+50       0.5966      2.10  q  Q      |         |         |         |
   18+55       0.5845      2.03  q  Q      |         |         |         |
   19+ 0       0.5730      1.96  q  Q      |         |         |         |
   19+ 5       0.5620      1.91  q  Q      |         |         |         |
   19+10       0.5516      1.86  q  Q      |         |         |         |
   19+15       0.5417      1.81  q  Q      |         |         |         |
   19+20       0.5322      1.77  q Q       |         |         |         |
   19+25       0.5232      1.73  q Q       |         |         |         |
   19+30       0.5145      1.70  q Q       |         |         |         |
   19+35       0.5062      1.66  q Q       |         |         |         |
   19+40       0.4983      1.63  q Q       |         |         |         |
   19+45       0.4906      1.60  q Q       |         |         |         |
   19+50       0.4833      1.57  q Q       |         |         |         |

-----------------------------------------------------------------------
        ****************************HYDROGRAPH DATA****************************
                        Number of intervals =   360
                        Time interval =    5.0 (Min.)
                        Maximum/Peak flow rate =       23.959 (CFS)
                        Total volume =       4.422 (Ac.Ft)
                Status of hydrographs being held in storage
                           Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
                Peak (CFS)      0.000     0.000     0.000     0.000     0.000
                Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
        ***********************************************************************

        --------------------------------------------------------------------
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TTG

Appendix D-Existing Residential Percent Pervious Calculations

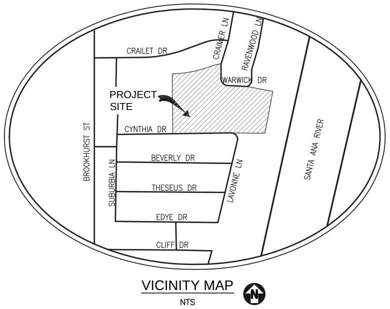
(Crailet Drive)

CRAILET DRIVE-LOTS 50 THRU 61-% PERVIOUS CALCULATION

Lot No.	Lot Area (sf)	Pervious Area (sf)	% Pervious
50	8860	3700	42
51	7150	2930	41
52	7400	3420	46
53	6870	2920	43
54	6830	2540	37
55	6830	1980	29
56	6830	3300	48
57	6830	2030	30
58	6830	3580	52
59	6830	2400	35
60	6830	3000	44
61	6650	2500	38
		Average	40%
		Impervious Cover	60%

Total DU	12
Total Ac	1.95
DU/AC	6.2

1. OCHM recommended Impervious cover for 5-7 DU/Acre = 50%
2. Existing condition impervious cover for Lots 50-61 = 60 %
3. Proposed Subdivision total impervious cover using 60% impervious cover for lots and 90% cover for streeet R/W = 65%
4. "Condominium" land use will be used for development type within new subdivision to mimic 65% impervious cover. (program does not allow user defined Ap values for initial subareas)



VICINITY MAP
NTS

LEGEND

- EXISTING CONTOURS
- FLOW LINE
- FLOW DIRECTION
- SUB-DRAINAGE AREA BOUNDARY
- DRAINAGE AREA BOUNDARY
- (3) DRAINAGE NODE NUMBER
- (2A / X.XX) SUB-DRAINAGE AREA NUMBER / AREA ACREAGE (AC)
- (A) DRAINAGE AREA

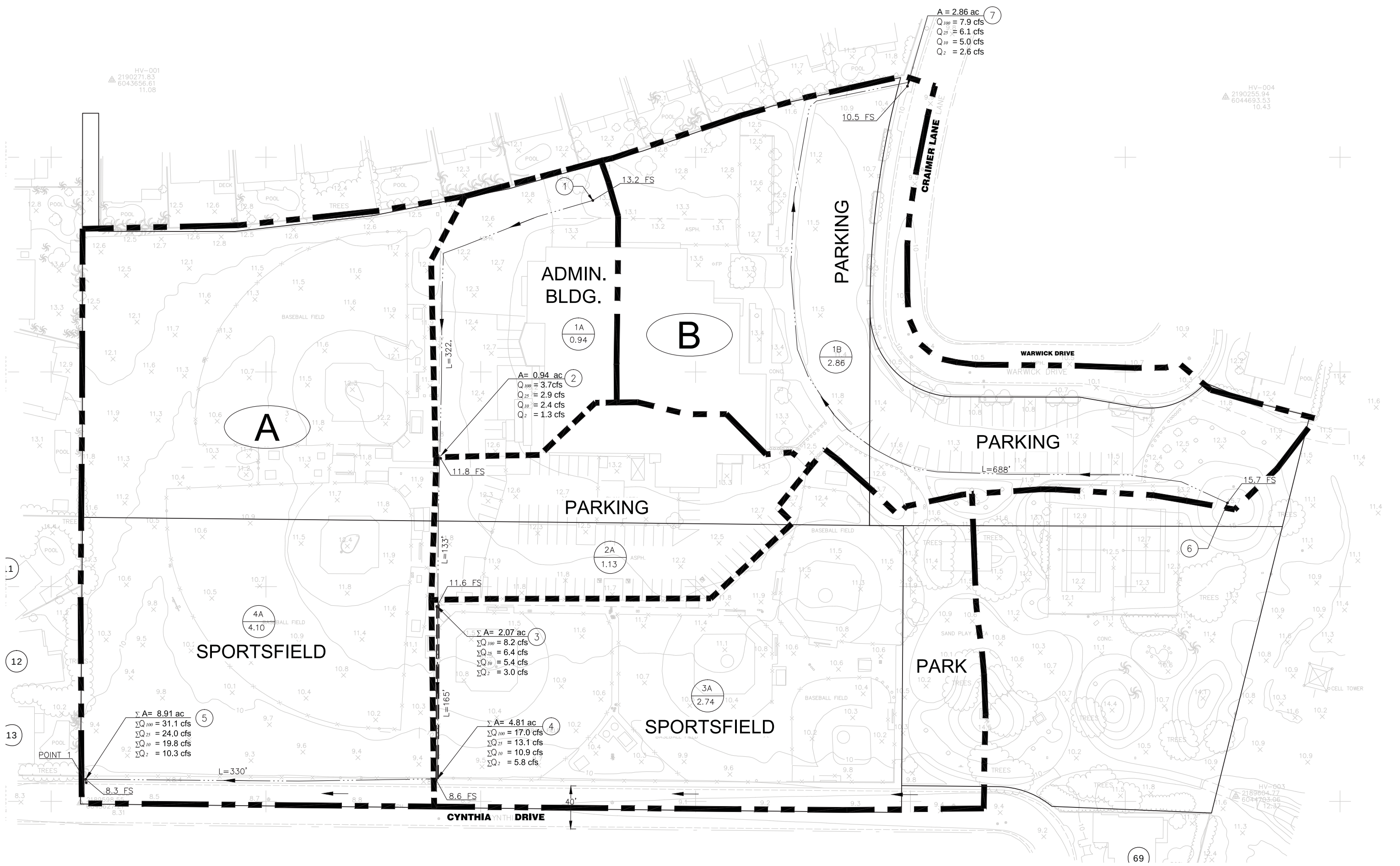
Σ A=10.0 ac	TOTAL DRAINAGE AREA
Q_{100} =4.0 cfs	100-YEAR STORM PEAK FLOW RATE
Q_{25} =3.0 cfs	25-YEAR STORM PEAK FLOW RATE
Q_{10} =2.0 cfs	10-YEAR STORM PEAK FLOW RATE
Q_{2} =1.0 cfs	2-YEAR STORM PEAK FLOW RATE

HYDROLOGY INFORMATION

SITE AREA:	11.7 ACRE
SOIL GROUP:	D
IMPERVIOUS:	PER CALCULATIONS
ISOHYETALS:	PER ORANGE COUNTY HYDROLOGY MANUAL
T_C:	PER CALCULATIONS
FREQUENCY:	100-YR, 25-YR, 10-YR & 2-YR
METHOD:	ORANGE COUNTY HYDROLOGY MANUAL MODIFIED RATIONAL METHOD

PRE-DEVELOPMENT HYDROLOGY TABLE:

DRAINAGE AREA NO.	SUB-DRAINAGE AREA NO.	AREA (acre)	PEAK FLOW RATE Q100 (cfs)	PEAK FLOW RATE Q25 (cfs)	PEAK FLOW RATE Q10 (cfs)	PEAK FLOW RATE Q2 (cfs)
A	1A	0.94	3.70	2.89	2.42	1.34
	2A	1.13	4.47	3.50	2.93	1.63
	3A	2.74	8.78	6.72	5.50	2.78
	4A	4.10	14.10	10.84	8.92	4.57
B	1B	2.86	7.85	6.10	5.03	2.64



GRAPHIC SCALE
50 0 25 50 100 150
(IN FEET)
1 inch = 50 ft.

REGISTERED PROFESSIONAL ENGINEER CRAIG HAUSE NO. 63620 CIVIL STATE OF CALIFORNIA

NO.	DATE	REVISIONS	APP'D	DATE

JOB NO.: 0214693.00
SCALE: 1" = 50'
DATE: 12/4/2014
DESIGNED BY: C.H.

TMAD TAYLOR & GAINES
901 Via Piemonte, Suite 400
Ontario, California 91764
Phone: 909.477.6915 Fax: 909.477.6916
www.ttgcorp.com
Project No. 0012.059.00

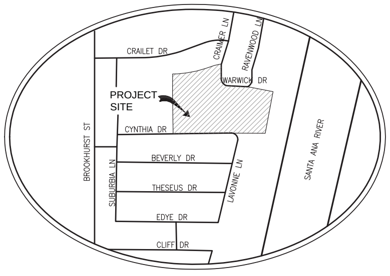
PREPARED UNDER THE SUPERVISION OF:

CRAIG A HAUSE RCE NO. 63620 DATE

LE BARD DEVELOPMENT PROJECT
EXISTING CONDITION
HYDROLOGY MAP

CITY OF HUNTINGTON BEACH

SHEET 1 OF 2 SHEETS



VICINITY MAP
NTS

LEGEND

SITE LIMITS
RIGHT OF WAY
PROPERTY LINE
CENTERLINE
FLOW LINE
FLOW DIRECTION
SUB-DRAINAGE AREA BOUNDARY
DRAINAGE AREA BOUNDARY
(3) DRAINAGE AREA REACH NUMBER
(2A) SUB-DRAINAGE AREA NUMBER
(X.XX) AREA ACREAGE (AC)
(A) DRAINAGE AREA

Σ A=4.2 ac	TOTAL DRAINAGE AREA
Q_{100} =6.5 cfs	100-YEAR STORM PEAK FLOW RATE
Q_{25} =5.6 cfs	25-YEAR STORM PEAK FLOW RATE
Q_{10} =3.4 cfs	10-YEAR STORM PEAK FLOW RATE
Q_{2} =1.4 cfs	2-YEAR STORM PEAK FLOW RATE

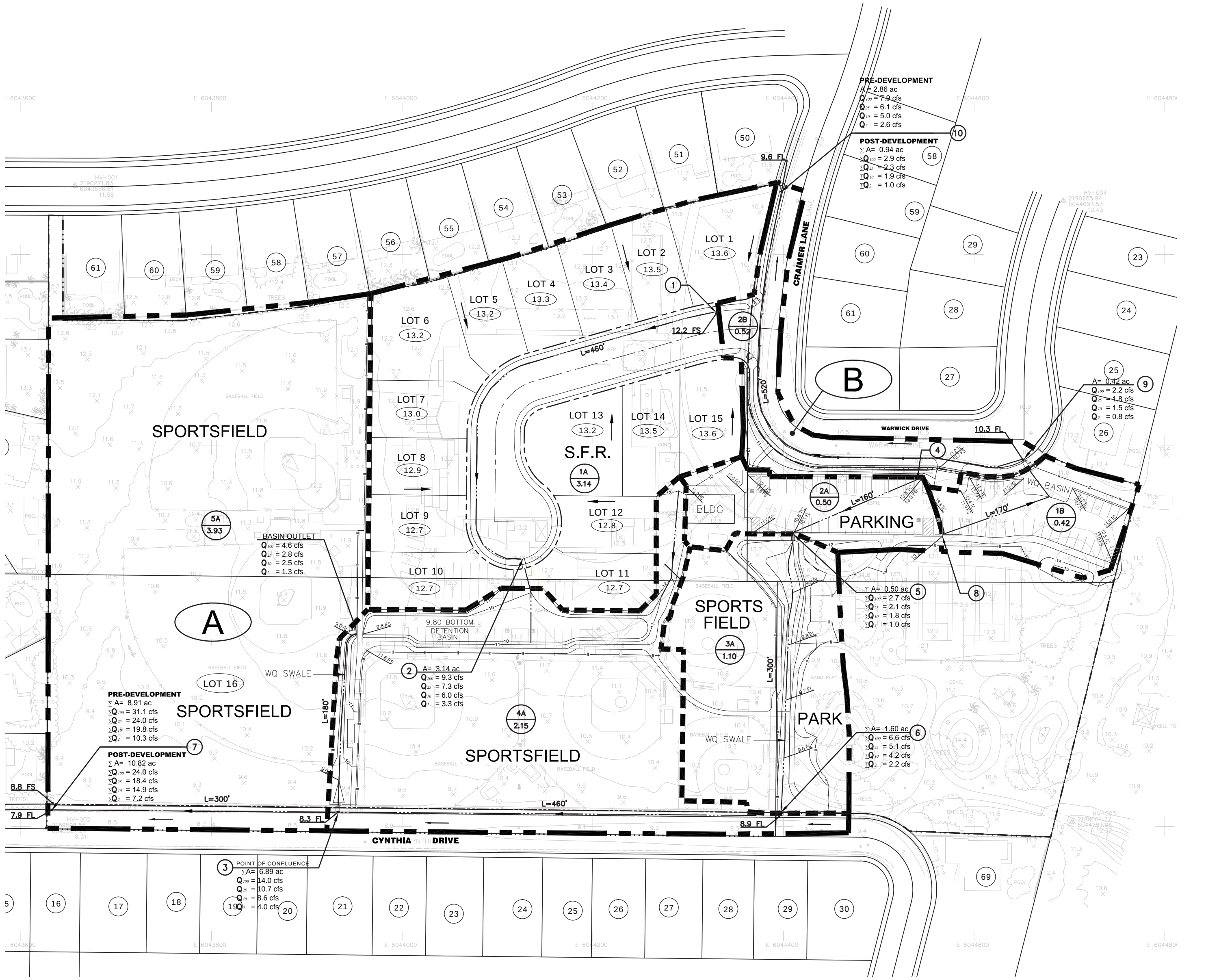
HYDROLOGY INFORMATION

SITE AREA: 11.7 ACRE
SOIL GROUP: D
IMPERVIOUS: PER CALCULATIONS
ISOHYETALS: PER ORANGE COUNTY HYDROLOGY MANUAL
T_C: PER CALCULATIONS
FREQUENCY: 100-YR, 25-YR, 10-YR & 2-YR
METHOD: ORANGE COUNTY HYDROLOGY MANUAL
1. MODIFIED RATIONAL METHOD (PRE-DEV. CONDITION) AND PROP. CONDITION Tc CALCULATIONS
2. UNIT HYDROGRAPH METHOD WITH BASIN ROUTING (PROPOSED CONDITION)

POST-DEVELOPMENT HYDROLOGY TABLE:

DRAINAGE AREA NO.	SUB-DRAINAGE AREA NO.	AREA (acre)	PEAK FLOW RATE Q100 (cfs)	PEAK FLOW RATE Q25 (cfs)	PEAK FLOW RATE Q10 (cfs)	PEAK FLOW RATE Q2 (cfs)
A	1A	3.14	9.28	7.25	6.02	3.27
	2A	0.50	2.73	2.12	1.79	0.99
	3A	1.10	3.92	2.96	2.40	1.17
	4A	2.15	4.68	3.46	2.72	1.23
	5A	3.93	7.92	5.74	4.42	1.84
B	1B	0.42	2.24	1.75	1.47	0.82
	2B	0.52	0.70	0.51	0.38	0.16

GRAPHIC SCALE
50 0 25 50 100 150
(IN FEET)
1 inch = 50 ft.



JOB NO.:	0214693.00
SCALE:	1" = 50'
DATE:	12/4/2014
DESIGNED BY:	C.H.

NO.	DATE	REVISIONS	APP'D	DATE

REGISTERED PROFESSIONAL ENGINEER CRAIG HAUSE NO. 63620 CIVIL STATE OF CALIFORNIA

TMAD TAYLOR & GAINES
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Phone: 909.477.6915 Fax: 909.477.6916
www.ttgcorp.com Project No. 0012.059.00

PREPARED UNDER THE SUPERVISION OF:

CRAIG A HAUSE RCE NO. 63620 DATE

LE BARD DEVELOPMENT
PROPOSED CONDITION
HYDROLOGY MAP

CITY OF HUNTINGTON BEACH

SHEET 2 OF 2 SHEETS

Preliminary Water Quality Management Plan for LeBard Park Site

Preliminary Water Quality Management Plan (PWQMP)

Project Name:

LeBard Park Site

Prepared for:

City of Huntington Beach

2000 Main Street

Huntington Beach, CA 92648

714-536-5511

Prepared by:

TTG Engineers

Engineer: Craig Hause, P.E. Registration No. C63620

20532 El Toro Road Suite 203

Mission Viejo, CA 92692

949-716-7460

Project Owner's Certification

Permit/Application No.	2012-0229	Grading Permit No.	TBD
Tract/Parcel Map No.	TTM 17801	Building Permit No.	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract)			APN 155-145-01 155-131-29

This Water Quality Management Plan (WQMP) has been prepared for the City of Huntington Beach by TTG Engineers. The WQMP is intended to comply with the requirements of the local NPDES Stormwater Program requiring the preparation of the plan.

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 the current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

Owner:			
Title			
Company	City of Huntington Beach		
Address			
Email			
Telephone #			
Signature		Date	

Contents

Page No.

Attachments (PROVIDED IN FINAL WQMP)

Section I Discretionary Permit(s) and Water Quality Conditions

Provide discretionary permit and water quality information. *Refer to Section 2.1 in the Technical Guidance Document (TGD) available from the Orange County Stormwater Program (ocwatersheds.com).*

Project Infomation			
Permit/Application No.	2012-0229	Tract/Parcel Map No.	TTM 17801
Additional Information/ Comments:			
Water Quality Conditions			
Water Quality Conditions (list verbatim)	**THE FOLLOWING DEVELOPMENT REQUIREMENTS SHALL BE COMPLETED PRIOR TO ISSUANCE OF A GRADING PERMIT:** 1. A Project Water Quality Management Plan (WQMP) conforming to the current Waste Discharge Requirements Permit for the County of Orange (Order No. R8-2009-0030) [MS4 Permit] prepared by a Licensed Civil Engineer, shall be submitted to the Department of Public Works for review and acceptance. The WQMP shall address Section XII of the MS4 Permit and all current surface water quality issues. 2. The project WQMP shall include the following: a. Low Impact Development. b. Discusses regional or watershed programs (if applicable). c. Addresses Site Design BMPs (as applicable) such as minimizing impervious areas, maximizing permeability, minimizing directly connected impervious areas, creating reduced or “zero discharge” areas, and conserving natural areas. d. Incorporates the applicable Routine Source Control BMPs as defined in the Drainage Area Management Plan. (DAMP) e. Incorporates Treatment Control BMPs as defined in the DAMP. f. Generally describes the long-term operation and maintenance		

	requirements for the Treatment Control BMPs. g. Identifies the entity that will be responsible for long-term operation and maintenance of the Treatment Control BMPs. h. Describes the mechanism for funding the long-term operation and maintenance of the Treatment Control BMPs. i. Includes an Operations and Maintenance (O&M) Plan for all structural BMPs. j. After incorporating plan check comments of Public Works, three final WQMPs (signed by the owner and the Registered Civil Engineer of record) shall be submitted to Public Works for acceptance. After acceptance, two copies of the final report shall be returned to applicant for the production of a single complete electronic copy of the accepted version of the WQMP on CD media that includes: i. The 11" by 17" Site Plan in .TIFF format (400 by 400 dpi minimum). ii. The remainder of the complete WQMP in .PDF format including the signed and stamped title sheet, owner's certification sheet, Inspection/Maintenance Responsibility sheet, appendices, attachments and all educational material. k. The applicant shall return one CD media to Public Works for the project record file. 3. Indicate the type and location of Water Quality Treatment Control Best Management Practices (BMPs) on the Grading Plan consistent with the Project WQMP. The WQMP shall follow the City of Huntington Beach; Project Water Quality Management Plan Preparation Guidance Manual dated June 2006. The WQMP shall be submitted with the first submittal of the Grading Plan. 4. A suitable location, as approved by the City, shall be depicted on the grading plan for the necessary trash enclosure(s). The area shall be paved with an impervious surface, designed not to allow run-on from adjoining areas, designed to divert drainage from adjoining roofs and pavements diverted around the area, and screened or walled to prevent off-site transport of trash. The trash enclosure area shall be covered or roofed with a solid, impervious material. Connection of trash area drains into the storm drain system is prohibited. If feasible, the trash enclosure area shall be connected into the sanitary sewer. (DAMP)

	THE FOLLOWING DEVELOPMENT REQUIREMENTS SHALL BE COMPLETED PRIOR TO FINAL INSPECTION OR OCCUPANCY: 5. Prior to grading or building permit close-out and/or the issuance of a certificate of use or a certificate of occupancy, the applicant shall: a. Demonstrate that all structural Best Management Practices (BMPs) described in the Project WQMP have been constructed and installed in conformance with approved plans and specifications. b. Demonstrate all drainage courses, pipes, gutters, basins, etc. are clean and properly constructed. c. Demonstrate that applicant is prepared to implement all non-structural BMPs described in the Project WQMP. d. Demonstrate that an adequate number of copies of the approved Project WQMP are available for the future occupiers.
Watershed-Based Plan Conditions	
Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	N/A

Section II Project Description

II.1 Project Description

Provide a detailed project description including:

- Project area is 2.0 acres.
- Land uses: Existing: Park/Recreation Center/Parking Lot; Proposed: No Change
- Land cover: Existing: Grass/Asphalt; Proposed: No Change
- Design elements: Vegetated Swale, Bioretention Basin

Include attributes relevant to determining applicable source controls. *Refer to Section 2.2 in the TGD for information that must be included in the project description.*

Description of Proposed Project				
Development Category (Verbatim from WQMP):	This is a significant redevelopment project as it replaces in excess of 5,000 sf of impervious surfaces per table 7.II-2 of the Model WQMP			
Project Area (ft²): __ 2.0 acre (87,120 _ft²)__	Number of Dwelling Units: 0		SIC Code: 6552	
Narrative Project Description:	The existing land use is a park and sportsfield site with associated parking lot. The proposed land use is the same. The existing parking lot shared between the school and park is being removed as part of the proposed 15-lot residential subdivision replacing the school. A new parking lot is provided. The existing ball fields and park facilities will remain.			
Project Area:	Pervious		Impervious	
	Area (acres or sq ft)	Percentage	Area (acres or sq ft)	Percentage
Pre-Project Conditions	1.4	70	0.6	30
Post-Project Conditions	1.1	55	0.9	45
Drainage Patterns/Connections	Surface flow to city storm drain system. Outlets to Santa Ana River.			

II.2 Potential Stormwater Pollutants

Determine and list expected stormwater pollutants based on land uses and site activities. *Refer to Section 2.2.2 and Table 2.1 in the TGD for guidance.*

Pollutants of Concern			
Pollutant	Circle One: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment	E		Should be reduced. Total parking area is less.
Nutrients	E		Pre and post development condition expect to equal in volumetric proportions
Heavy Metals	E		
Pathogens (Bacteria/Virus)	E		
Pesticides	E		Pre and post-development condition expect to equal in volumetric proportions
Oil and Grease	E		
Toxic Organic Compounds	E		
Trash and Debris	E		

II.3 Hydrologic Conditions of Concern

Determine if streams located downstream from the project area are determined to be potentially susceptible to hydromodification impacts. *Refer to Section 2.2.3.1 in the TGD for* NOC *or Section 2.2.3.2 for* <SOC>.

☒ No – Show map

☐ Yes – Describe applicable hydrologic conditions of concern below. *Refer to Section 2.2.3 in the TGD.*

II.4 Post Development Drainage Characteristics

Describe post development drainage characteristics. *Refer to Section 2.2.4 in the TGD.*

The proposed parking lot redevelopment area has two separate drainage courses. The west side of the parking lot (Area 1A on the WQMP Map) drains south to Cynthia Drive via a proposed vegetated swale the runs between the existing ball fields and the park. The east side of the lot (Area 2A) drains north to Warwick Drive through a bioretention basin located in the proposed landscaped area. The remaining undisturbed areas (Area 3A) continue to sheet flow south to Cynthia Drive.

II.5 Property Ownership/Management

The property is owned by the City of Huntington Beach (APN 155-145-01 & 155-131-29) and includes parking and park uses that will be modified to accommodate the proposed project.

The adjacent property is owned by Huntington Beach City School District. A proposed 15-lot subdivision is planned to replace the existing school and administration buildings. A separate WQMP will be prepared for the property owned by the district and is not within the boundary of this WQMP.

Section III Site Description

III.1 Physical Setting

Fill out table with relevant information. *Refer to Section 2.3.1 in the TGD.*

Planning Area/ Community Name	TTM 17801
Location/Address	20461 Craimer Lane Huntington Beach, CA
Land Use	Park/Recreational Area/Parking Lot
Zoning	OS-PR
Acreage	2.0
Predominant Soil Type	D

III.2 Site Characteristics

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. Refer to Section 2.3.2 in the TGD.

Precipitation Zone	*1*
Topography	*The site is relatively constant grade sloping approximately 1% to the South.*
Drainage Patterns/Connections	*Surface flow & outlet to existing street. There is no connection to city's storm drain system.*
Soil Type, Geology, and Infiltration Properties	*Soil Type: D* *Type D soil is not suitable for infiltration.*

Site Characteristics (continued)	
Hydrogeologic (Groundwater) Conditions	*Historic high groundwater levels may be as shallow as 3'*
Geotechnical Conditions (relevant to infiltration)	*Site lies within liquefaction zone*
Off-Site Drainage	*None*
Utility and Infrastructure Information	*There are no storm drain facilities serving the site. The nearest storm drain facilities are located at the corner of corner of Jon Day Drive & Craimer Ln. Runoff surface flows to the street curb and conveyed to this location.*

III.3 Watershed Description

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. *Refer to Section 2.3.3 in the TGD.*

Receiving Waters	Santa Ana River, Reach 1
303(d) Listed Impairments	None
Applicable TMDLs	None
Pollutants of Concern for the Project	Sediment, Nutrients, Pesticides, Oil and Greases, Heavy Metals, Pathogens, Toxic organic compounds, Trash & Debris (Parking Lot)
Environmentally Sensitive and Special Biological Significant Areas	None

Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

Describe project performance criteria. Several steps must be followed in order to determine what performance criteria will apply to a project. These steps include:

- If the project has an approved WIHMP or equivalent, then any watershed specific criteria must be used and the project can evaluate participation in the approved regional or sub-regional opportunities. The local Permittee planning or NPDES staff should be consulted regarding the existence of an approved WIHMP or equivalent.
- Determine applicable hydromodification control performance criteria. *Refer to Section 7.II-2.4.2.2 of the Model WQMP.*
- Determine applicable LID performance criteria. *Refer to Section 7.II-2.4.3 of the Model WQMP.*
- Determine applicable treatment control BMP performance criteria. *Refer to Section 7.II-*3.2.2 *of the Model WQMP.*
- Calculate the LID design storm capture volume for the project. *Refer to Section 7.II-2.4.3 of the Model WQMP.*

(NOC Permit Area only) Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis?	YES ☐	NO ☒
If yes, describe WIHMP feasibility criteria or regional/sub-regional LID opportunities.		

Project Performance Criteria (continued)

If HCOC exists, list applicable hydromodification control performance criteria (Section 7.II-2.4.2.2 in MWQMP)	The proposed development does not have a HCOC because the post-development runoff volume for the 2-year, 24-hr storm does not exceed the pre-development runoff volume for the 2-year, 24-hr storm by more than 5%.
List applicable LID performance criteria (Section 7.II-2.4.3 from MWQMP)	According to Section 7.II-2.4.3 within the Model WQMP Template (MWQMP), a properly designed biotreatment system can only be considered if infiltration, harvest and use, and evapotranspiration cannot be feasibly implemented for the full design capture volume. These are not feasible for the project given the soil conditions. The LID and Treatment Control BMP Performance Criteria within the MWQMP states that LID BMPs must be designed to biotreat 80 percent average annual capture efficiency. The proposed vegetated swale and bioretention basin has been design accordingly.
List applicable treatment control BMP performance criteria (Section 7.II-3.2.2 from MWQMP)	According to the requirements presented for North Orange County, if LID performance criteria through retention and or biotreatment is not feasible then treatment control BMPs shall be implemented off-site prior o runoff discharge from development to the waterbody. There will be no need for any other BMP treatment as the biotreatment provided by the vegetated swale and bioretention basin is sufficient to treat the 80 percent average annual capture efficiency.
Calculate LID design storm capture volume for Project.	(see table below)

DRAINAGE AREA NO.	SUB-DRAINAGE AREA NO.	AREA (acre)	IMPERVIOUS NO. (%)	Q (cfs)	DCV (cft)	BMP DEVICES
A	**1A**	**0.50**	**78**	**0.07**	940	**VEGETATED SWALE**
	2A	**0.42**	**65**	0.05	**683**	**BIORETENTION BASIN**
	3A	1.10	13	0.06	699	GRASS COVER*

* EXISTING WELL MAITAINED GRASS COVER TO REMAIN, WHICH SERVES AS VEGETATED FILTER STRIP

A flow-based vegetated swale is provided for DMA 1A. A volume-based bioretention basin is provided for DMA 2A. DMA 3A are existing sports fields and park and not part of the disturbed area and require no BMP. The poor soil quality at the site does not allow for natural infiltration into the existing ground. The site must surface drain to the surrounding streets given the lack of storm drain facilities.

lebardparkswale.out

```
  CIVILCADD/CIVILDESIGN  Engineering Software, (c) 2004   Version 7.0
 --------------------------------------------------------------------
 LEBARD-AREA 1A SWALE-PARK SITE
 LID DESIGN Q


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

 Program License Serial Number 6201

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                *** Improved Channel Analysis ***

        Upstream (headworks) Elevation =     10.000(Ft.)
        Downstream (outlet) Elevation =      9.500(Ft.)
        Runoff/Flow Distance =    280.000(Ft.)
        Maximum flow rate in channel(s) =      0.090(CFS)


 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 *** CALCULATED DEPTH DATA AT FLOW =    0.09(CFS) ***
 Channel base width  =    2.000(Ft.)
 Slope or 'Z' of left channel bank =   3.000
 Slope or 'Z' of right channel bank =   3.000
 Manning's 'N'    = 0.240
 Maximum depth of channel  =    0.500(Ft.)
 Flow(q) thru channel =      0.090(CFS)
 Depth of flow =   0.312(Ft.)
 Average velocity =   0.098(Ft/s)
 Total flow rate in 1/2 street =   0.090(CFS)
 Channel flow top width =    3.871(Ft.)
 Depth of flow in channel =   0.31(Ft.)

 Total number of channels (same dimensions) = 1
 Flow Velocity =    0.10(Ft/s)
 Individual channel flow =    0.090(CFS)
 Total capacity of channel(s) =      0.090(CFS)
```
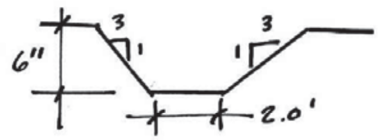



SWALE LENGTH:

L = 60 · t_{HR} · V_{WQ}

ASSUME: t_{HR} = 10 min. (HYDRAULIC RESIDENCE TIME)

V_{WQ} = 0.1 ft/sec

L = 60 · 10 · 0.1

= 60' min > 100' MIN. PER T.G.D.

280' PROVIDED ✓

Page 1

BIORETENTION BASIN

DESIGN CAPTURE VOLUME $DCV = 683\ ft^3$

DRAW-DOWN TIME: $DD_P = (d_P / K_{MEDIA}) \times 12\ in/ft$

d_P = PONDING DEPTH = 6"

K_{MEDIA} = 2.5 in/hr (PER TGD)

$\therefore DD_P = (6/2.5)(12) = 29$ HRS < 48 HRS OK ✓

FACILITY SURFACE AREA:

$A = DCV / d_P$

$= 683'/0.5' = 1366$ sq. ft. <= 1400 sq. ft provided.

OK ✓

stability, maintenance access and public safety considerations are met.

- ☐ The minimum swale length for biotreatment applications is 100 feet. The minimum residence time for flows in the swale is 10 minutes.
- ☐ If slope is less than 1.5%, underdrains should be provided for the length of the swale
- ☐ A gravel blanket or bedding is required around the underdrain pipe(s). At least 0.5 feet of washed aggregate must be placed below, to the top, and to the sides of the underdrain pipe(s).
- ☐ If an underdrain is included, an amended soil layer of 1 foot minimum thickness must be provided above the underdrain meeting the specifications of MISC-1: Planting/Storage Media.
- ☐ The maximum bed slope in flow direction should not exceed 6% (unles check dams are provided).
- ☐ The maximum flow velocity should not exceed 1.0 ft/sec for water quality treatment swales.
- ☐ For infrequently mowed swales, a maximum flow depth of 4 inches should be implemented. For frequently mowed turf swales, the maximum flow depth is 2 inches.
- ☐ The vegetation height should be maintained between 4 to 6 inches.
- ☐ Gradual meandering bends in the swale are desirable for aesthetic purposes and to promote slower flow and particulate settling.
- ☐ Blockages in the swale that result in uneven flow distribution and points of concentrated flow should be avoided. Blockages that should be avoided include trees, bushes, light pole piers, and utility vaults or pads.

Sizing Method for Vegetated Swales

The Design Capture Method for Flow-based BMPs should be used to determine the design flowrate for a vegetated swale. The user then selects the design flow depth and longitudinal slope and uses the sizing steps below to determine the length and width of the swale. The sizing steps are as follows:

Step 1: Determine Design Flowrate (Q)

Calculate the Design Flowrate (Q) using the Capture Efficiency Method for Flow-based BMPs (See **Appendix III.3.3**). Inputs include the time of concentration of the catchment (T_c) and the capture efficiency achieved upstream by HSCs or other BMPs.

Step 2: Estimate the Swale Bottom Width

For shallow flow depths, channel side slopes can be ignored and the bottom width can be calculated using a simplified form of Manning's formula:

$$b = (Q \times n_{WQ}) / (1.49 \times y^{1.67} \times s^{0.5})$$

Where:

b = estimated swale bottom width, ft

Q = design flowrate, cfs

n_{WQ} = Manning's roughness coefficient for shallow flow conditions, use 0.2 unless other information is available

y = design flow depth, ft (not to exceed 4 inches or 0.33 ft)

s = longitudinal slope in flow direction, ft/ft (not to exceed 0.06)

If b is between 2 and 10 feet, proceed to step 3.

If b is less than 2 feet, increase b to 2 feet and recalculate design flow depth using the following:

$y = ((Q \times n_{WQ}) / (1.49 \times b \times s^{0.5}))^{0.6}$

If b is greater than 10 feet, one of the following steps is necessary:

- Increase longitudinal slope to a maximum of 6% or 0.06, and recalculate b
- Increase design flow depth to a maximum of 4 inches or 0.33 ft, and recalculate b
- Install a divider lengthwise along swale bottom at least three-quarters of the swale length, beginning at the inlet. The swale width can be increased to 16 feet if a divider is provided.

Step 3: Determine Design Flow Velocity

Calculate the design flow velocity using the following equation:

$V_{WQ} = Q / A_{WQ}$

Where:

V_{WQ} = design flow velocity, fps

Q = design flowrate, cfs

$A_{WQ} = by + Zy^2$, cross sectional area of flow at design depth

Z = side slope length per unit height

If the design flow velocity exceeds 1 foot per second, design parameters in Step 2 should be adjusted (slope, bottom width, or design flow depth) until V_{WQ} is equal or less than 1 fps.

Step 4: Calculate Swale Length

Calculate the swale length needed to achieve a minimum hydraulic residence time of 10 minutes using the following equation:

$L = 60 \times t_{HR} \times V_{WQ}$

Where:

L = swale length, ft

t_{HR} = hydraulic residence time, min (minimum 10 minutes)

V_{WQ} = design flow velocity, fps

Step 5: If Needed, Adjust Swale Length to Site Constraints

Note that oftentimes swale length can be accomodated by providing a meandering swale. However, if swale length is too large for the site, the length can be adjusted as follows:

- Calculate the swale treatment top area (A_{top}), based on the swale length calculated in Step 4:

$A_{TOP} = (b_i + b_{SLOPE}) \times L_i$

Where:

A_{TOP} = top area (ft^2) at the design treatment depth

b_i = bottom width (ft), calculated in Step 2

b_{SLOPE} = the additional top width (ft) above the side slope for the design water depth (for 3:1 side slopes and a 4-inch water depth, b_{slope} = 2 feet)

L_i = initial length (ft) calculated in Step 4

- Use the swale top area and a reduced swale length (L_f) to increase the bottom width, using the following equation:

$L_F = A_{TOP} / (b_F + b_{SLOPE})$

Where:

BIO-2: Vegetated Swale

Also known as:
- *Bioswale*
- *Biofiltration swale*
- *Grass swale*

Vegetated Swale
Source: Geosyntec Consultants

Vegetated swale filters (vegetated swales) are open, shallow channels with low-lying vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. Vegetated swales provide pollutant removal through settling and filtration in the vegetation (usually grasses) lining the channels. In addition, they provide the opportunity for volume reduction through infiltration and ET, and reduce the flow velocity in addition to conveying storm water runoff. Where soil conditions allow, volume reduction in vegetated swales can be enhanced by adding a gravel drainage layer underneath the swale allowing additional flows to be retained and infiltrated. Where slopes are shallow and soil conditions limit or prohibit infiltration, an underdrain system or low flow channel for dry weather flows may be required to minimize ponding and convey treated and/or dry weather flows to an acceptable discharge point. An effective vegetated swale achieves uniform sheet flow through a densely vegetated area for a period of several minutes. The vegetation in the swale can vary depending on its location within the project area and is generally the choice of the designer, subject to the design criteria outlined in this section.

Feasibility Screening Considerations

- Swales may cause incidental infiltration; however, infiltration is not a mandatory mechanism for pollutant removal for swales and it may create hazards in some circumstances. Therefore, conditions should be evaluated to determine whether circumstances require an impermeable liner to avoid infiltration into the subsurface.

Opportunity Criteria

- Open areas are needed for vegetated swales, including, but not limited to, road shoulders, road medians, parks and athletic fields and can be constructed in residential or commercial areas.
- Site slope is less than 10 percent.
- Drainage area is ≤ 5 acres.
- Vegetated swales must not interfere with flood control functions of existing conveyance and detention structures.

OC-Specific Design Criteria and Considerations

☐ Swales should have a minimum bottom width of 2 feet and a maximum bottom width of 10 feet. Swale dividers should be used if the bottom width must exceed 10 feet to promote even distribution of flow across the swale. Local juridictions may require larger minimum widths based on maintenance requirements.

☐ The channel side slope should not exceed 2:1 (H:V) for a total swale depth of 1 foot or less. For deeper swales or mowed grass swales, the maximum channel side slope should be 3:1. Where space is constrained, swales may have vertical concrete or block walls provided that slope

L_F = reduced swale length (ft)

b_F = increased bottom width (ft)

- Recalculate V_{WQ} according to Step 3 using the revised cross-sectional area A_{WQ} based on the increased bottom width (b_F). Revise the design as necessary if the design flow velocity exceeds 1 foot per second.
- Recalculate to ensure that the 10 minute retention time is retained.

Configuration for Use in a Treatment Train

- Vegetated swales can be incorporated in a treatment train to provide enhanced water quality treatment and reductions in runoff volume and rate. For example, if a vegetated swale is placed upgradient of a dry extended detention (ED) basin, the rate and volume of water flowing to the dry ED basin can be reduced and the water quality enhanced. As another example, dry ED basins may be placed upstream a vegetated swale to reduce the size of the vegetated swale.
- Vegetated swales can be used as pretreatment for infiltration BMPs.
- If designed with an infiltration sump, vegetated "bioinfiltration" swales can provide retention and biotreatment capacity.

Additional References for Design Guidance

Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 4: http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850

Santa Barbara BMP Guidance Manual, Chapter 6: http://www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf

- County of San Diego Drainage Design Manual for design criteria, Section 5.5: http://www.co.san-diego.ca.us/dpw/floodcontrol/floodcontrolpdf/drainage-designmanual05.pdf

County of Los Angeles Low Impact Development Standards Manual, Chapter 5: http://dpw.lacounty.gov/wmd/LA_County_LID_Manual.pdf

- Los Angeles County Stormwater BMP Design and Maintenance Manual: http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf

c. Compute the drawdown time of the cistern as:

   Drawdown Time (hr) = [Volume (cu-ft) × 7.48 gal/cu-ft× 24hr/day]/[Demand (gpd)]

d. Based on 1.0 × design capture storm depth and the drawdown time computed in Step I, calculate the long term average capture efficiency using the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (See **Appendix** III.3.2).

e. If capture efficiency is less than 40 percent, harvest and use is not required to be considered for use on the project.

f. If capture efficiency is greater than 40 percent, provide a cistern sized for the DCV and provide volume or flowate to treat the remaining volume up to 80 percent total average annual capture using biotreatment BMP.

Configuration for Use in a Treatment Train

- Cisterns can be combined into a treatment train to provide enhanced water quality treatment and reductions in the runoff volume and rate. For example, if a green roof is placed upgradient of a cistern, the rate and volume of water flowing to the cistern can be reduced and the water quality enhanced.
- Cisterns can be incorporated into the landscape design of a site and can be aesthetically pleasing as well as functional for irrigation purposes.
- Treatment of the captured rainwater (i.e. disinfection) may be required depending on the end use of the water.
- Cisterns can be designed to overflow to biotreatment BMPs.

Additional References for Design Guidance

Santa Barbara BMP Guidance Manual, Chapter 6: http://www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf

- County of Los Angeles Low Impact Development Standards Manual, Chapter 5: http://dpw.lacounty.gov/wmd/LA_County_LID_Manual.pdf
- SMC LID Manual (pp 114): http://www.lowimpactdevelopment.org/guest75/pub/All_Projects/SoCal_LID_Manual/SoCalLID_Manual_FINAL_040910.pdf

San Diego County LID Handbook Appendix 4 (Factsheet 26): http://www.sdcounty.ca.gov/dplu/docs/LID-Appendices.pdf

XIV.5. Biotreatment BMP Fact Sheets (BIO)

Conceptual criteria for biotreatment BMP selection, design, and maintenance are contained in Appendix XII. These criteria are generally applicable to the design of biotreatment BMPs in Orange County and BMP-specific guidance is provided in the following fact sheets. [24]

Note: Biotreatment BMPs shall be designed to provide the maximum feasible infiltration and ET based on criteria contained in ***Appendix*** *XI.2.*

BIO-1: Bioretention with Underdrains

Bioretention stormwater treatment facilities are landscaped shallow depressions that capture and filter stormwater runoff. These facilities function as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. The facilities normally consist of a ponding area, mulch layer, planting soils, and plants. As stormwater passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded, and sequestered by the soil and plants. Bioretention with an underdrain are utilized for areas with low permeability native soils or steep slopes where the underdrain system that routes the treated runoff to the storm drain system rather than depending entirely on infiltration. Bioretention must be designed without an underdrain in areas of high soil permeability.

Also known as:

- *Rain gardens with underdrains*
- *Vegetated media filter*
- *Downspout planter boxes*

Bioretention
Source: Geosyntec Consultants

Feasibility Screening Considerations

- If there are no hazards associated with infiltration (such as groundwater concerns, contaminant plumes or geotechnical concerns), bioinfiltration facilities, which achieve partial infiltration, should be used to maximize infiltration.

[24] Not all BMPs presented in this section are considered "biofiltration BMPs" under the South Orange County Permit Area. Biofiltration BMPs are vegetated treat-and-release BMPs that filter stormwater through amended soil media that is biologically active, support plant growth, and also promote infiltration and/or evapotranspiration. For projects in South Orange County, the total volume of storage in surface ponding and pores spaces is required to be at least 75% of the remaining DCV that the biofiltration BMP is designed to address. This prevents significant down-sizing of BMPs which otherwise may be possible via routing calculations. Biotreatment BMPs that do not meet this definition are not considered to be LID BMPs, but may be used as treatment control or pre-treatment BMPs. See Section III.7 and Worksheet SOC-1 for guidance.

- Bioretention with underdrain facilities should be lined if contaminant plumes or geotechnical concerns exist. If high groundwater is the reason for infiltration infeasibility, bioretention facilities with underdrains do not need to be lined.

Opportunity Criteria

- Land use may include commercial, residential, mixed use, institutional, and subdivisions. Bioretention may also be applied in parking lot islands, cul-de-sacs, traffic circles, road shoulders, road medians, and next to buildings in planter boxes.
- Drainage area is ≤ 5 acres.
- Area is available for infiltration.
- Site must have adequate relief between land surface and the stormwater conveyance system to permit vertical percolation through the soil media and collection and conveyance in underdrain to stormwater conveyance system.

OC-Specific Design Criteria and Considerations

- ☐ Ponding depth should not exceed 18 inches; fencing may be required if ponding depth is greater than 6 inches to mitigate drowning.
- ☐ The minimum soil depth is 2 feet (3 feet is preferred).
- ☐ The maximum drawdown time of the bioretention ponding area is 48 hours. The maximum drawdown time of the planting media and gravel drainage layer is 96 hours, if applicable.
- ☐ Infiltration pathways may need to be restricted due to the close proximity of roads, foundations, or other infrastructure. A geomembrane liner, or other equivalent water proofing, may be placed along the vertical walls to reduce lateral flows. This liner should have a minimum thickness of 30 mils.
- ☐ If infiltration in bioretention location is hazardous due to groundwater or geotechnical concerns, a geomembrane liner must be installed at the base of the bioretention facility. This liner should have a minimum thickness of 30 mils.
- ☐ The planting media placed in the cell shall be designed per the recommendations contained in MISC-1: Planting/Storage Media
- ☐ Plant materials should be tolerant of summer drought, ponding fluctuations, and saturated soil conditions for 48 hours; native plant species and/or hardy cultivars that are not invasive and do not require chemical inputs should be used to the maximum extent feasible
- ☐ The bioretention area should be covered with 2-4 inches (average 3 inches) or mulch at the start and an additional placement of 1-2 inches of mulch should be added annually.
- ☐ Underdrain should be sized with a 6 inch minimum diameter and have a 0.5% minimum slope. Underdrain should be slotted polyvinyl chloride (PVC) pipe; underdrain pipe should be more than 5 feet from tree locations (if space allows).
- ☐ A gravel blanket or bedding is required for the underdrain pipe(s). At least 0.5 feet of washed aggregate must be placed below, to the top, and to the sides of the underdrain pipe(s).
- ☐ An overflow device is required at the top of the bioretention area ponding depth.
- ☐ Dispersed flow or energy dissipation (i.e. splash rocks) for piped inlets should be provided at basin inlet to prevent erosion.
- ☐ Ponding area side slopes shall be no steeper than 3:1 (H:V) unless designed as a planter box BMP with appropriate consideration for trip and fall hazards.

Simple Sizing Method for Bioretention with Underdrain

If the Simple Design Capture Volume Sizing Method described in **Appendix** III.3.1 is used to size a bioretention with underdrain facility, the user selects the basin depth and then determines the appropriate surface area to capture the DCV. The sizing steps are as follows:

Step 1: Determine DCV

Calculate the DCV using the Simple Design Capture Volume Sizing Method described in **Appendix** III.3.1.

Step 2: Verify that the Ponding Depth will Draw Down within 48 Hours

The ponding area drawdown time can be calculated using the following equation:

$$DD_P = (d_P / K_{MEDIA}) \times 12 \text{ in/ft}$$

Where:

DD_P = time to drain ponded water, hours

d_P = depth of ponding above bioretention area, ft (not to exceed 1.5 ft)

K_{MEDIA} = media design infiltration rate, in/hr (equivalent to the media hydraulic conductivity with a factor of safety of 2; K_{MEDIA} of 2.5 in/hr should be used unless other information is available)

If the drawdown time exceeds 48 hours, adjust ponding depth and/or media infiltration rate until 48 hour drawdown time is achieved.

Step 3: Determine the Depth of Water Filtered During Design Capture Storm

The depth of water filtered during the design capture storm can be estimated as the amount routed through the media during the storm, or the ponding depth, whichever is smaller.

$$d_{FILTERED} = \text{Minimum} \left[((K_{MEDIA} \times T_{ROUTING})/12), d_P \right]$$

Where:

$d_{FILTERED}$ = depth of water that may be considered to be filtered during the design storm event, ft

K_{MEDIA} = media design infiltration rate, in/hr (equivalent to the media hydraulic conductivity with a factor of safety of 2; K_{MEDIA} of 2.5 in/hr should be used unless other information is available)

$T_{ROUTING}$ = storm duration that may be assumed for routing calculations; this should be assumed to be no greater than 3 hours. If the designer desires to account for further routing effects, the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (See **Appendix** III.3.2) should be used.

d_P = depth of ponding above bioretention area, ft (not to exceed 1.5 ft)

Step 4: Determine the Facility Surface Area

$$A = DCV / (d_P + d_{FILTERED})$$

Where:

A = required area of bioretention facility, sq-ft

DCV = design capture volume, cu-ft

$d_{FILTERED}$ = depth of water that may be considered to be filtered during the design storm event, ft

d_P = depth of ponding above bioretention area, ft (not to exceed 1.5 ft)

In South Orange County, the provided ponding plus pore volume must be checked to demonstrate that it is greater than 0.75 of the remaining DCV that this BMP is designed to address. See Section III.7 and Worksheet SOC-1.

Capture Efficiency Method for Bioretention with Underdrains

If the bioretention geometry has already been defined and the user wishes to account more explicitly for routing, the user can determine the required footprint area using the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (See Appendix III.3.2) to determine the fraction of the DCV that must be provided to manage 80 percent of average annual runoff volume. This method accounts for drawdown time different than 48 hours.

Step 1: Determine the drawdown time associated with the selected basin geometry

$DD = (d_p / K_{DESIGN}) \times 12$ in/ft

Where:

DD = time to completely drain infiltration basin ponding depth, hours

d_P = bioretention ponding depth, ft (should be less than or equal to 1.5 ft)

K_{DESIGN} = design media infiltration rate, in/hr (assume 2.5 inches per hour unless otherwise proposed)

If drawdown is less than 3 hours, the drawdown time should be rounded to 3 hours or the Capture Efficiency Method for Flow-based BMPs (See Appendix III.3.3) shall be used.

Step 2: Determine the Required Adjusted DCV for this Drawdown Time

Use the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (See Appendix III.3.2) to calculate the fraction of the DCV the basin must hold to achieve 80 percent capture of average annual stormwater runoff volume based on the basin drawdown time calculated above.

Step 3: Determine the Basin Infiltrating Area Needed

The required infiltrating area (i.e. the surface area of the top of the media layer) can be calculated using the following equation:

$A = \text{Design Volume} / d_p$

Where:

A = required infiltrating area, sq-ft (measured at the media surface)

Design Volume = fraction of DCV, adjusted for drawdown, cu-ft (see Step 2)

d_p = ponding depth of water stored in bioretention area, ft (from Step 1)

This does not include the side slopes, access roads, etc. which would increase bioretention footprint. If the area required is greater than the selected basin area, adjust surface area or adjust ponding depth and recalculate required area until the required area is achieved.

In South Orange County, the provided ponding plus pore volume must be checked to demonstrate that it is greater than 0.75 of the remaining DCV that this BMP is designed to address. See Section III.7 and Worksheet SOC-1.

Configuration for Use in a Treatment Train

- Bioretention areas may be preceeded in a treatment train by HSCs in the drainage area, which would reduce the required design volume of the bioretention cell. For example, bioretention could be used to manage overflow from a cistern.
- Bioretention areas can be used to provide pretreatment for underground infiltration systems.

Additional References for Design Guidance

- CASQA BMP Handbook for New and Redevelopment: http://www.cabmphandbooks.com/Documents/Development/TC-32.pdf

TECHNICAL GUIDANCE DOCUMENT APPENDICES

- SMC LID Manual (pp 68):
  http://www.lowimpactdevelopment.org/guest75/pub/All_Projects/SoCal_LID_Manual/SoCalLID_Manual_FINAL_040910.pdf
- Los Angeles County Stormwater BMP Design and Maintenance Manual, Chapter 5:
  http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf
- San Diego County LID Handbook Appendix 4 (Factsheet 7):
  http://www.sdcounty.ca.gov/dplu/docs/LID-Appendices.pdf

  Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 4:
  http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850
- County of Los Angeles Low Impact Development Standards Manual, Chapter 5:
  http://dpw.lacounty.gov/wmd/LA_County_LID_Manual.pdf

IV.2. SITE DESIGN AND DRAINAGE PLAN

Describe site design and drainage plan including

- A narrative of site design practices utilized or rationale for not using practices;
- A narrative of how site is designed to allow BMPs to be incorporated to the MEP
- A table of DMA characteristics and list of LID BMPs proposed in each DMA.
- Reference to the WQMP plot plan.
- Calculation of Design Capture Volume (DCV) for each drainage area.
- A listing of GIS coordinates for LID and Treatment Control BMPs (unless not required by local jurisdiction).

Refer to Section 2.4.2 in the TGD.

The options for LID site design are limited given the scope of the project of a small parking lot reconstruction. The existing park area south of the parking lot is used as treatment for DMA 1A as it allows enough bioswale length to satisfy the hydraulic residence time. A portion of the proposed landscape areas for DMA 2A is used to incorporate a bioretention basin for treatment. The lack of any existing storm drain facilities serving the site is also a limiting factor. The WQMP Map and BMP site plan can be found at the end of this report.

Because the proposed project is less than 5.0 acres, the MWQMP allows for a simplified calculation of the LID Design Q. Per Section III.1.2 Simple Method Runoff Coefficient for Flow-Based BMP Sizing, Equation III.3 states:

Q=C x I x A, where…

Q=Design Flow Rate (cfs)

I= Design Intensity (0.25 in/hr per Figure III.4 (TGD) for a 5 min. Tc and 80% capture efficiency)

C= Runoff Coefficient= (0.75 x % imp + 0.15)

A=Tributary Area (acres): 0.50

DMA 1A:

Q= ((0.75 x 0.78) + 0.15) x 0.25 in/hr x 0.50 acres

Q= 0.09 cfs

Given the small nature of the project, GIS coordinates are not necessary.

The simple DCV sizing method calculation in Section III.3 of the TGD states:

DCV= C x I x A x (1 ft./12 in.) (43,560 sq. ft./acre), where….

DCV= Design Capture Volume (cu. ft.)

I= 85th percentile-24 hr. storm depth (in.): 0.70

C= Runoff Coefficient= (0.75 x % imp + 0.15)

A=Tributary Area (acres): 0.42

DMA 2A:

DCV= ((0.75 x 0.65) + 0.15) x 0.70 in x 0.42 acres x (1 ft./12in) (43,560 sq. ft/acre)

DCV= 683 cu. ft.

Given the small nature of the project, GIS coordinates are not necessary. DMA 3A has no water quality requirement. The WQMP Site Plan and BMP Exhibit can be found at the end of the report.

IV.3 LID BMP SELECTION AND PROJECT CONFORMANCE ANALYSIS

Each sub-section below documents that the proposed design features conform to the applicable project performance criteria via check boxes, tables, calculations, narratives, and/or references to worksheets. *Refer to Section 2.4.2.3 in the TGD for selecting LID BMPs and Section 2.4.3 in the TGD for conducting conformance analysis with project performance criteria.*

IV.3.1 Hydrologic Source Controls

If required HSCs are included, fill out applicable check box forms. If the retention criteria are otherwise met with other LID BMPs, include a statement indicating HSCs not required.

Name	Included?
Localized on-lot infiltration	☐
Impervious area dispersion (e.g. roof top disconnection)	☐
Street trees (canopy interception)	☐
Residential rain barrels (not actively managed)	☐
Green roofs/Brown roofs	☐
Blue roofs	☐
Impervious area reduction (e.g. permeable pavers, site design)	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐

HSCs are not required for the project. The full LID requirements can be met without them.

IV.3.2 Infiltration BMPs

Identify infiltration BMPs to be used in project. If design volume cannot be met state why BMPs cannot be met

Name	Included?
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐
Infiltration basins	☐
Drywells	☐
Subsurface infiltration galleries	☐
French drains	☐
Permeable asphalt	☐
Permeable concrete	☐
Permeable concrete pavers	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Strom Capture Volume can be met with infiltration BMPs. If not document how much can be met with infiltration and document why it is not feasible to meet the full volume with infiltration BMPs.

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, describe any evapotranspiration, rainwater harvesting BMPs.

Name	Included?
All HSCs; *See Section IV.3.1*	☐
Surface-based infiltration BMPs	☐
Biotreatment BMPs	☒
Above-ground cisterns and basins	☐
Underground detention	☐
Other:	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Strom Capture Volume can be met with evapotranspiration, rainwater harvesting BMPs in combination with infiltration BMPs. If not document how much can be met with either infiltration BMPs, evapotranspiration, rainwater harvesting BMPs, or a combination, and document why it is not feasible to meet the full volume with either of these BMPs categories.

See LID Volume calculations.

IV.3.4 Biotreatment BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, and/or evapotranspiration and rainwater harvesting BMPs, describe biotreatment BMPs. Include sections for selection, suitability, sizing, and infeasibility, as applicable.

Name	Included?
Bioretention with underdrains	☒
Stormwater planter boxes with underdrains	☐
Rain gardens with underdrains	☐
Constructed wetlands	☐
Vegetated swales	☒
Vegetated filter strips	☐
Proprietary vegetated biotreatment systems	☐
Wet extended detention basin	☐
Dry extended detention basins	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Strom Capture Volume can be met with infiltration, evapotranspiration, rainwater harvesting and/or biotreatment BMPs. If not document how much can be met with either infiltration BMPs, evapotranspiration, rainwater harvesting BMPs, or a combination, and document why it is not feasible to meet the full volume with either of these BMPs categories.

Same as LID calculation.

IV.3.5 Hydromodification Control BMPs

Describe hydromodification control BMPs. See Section 5 TGD. Include sections for selection, suitability, sizing, and infeasibility, as applicable. Detail compliance with Prior Conditions of Approval.

Hydromodification Control BMPs	
BMP Name	**BMP Description**

IV.3.6 Regional/Sub-Regional LID BMPs

Describe regional/sub-regional LID BMPs in which the project will participate. *Refer to Section 7.II-2.4.3.2 of the Model WQMP*.

Regional/Sub-Regional LID BMPs

IV.3.7 Treatment Control BMPs

Treatment control BMPs can only be considered if the project conformance analysis indicates that it is not feasible to retain the full design capture volume with LID BMPs. Describe treatment control BMPs including sections for selection, sizing, and infeasibility, as applicable.

Treatment Control BMPs	
BMP Name	**BMP Description**
Vegetated Swale	Westerly portion of proposed parking area to drain south to low point in curb and underwalk drain into vegetated swale.
Bioretention basin	Easterly portion of proposed parking area drains to bioretention basin/planter. Underdrains will carry excess flows via under sidewalk drain.

IV.3.8 Non-structural Source Control BMPs

Fill out non-structural source control check box forms or provide a brief narrative explaining if non-structural source controls were not used **(BMP FACT SHEETS WILL BE PROVIDED WITH FINAL WQMP).**

Non-Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
N1	Education for Property Owners, Tenants and Occupants	☒	☐	
N2	Activity Restrictions	☐	☒	Not applicable
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	No hazardous waste management needed
N6	Local Industrial Permit Compliance	☐	☒	Not an industrial project
N7	Spill Contingency Plan	☐	☒	No hazardous materials
N8	Underground Storage Tank Compliance	☐	☒	No storage tanks
N9	Hazardous Materials Disclosure Compliance	☐	☒	No hazardous materials
N10	Uniform Fire Code Implementation	☒	☐	
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☐	☒	No Employees
N13	Housekeeping of Loading Docks	☐	☒	No Loading Docks
N14	Common Area Catch Basin Inspection	☐	☒	No catch basins
N15	Street Sweeping Private Streets and Parking Lots	☐	☒	Public Street-City Sweeping
N16	Retail Gasoline Outlets	☐	☒	Not a proposed facility

IV.3.9 Structural Source Control BMPs

Fill out structural source control check box forms or provide a brief narrative explaining if Structural source controls were not used *(BMP FACT SHEETS WILL BE PROVIDED WITH FINAL WQMP).*

Structural Source Control BMPs

Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
S1	Provide storm drain system stenciling and signage	☐	☒	No Storm Drain System Onsite
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	Not part of development
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☐	☒	Existing Park Trash Receptacles to remain
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☐	☒	No slopes and channels exist. No need for energy dissipation.
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☒	☐	
S6	Dock areas	☐	☒	Not a proposed facility
S7	Maintenance bays	☐	☒	Not a proposed facility
S8	Vehicle wash areas	☐	☒	Not a proposed facility
S9	Outdoor processing areas	☐	☒	Not a proposed facility
S10	Equipment wash areas	☐	☒	Not a proposed facility
S11	Fueling areas	☐	☒	Not a proposed facility
S12	Hillside landscaping	☐	☒	No hillsides
S13	Wash water control for food preparation areas	☐	☒	Not a proposed facility
S14	Community car wash racks	☐	☒	Not a proposed facility

IV.4 ALTERNATIVE COMPLIANCE PLAN (IF APPLICABLE)

IV.4.1 Water Quality Credits

Determine if water quality credits are applicable for the project. *Refer to Section 3.1 of the Model WQMP for description of credits and Appendix VI of the TGD for calculation methods for applying water quality credits.*

Description of Proposed Project

Project Types that Qualify for Water Quality Credits (Select all that apply):

☐Redevelopment projects that reduce the overall impervious footprint of the project site.	☐Brownfield redevelopment, meaning redevelopment, expansion, or reuse of real property which may be complicated by the presence or potential presence of hazardous substances, pollutants or contaminants, and which have the potential to contribute to adverse ground or surface WQ if not redeveloped.	☐ Higher density development projects which include two distinct categories (credits can only be taken for one category): those with more than seven units per acre of development (lower credit allowance); vertical density developments, for example, those with a Floor to Area Ratio (FAR) of 2 or those having more than 18 units per acre (greater credit allowance).

☐ Mixed use development, such as a combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that can demonstrate environmental benefits that would not be realized through single use projects (e.g. reduced vehicle trip traffic with the potential to reduce sources of water or air pollution).	☐ Transit-oriented developments, such as a mixed use residential or commercial area designed to maximize access to public transportation; similar to above criterion, but where the development center is within one half mile of a mass transit center (e.g. bus, rail, light rail or commuter train station). Such projects would not be able to take credit for both categories, but may have greater credit assigned	☐ Redevelopment projects in an established historic district, historic preservation area, or similar significant city area including core City Center areas (to be defined through mapping).

☐Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses.	☐ Developments in a city center area.	☐ Developments in historic districts or historic preservation areas.	☐ Live-work developments, a variety of developments designed to support residential and vocational needs together – similar to criteria to mixed use development; would not be able to take credit for both categories.	☐In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.

Calculation of Water Quality Credits (if applicable)	

IV.4.2 Alternative Compliance Plan Information

Describe an alternative compliance plan (if applicable). Include alternative compliance obligations (i.e., gallons, pounds) and describe proposed alternative compliance measures. *Refer to Section 7.II 3.0 in the WQMP.*

Section V Inspection/Maintenance Responsibility for BMPs

Fill out information in table below. Prepare and attach an Operation and Maintenance Plan. Identify the mechanism through which BMPs will be maintained. Inspection and maintenance records must be kept for a minimum of five years for inspection by the regulatory agencies. *Refer to Section 7.II 4.0 in the Model WQMP.*

BMP Inspection/Maintenance			
BMP	**Reponsible Party(s)**	**Inspection/ Maintenance Activities Required**	**Minimum Frequency of Activities**
Vegetated Swale	City of Huntington Beach	Remove excessive sediment, weeds and debris. Keep grass approx. 4”-6” in height (do not over-mow)	Minimum twice yearly Ideally at the beginning and end of the rainy season.
Bioretention Basin	City of Huntington Beach	Remove debris and replace dead or diseased plants. Re-mulch if necessary. Ensure adequate drainage.	Minimum twice yearly Ideally at the beginning and end of the rainy season.

BMP Inspection/Maintenance			
BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities

Section VI Site Plan and Drainage Plan

VI.1 SITE PLAN AND DRAINAGE PLAN

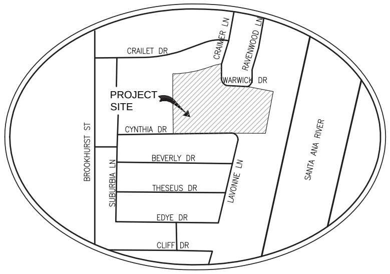
Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural BMP locations
- Drainage delineations and flow information
- Drainage connections
- BMP details

VI.2 ELECTRONIC DATA SUBMITTAL

The minimum requirement is to provide submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open.

If the local jurisdiction requires specialized electronic document formats (CAD, GIS) to be submitted, this section will be used to describe the contents (e.g., layering, nomenclature, georeferencing, etc.) of these documents so that they may be interpreted efficiently and accurately.



VICINITY MAP
NTS

LEGEND

- SITE LIMITS
- RIGHT OF WAY
- PROPERTY LINE
- CENTERLINE
- FLOW LINE
- FLOW DIRECTION
- SUB-DRAINAGE AREA BOUNDARY
- PROJECT STUDY AREA BOUNDARY
- (3) DRAINAGE AREA REACH NUMBER
- (2A / X.XX) SUB-DRAINAGE AREA NUMBER; AREA ACREAGE (AC)
- (A) DRAINAGE AREA

WQMP INFORMATION

SITE AREA: 2.0 ACRE
SOIL GROUP: D
IMPERVIOUS: PER CALCULATIONS
METHOD: ORANGE COUNTY STORMWATER PROGRAM (May 19, 2011)
EXHIBIT 7.II–MODEL WATER QUALITY MANAGEMENT PLAN (WQMP)

POST-DEVELOPMENT STORMWATER QUALITY DESIGN FLOW (LID DESIGN Q) TABLE:

DRAINAGE AREA NO.	SUB-DRAINAGE AREA NO.	AREA A (acre)	IMPERVIOUS NO. (%)	RUNOFF COEFFICIENT C Value***	RAINFALL INTENSITY ** I (in/hr)	LID Design Q (cfs)
	1A	0.50	78	0.74	0.25	0.09
A	2A	0.42	65	0.64	0.25	0.07
	3A	1.10	13	0.25	0.25	0.07

NOTE:
* SQDF - Stormwater Quality Design Flow (Qp), Qp=C*I*A*
** Figure III.4 of OC Stormwater Program Exhibit 7.III WQMP Technical Guidance Document
*** C Values per Equation III.1 of OC Stormwater Program Exhibit 7.III WQMP Technical Guidance Document; C = (.75 x %IMP) + 0.15

POST-DEVELOPMENT STORMWATER QUALITY DESIGN VOLUME (DCV) TABLE:

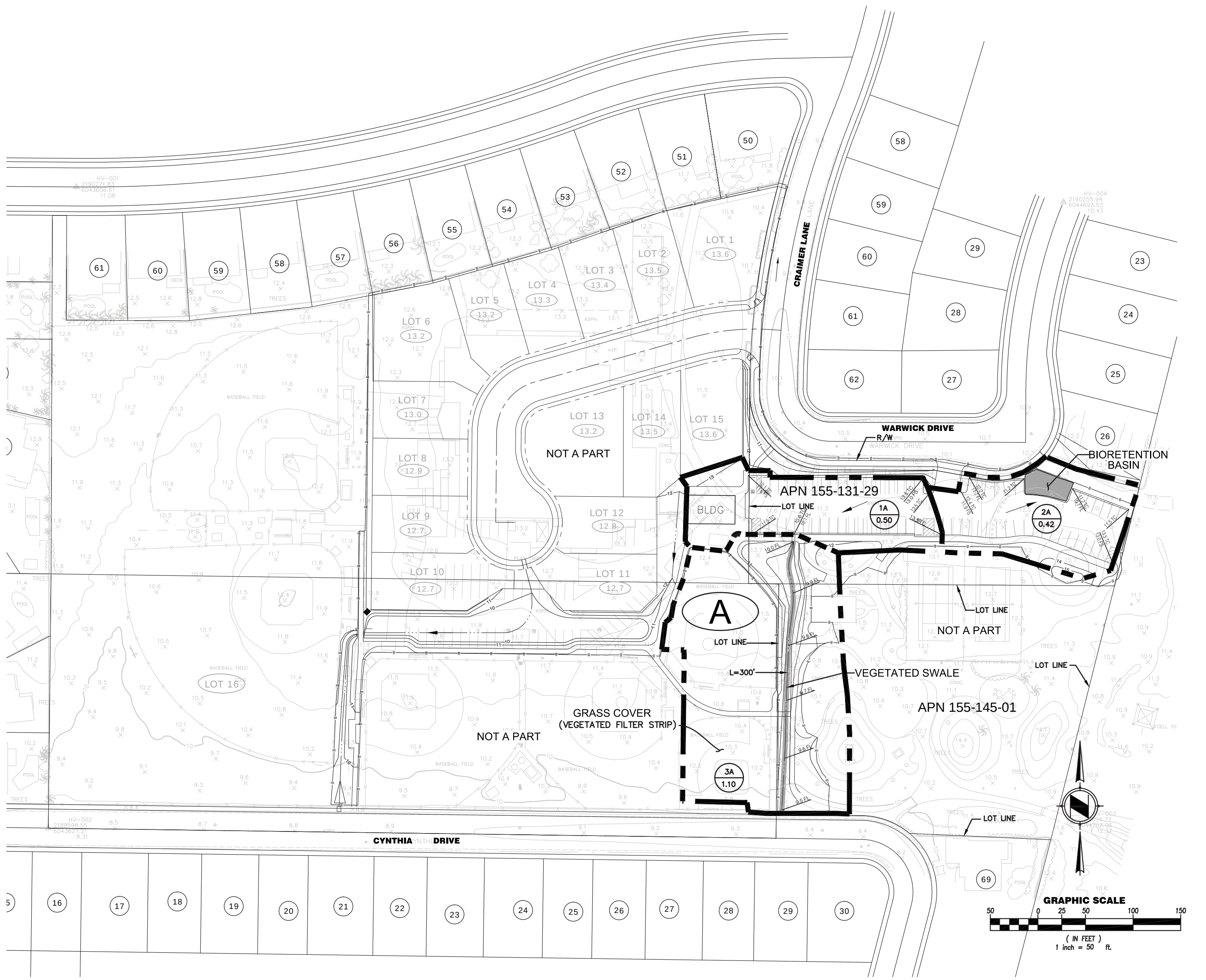
DRAINAGE AREA NO.	SUB-DRAINAGE AREA NO.	AREA A (acre)	IMPERVIOUS NO. (%)	RUNOFF COEFFICIENT C Value***	RAINFALL Zone 1 ** Rainfall - I (in)	DVC* Vo (cft)
A	1A	0.50	78	0.74	0.7	940
	2A	0.42	65	0.64	0.7	683
	3A	1.10	13	0.25	0.7	699

NOTE:
* DCV - Design Capture Volume, DCV=C*I*A* (1/12in)(43,560 ft^2/acre) Section III.3 of TGD
** OC California 24-hour, 85th Percentile Rainfall Map, Fig. XVI-1 of TGD
*** C Values per Equation III.1 of OC Stormwater Program Exhibit 7.III WQMP Technical Guidance Document; C = (.75 x %IMP) + 0.15

BMP DEVICES SUMMERY TABLE:

DRAINAGE AREA NO.	SUB-DRAINAGE AREA NO.	AREA (acre)	IMPERVIOUS NO. (%)	LID Design Q (cfs)	DCV (cft)	BMP DEVICES
A	1A	0.50	78	0.09	940	VEGETATED SWALE
	2A	0.42	65	0.07	683	BIORETENTION BASIN
	3A	1.10	13	0.07	699	GRASS COVER*

NOTE: * EXISTING WELL MAITAINED GRASS COVER TO REMAIN, WHICH SERVES AS VEGETATED FILTER STRIP



NO.	DATE	REVISIONS	APP'D	DATE

JOB NO.: 0214693.00
SCALE: 1" = 50'
DATE: 12/4/2014
DESIGNED BY: C.H.

TMAD TAYLOR & GAINES
901 Via Piemonte, Suite 400
Ontario, California 91764
Phone: 909.477.6915 Fax: 909.477.6916
www.ttgcorp.com
Project No. 0012.059.00

PREPARED UNDER THE SUPERVISION OF:
CRAIG A HAUSE RCE NO. 63620 DATE

REGISTERED PROFESSIONAL ENGINEER CRAIG HAUSE NO. 63620 CIVIL STATE OF CALIFORNIA

LE BARD DEVELOPMENT
CONCEPTUAL WQMP MAP
& BMP EXHIBIT (PARK SITE)

CITY OF HUNTINGTON BEACH

SHEET 1 OF 1 SHEETS

Section VII Educational Materials

Refer to the Orange County Stormwater Program (ocwatersheds.com) for a library of materials available. For the copy submitted to the Permittee, only attach the educational materials specifically applicable to the project. Other materials specific to the project may be included as well and must be attached. **(EDUCATIONAL MATERIAL WILL BE PROVIDED WITH FINAL WQMP)**

Education Materials			
Residential Material (http://www.ocwatersheds.com)	**Check If Applicable**	**Business Material (http://www.ocwatersheds.com)**	**Check If Applicable**
The Ocean Begins at Your Front Door	☐	Tips for the Automotive Industry	☐
Tips for Car Wash Fund-raisers	☐	Tips for Using Concrete and Mortar	☐
Tips for the Home Mechanic	☐	Tips for the Food Service Industry	☐
Homeowners Guide for Sustainable Water Use	☐	Proper Maintenance Practices for Your Business	☐
Household Tips	☐	**Other Material**	**Check If Attached**
Proper Disposal of Household Hazardous Waste	☐		
Recycle at Your Local Used Oil Collection Center (North County)	☐		☐
Recycle at Your Local Used Oil Collection Center (Central County)	☐		☐
Recycle at Your Local Used Oil Collection Center (South County)	☐		☐
Tips for Maintaining a Septic Tank System	☐		☐
Responsible Pest Control	☐		☐
Sewer Spill	☐		☐
Tips for the Home Improvement Projects	☐		☐
Tips for Horse Care	☐		☐
Tips for Landscaping and Gardening	☐		☐
Tips for Pet Care	☐		☐
Tips for Pool Maintenance	☐		☐
Tips for Residential Pool, Landscape and Hardscape Drains	☐		☐
Tips for Projects Using Paint	☐		☐

Preliminary Water Quality Management Plan for LeBard School Site

Preliminary Water Quality Management Plan (PWQMP)

Project Name:

LeBard School Site

Prepared for:

Huntington Beach City School District

20451 Craimer Lane

Huntington Beach, CA 92646

714-378-2050

Prepared by:

TTG Engineers

Engineer: Craig Hause, P.E. Registration No. C63620

20532 El Toro Road Suite 203

Mission Viejo, CA 92692

949-716-7460

Project Owner's Certification			
Permit/Application No.	2012-0229	Grading Permit No.	TBD
Tract/Parcel Map No.	TTM 17801	Building Permit No.	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract)			APN 155-151-01

This Water Quality Management Plan (WQMP) has been prepared for Huntington Beach City School District by TTG Engineers. The WQMP is intended to comply with the requirements of the local NPDES Stormwater Program requiring the preparation of the plan.

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 the current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

Owner:			
Title	Assistant Superintendent		
Company	Huntington Beach City School District		
Address	20451 Craimer Lane, Huntington Beach, CA 92646		
Email	jarchibald@hbcsd.k12.ca.us		
Telephone #	(714) 378-2050		
Signature		Date	

Contents

Page No.

Attachments (PROVIDED IN FINAL WQMP)

Section I Discretionary Permit(s) and Water Quality Conditions

Provide discretionary permit and water quality information. *Refer to Section 2.1 in the Technical Guidance Document (TGD) available from the Orange County Stormwater Program (ocwatersheds.com).*

<table>
<tr><th colspan="4">Project Infomation</th></tr>
<tr><td>Permit/Application No.</td><td>2012-0229</td><td>Tract/Parcel Map No.</td><td>TTM 17801</td></tr>
<tr><td>Additional Information/
Comments:</td><td colspan="3"></td></tr>
<tr><th colspan="4">Water Quality Conditions</th></tr>
<tr><td>Water Quality Conditions
(list verbatim)</td><td colspan="3">THE FOLLOWING DEVELOPMENT REQUIREMENTS SHALL BE COMPLETED PRIOR TO ISSUANCE OF A GRADING PERMIT:
1. A Project Water Quality Management Plan (WQMP) conforming to the current Waste Discharge Requirements Permit for the County of Orange (Order No. R8-2009-0030) [MS4 Permit] prepared by a Licensed Civil Engineer, shall be submitted to the Department of Public Works for review and acceptance. The WQMP shall address Section XII of the MS4 Permit and all current surface water quality issues.
2. The project WQMP shall include the following:
a. Low Impact Development.
b. Discusses regional or watershed programs (if applicable).
c. Addresses Site Design BMPs (as applicable) such as minimizing impervious areas, maximizing permeability, minimizing directly connected impervious areas, creating reduced or “zero discharge” areas, and conserving natural areas.
d. Incorporates the applicable Routine Source Control BMPs as defined in the Drainage Area Management Plan. (DAMP)
e. Incorporates Treatment Control BMPs as defined in the DAMP.
f. Generally describes the long-term operation and</td></tr>
</table>

maintenance requirements for the Treatment Control BMPs.

g. Identifies the entity that will be responsible for long-term operation and maintenance of the Treatment Control BMPs.

h. Describes the mechanism for funding the long-term operation and maintenance of the Treatment Control BMPs.

i. Includes an Operations and Maintenance (O&M) Plan for all structural BMPs.

j. After incorporating plan check comments of Public Works, three final WQMPs (signed by the owner and the Registered Civil Engineer of record) shall be submitted to Public Works for acceptance. After acceptance, two copies of the final report shall be returned to applicant for the production of a single complete electronic copy of the accepted version of the WQMP on CD media that includes:

   i. The 11" by 17" Site Plan in .TIFF format (400 by 400 dpi minimum).

   ii. The remainder of the complete WQMP in .PDF format including the signed and stamped title sheet, owner's certification sheet, Inspection/Maintenance Responsibility sheet, appendices, attachments and all educational material.

k. The applicant shall return one CD media to Public Works for the project record file.

3. Indicate the type and location of Water Quality Treatment Control Best Management Practices (BMPs) on the Grading Plan consistent with the Project WQMP. The WQMP shall follow the City of Huntington Beach; Project Water Quality Management Plan Preparation Guidance Manual dated June 2006. The WQMP shall be submitted with the first submittal of the Grading Plan.

4. A suitable location, as approved by the City, shall be depicted on the grading plan for the necessary trash enclosure(s). The area shall be paved with an impervious surface, designed not to allow run-on from adjoining areas, designed to divert drainage from adjoining roofs and pavements diverted around the area, and screened or walled to prevent off-site transport of trash. The trash enclosure area shall be covered or roofed with a solid, impervious material. Connection of trash area drains into the storm drain system is prohibited. If feasible, the trash enclosure area shall be connected into the sanitary sewer. (DAMP)

	THE FOLLOWING DEVELOPMENT REQUIREMENTS SHALL BE COMPLETED PRIOR TO FINAL INSPECTION OR OCCUPANCY: 5. Prior to grading or building permit close-out and/or the issuance of a certificate of use or a certificate of occupancy, the applicant shall: a. Demonstrate that all structural Best Management Practices (BMPs) described in the Project WQMP have been constructed and installed in conformance with approved plans and specifications. b. Demonstrate all drainage courses, pipes, gutters, basins, etc. are clean and properly constructed. c. Demonstrate that applicant is prepared to implement all non-structural BMPs described in the Project WQMP. d. Demonstrate that an adequate number of copies of the approved Project WQMP are available for the future occupiers.

Watershed-Based Plan Conditions

Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	N/A

Section II Project Description

II.1 Project Description

Provide a detailed project description including:

- Project area is 10.2 acres.
- Land uses: Existing was Park/Recreation Center; Proposed is Single Family Homes.
- Land cover: Existing: Grass/Asphalt; Proposed: Single Family Homes.
- Design elements: Vegetated Swale, Retention Basin
- Pre-development & Post-Development drainage has the same outlet locations, drain to existing street. Not broken down by drainage management areas.

Include attributes relevant to determining applicable source controls. *Refer to Section 2.2 in the TGD for information that must be included in the project description.*

Description of Proposed Project				
Development Category (Verbatim from WQMP):	Proposed development is 15 unit single family homes.			
Project Area (ft^2): __ 10.2 acre (444,300 _ft^2)__	Number of Dwelling Units: 15		SIC Code: 6552	
Narrative Project Description:	The existing land use is school with associated buildings, parking lot & sportsfield. The proposed land use is single family residential and remaining sportsfield.			
Project Area:	Pervious		Impervious	
	Area (acres or sq ft)	Percentage	Area (acres or sq ft)	Percentage
Pre-Project Conditions	6.3	63	3.9	38
Post-Project Conditions	7.3	72	2.9	28
Drainage Patterns/Connections	Surface flow to city storm drain system. Outlets to Santa Ana River.			

II.2 Potential Stormwater Pollutants

Determine and list expected stormwater pollutants based on land uses and site activities. *Refer to Section 2.2.2 and Table 2.1 in the TGD for guidance.*

Pollutants of Concern			
Pollutant	Circle One: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment		N	Single Family home, no sediment discharges
Nutrients	E		Pre and post development condition expect to be equal in volumetric proportions.
Heavy Metals	E		Potential increase
Pathogens (Bacteria/Virus)	E		Both in the existing and post construction.
Pesticides	E		Potential increase resulting from residential uses and maintenance practices
Oil and Grease	E		Will be reduced by volume
Toxic Organic Compounds		N	Not consistent with proposed land use.
Trash and Debris	E		Will be reduced by volume

II.3 Hydrologic Conditions of Concern

Determine if streams located downstream from the project area are determined to be potentially susceptible to hydromodification impacts. *Refer to Section 2.2.3.1 in the TGD for* NOC *or Section 2.2.3.2 for* <SOC>.

☒ No – Show map

☐ Yes – Describe applicable hydrologic conditions of concern below. *Refer to Section 2.2.3 in the TGD.*

EXISTING SITE PLAN
N.T.S.

II.4 Post Development Drainage Characteristics

Describe post development drainage characteristics. *Refer to Section 2.2.4 in the TGD*.

The proposed subdivision drains to a detention basin for flood control purposes (mitigation). Due to the poor on-site soils, a vegetated flow-based bio-swale is used to treat the runoff from the new subdivision as infiltration is not feasible. The basin outlet pipe is located at the bottom of the basin to prevent standing water. The basin does not provide any water quality treatment. The bio-swale will discharge to Cynthia Drive.

II.5 Property Ownership/Management

The property is owned by Huntington Beach City School District (APN 155-151-01). A portion of the property includes the District's administrative offices with the balance being used sports fields for the local little league. The proposed project also involves modification to adjacent parking and landscape areas that are owned by the City of Huntington Beach (APN 155-145-01 & 155-131-29).

The District intends to file and seek approval for a tentative tract map (TTM) that would define 15 single family residential lots, a public street providing access and one open space lot (Lot 16 of TTM) that would be dedicated to the City of Huntington Beach for park purposes. Upon approval of the TTM the District would seek an owner/builder to develop and sell the residential properties. The owner/builder would prepare and record a final map, including all improvement plans, and be responsible for the future construction. The District will abandon their facility which will be demolished as part of the future construction

The adjacent property (Parcel 1 and 2 of Tract 6003), owned by the City of Huntington Beach, includes parking and park uses that will be reconstructed to accommodate the proposed project. A separate WQMP will be prepared for the property owned by the city and not within the boundary of this WQMP.

Section III Site Description

III.1 Physical Setting

Fill out table with relevant information. *Refer to Section 2.3.1 in the TGD.*

Planning Area/ Community Name	TTM 17801
Location/Address	20451 Craimer Lane
	Huntington Beach, CA
Land Use	Single Family Residential/Recreational Sports Fields
Zoning	RL, OS-PR
Acreage	10.2
Predominant Soil Type	D

III.2 Site Characteristics

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. Refer to Section 2.3.2 in the TGD.

Precipitation Zone	*1*
Topography	*The site is relatively constant grade sloping approximately 1% to the south*
Drainage Patterns/Connections	*Surface flow & outlet to existing street. There is no connection to city's storm drain system.*
Soil Type, Geology, and Infiltration Properties	*Soil Type: D* *Type D soil is not suitable for infiltration.*

Site Characteristics (continued)	
Hydrogeologic (Groundwater) Conditions	*Historic high groundwater levels may be as shallow as 3 feet.*
Geotechnical Conditions (relevant to infiltration)	*Site lies within liquefaction zone*
Off-Site Drainage	*None*
Utility and Infrastructure Information	*There are no storm drain facilities serving the site. The nearest storm drain facilities are located at the corner of corner of Beverly Drive & Suburbia Ln.*

III.3 Watershed Description

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. *Refer to Section 2.3.3 in the TGD.*

Receiving Waters	Santa Ana River, Reach 1
303(d) Listed Impairments	None
Applicable TMDLs	None
Pollutants of Concern for the Project	Nutrients, Pesticides, Oil and Greases
Environmentally Sensitive and Special Biological Significant Areas	None

Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

Describe project performance criteria. Several steps must be followed in order to determine what performance criteria will apply to a project. These steps include:

- If the project has an approved WIHMP or equivalent, then any watershed specific criteria must be used and the project can evaluate participation in the approved regional or sub-regional opportunities. The local Permittee planning or NPDES staff should be consulted regarding the existence of an approved WIHMP or equivalent.
- Determine applicable hydromodification control performance criteria. *Refer to Section 7.II-2.4.2.2 of the Model WQMP.*
- Determine applicable LID performance criteria. *Refer to Section 7.II-2.4.3 of the Model WQMP.*
- Determine applicable treatment control BMP performance criteria. *Refer to Section 7.II-*3.2.2 *of the Model WQMP.*
- Calculate the LID design storm capture volume for the project. *Refer to Section 7.II-2.4.3 of the Model WQMP.*

<table>
<tr><td colspan="2">(NOC Permit Area only) Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis?</td><td>YES ☐</td><td>NO ☒</td></tr>
<tr><td>If yes, describe WIHMP feasibility criteria or regional/sub-regional LID opportunities.</td><td colspan="3"></td></tr>
</table>

Project Performance Criteria (continued)

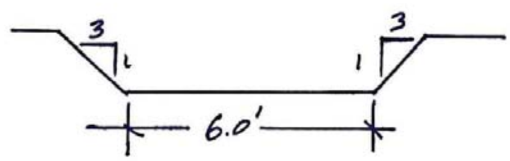
If HCOC exists, list applicable hydromodification control performance criteria (Section 7.II-2.4.2.2 in MWQMP)	The proposed development does not have a HCOC because the post-development runoff volume for the 2-year, 24-hr storm does not exceed the pre-development runoff volume for the 2-year, 24-hr storm by more than 5%.
List applicable LID performance criteria (Section 7.II-2.4.3 from MWQMP)	According to Section 7.II-2.4.3 within the Model WQMP Template (MWQMP), a properly designed biotreatment system can only be considered if infiltration, harvest and use, and evapotranspiration cannot be feasibly implemented for the full design capture volume. These are not feasible for the project given the soil condition. The LID and Treatment Control BMP Performance Criteria within the MWQMP states that LID BMPs must be designed to biotreat 80 percent average annual capture efficiency. The proposed vegetated swale has been design accordingly.
List applicable treatment control BMP performance criteria (Section 7.II-3.2.2 from MWQMP)	According to the requirements presented for North Orange County, if LID performance criteria through retention and or biotreatment is not feasible then treatment control BMPs shall be implemented off-site prior o runoff discharge from development to the waterbody. There will be no need for any other BMP treatment as the biotreatment provided by the vegetated swale is sufficient to treat the 80 percent average annual capture efficiency.
Calculate LID design storm capture volume for Project.	See table below.

DRAINAGE AREA NO.	DMA	AREA (acre)	IMPERVIOUS NO. (%)	LID Q (cfs)	BMP DEVICES
A	**1A**	**3.14**	**65**	**0.40**	**VEGETATED SWALE**
	2A	2.15	20	0.13	GRASS COVER*
	3A	4.93	10	0.22	GRASS COVER*

* EXISTING WELL MAITAINED GRASS COVER TO REMAIN FOR AREAS 2A AND 3A, WHICH SERVES AS VEGETATED FILTER STRIP.

A flow-based biotreatment vegetated swale is the only treatment device provided for DMA 1A (the proposed subdivision). Areas 2A and 3A are existing sports fields and not part of the disturbed area. The poor soil quality at the site does not allow for infiltration into the existing ground. The lack of underground storm drain facilities does not allow for filtration treatment facilities (i.e. a constructed sand filter) as there are no underground facilities to connect to. The site must surface drain to the surrounding streets given the lack of storm drain facilities. The detention basin provided serves only to mitigate storm flows for flood control purposes and does not provide any water quality benefit.

```
CIVILCADD/CIVILDESIGN  Engineering Software, (c) 2004   Version 7.0
-------------------------------------------------------------------
LEBARD-AREA 1A SWALE
-------------------------------------------------------------------
Program License Serial Number 6201
-------------------------------------------------------------------
            *** Improved Channel Analysis ***

      Upstream (headworks) Elevation =      9.600(Ft.)
      Downstream (outlet) Elevation =      9.000(Ft.)
      Runoff/Flow Distance =    180.000(Ft.)
      Maximum flow rate in channel(s) =      0.400(CFS) PER WQMP
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

*** CALCULATED DEPTH DATA AT FLOW =    0.40(CFS) ***
Channel base width  =    6.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Manning's 'N'    = 0.200
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru channel =      0.400(CFS)
Depth of flow =    0.317(Ft.)
Average velocity =    0.182(Ft/s)
Total flow rate in 1/2 street =    0.400(CFS)
Channel flow top width =      7.902(Ft.)
Depth of flow in channel =   0.32(Ft.)

Total number of channels (same dimensions) = 1
Flow Velocity =    0.18(Ft/s)
Individual channel flow =    0.400(CFS)
Total capacity of channel(s) =      0.400(CFS)
```



SWALE LENGTH:

$L = 60 \cdot t_{HR} \cdot V_{WQ}$

ASSUME: t_{HR} = 10 min (HYDRAULIC RESIDENCE TIME)

V_{WQ} = 0.18 FT/SEC

$L = 60 \times 10 \times 0.18$

= 108' MIN.

stability, maintenance access and public safety considerations are met.

- ☐ The minimum swale length for biotreatment applications is 100 feet. The minimum residence time for flows in the swale is 10 minutes.
- ☐ If slope is less than 1.5%, underdrains should be provided for the length of the swale
- ☐ A gravel blanket or bedding is required around the underdrain pipe(s). At least 0.5 feet of washed aggregate must be placed below, to the top, and to the sides of the underdrain pipe(s).
- ☐ If an underdrain is included, an amended soil layer of 1 foot minimum thickness must be provided above the underdrain meeting the specifications of MISC-1: Planting/Storage Media.
- ☐ The maximum bed slope in flow direction should not exceed 6% (unles check dams are provided).
- ☐ The maximum flow velocity should not exceed 1.0 ft/sec for water quality treatment swales.
- ☐ For infrequently mowed swales, a maximum flow depth of 4 inches should be implemented. For frequently mowed turf swales, the maximum flow depth is 2 inches.
- ☐ The vegetation height should be maintained between 4 to 6 inches.
- ☐ Gradual meandering bends in the swale are desirable for aesthetic purposes and to promote slower flow and particulate settling.
- ☐ Blockages in the swale that result in uneven flow distribution and points of concentrated flow should be avoided. Blockages that should be avoided include trees, bushes, light pole piers, and utility vaults or pads.

Sizing Method for Vegetated Swales

The Design Capture Method for Flow-based BMPs should be used to determine the design flowrate for a vegetated swale. The user then selects the design flow depth and longitudinal slope and uses the sizing steps below to determine the length and width of the swale. The sizing steps are as follows:

Step 1: Determine Design Flowrate (Q)

Calculate the Design Flowrate (Q) using the Capture Efficiency Method for Flow-based BMPs (See **Appendix III.3.3**). Inputs include the time of concentration of the catchment (T_c) and the capture efficiency achieved upstream by HSCs or other BMPs.

Step 2: Estimate the Swale Bottom Width

For shallow flow depths, channel side slopes can be ignored and the bottom width can be calculated using a simplified form of Manning's formula:

$$b = (Q \times n_{WQ}) / (1.49 \times y^{1.67} \times s^{0.5})$$

Where:

b = estimated swale bottom width, ft

Q = design flowrate, cfs

n_{WQ} = Manning's roughness coefficient for shallow flow conditions, use 0.2 unless other information is available

y = design flow depth, ft (not to exceed 4 inches or 0.33 ft)

s = longitudinal slope in flow direction, ft/ft (not to exceed 0.06)

If b is between 2 and 10 feet, proceed to step 3.

If b is less than 2 feet, increase b to 2 feet and recalculate design flow depth using the following:

$y = ((Q \times n_{WQ}) / (1.49 \times b \times s^{0.5}))^{0.6}$

If b is greater than 10 feet, one of the following steps is necessary:

- Increase longitudinal slope to a maximum of 6% or 0.06, and recalculate b
- Increase design flow depth to a maximum of 4 inches or 0.33 ft, and recalculate b
- Install a divider lengthwise along swale bottom at least three-quarters of the swale length, beginning at the inlet. The swale width can be increased to 16 feet if a divider is provided.

Step 3: Determine Design Flow Velocity

Calculate the design flow velocity using the following equation:

$V_{WQ} = Q / A_{WQ}$

Where:

V_{WQ} = design flow velocity, fps

Q = design flowrate, cfs

$A_{WQ} = by + Zy^2$, cross sectional area of flow at design depth

Z = side slope length per unit height

If the design flow velocity exceeds 1 foot per second, design parameters in Step 2 should be adjusted (slope, bottom width, or design flow depth) until V_{WQ} is equal or less than 1 fps.

Step 4: Calculate Swale Length

Calculate the swale length needed to achieve a minimum hydraulic residence time of 10 minutes using the following equation:

$L = 60 \times t_{HR} \times V_{WQ}$

Where:

L = swale length, ft

t_{HR} = hydraulic residence time, min (minimum 10 minutes)

V_{WQ} = design flow velocity, fps

Step 5: If Needed, Adjust Swale Length to Site Constraints

Note that oftentimes swale length can be accomodated by providing a meandering swale. However, if swale length is too large for the site, the length can be adjusted as follows:

- Calculate the swale treatment top area (A_{top}), based on the swale length calculated in Step 4:

$A_{TOP} = (b_i + b_{SLOPE}) \times L_i$

Where:

A_{TOP} = top area (ft^2) at the design treatment depth

b_i = bottom width (ft), calculated in Step 2

b_{SLOPE} = the additional top width (ft) above the side slope for the design water depth (for 3:1 side slopes and a 4-inch water depth, b_{slope} = 2 feet)

L_i = initial length (ft) calculated in Step 4

- Use the swale top area and a reduced swale length (L_f) to increase the bottom width, using the following equation:

$L_F = A_{TOP} / (b_F + b_{SLOPE})$

Where:

BIO-2: Vegetated Swale

Also known as:
- *Bioswale*
- *Biofiltration swale*
- *Grass swale*

Vegetated Swale
Source: Geosyntec Consultants

Vegetated swale filters (vegetated swales) are open, shallow channels with low-lying vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. Vegetated swales provide pollutant removal through settling and filtration in the vegetation (usually grasses) lining the channels. In addition, they provide the opportunity for volume reduction through infiltration and ET, and reduce the flow velocity in addition to conveying storm water runoff. Where soil conditions allow, volume reduction in vegetated swales can be enhanced by adding a gravel drainage layer underneath the swale allowing additional flows to be retained and infiltrated. Where slopes are shallow and soil conditions limit or prohibit infiltration, an underdrain system or low flow channel for dry weather flows may be required to minimize ponding and convey treated and/or dry weather flows to an acceptable discharge point. An effective vegetated swale achieves uniform sheet flow through a densely vegetated area for a period of several minutes. The vegetation in the swale can vary depending on its location within the project area and is generally the choice of the designer, subject to the design criteria outlined in this section.

Feasibility Screening Considerations

- Swales may cause incidental infiltration; however, infiltration is not a mandatory mechanism for pollutant removal for swales and it may create hazards in some circumstances. Therefore, conditions should be evaluated to determine whether circumstances require an impermeable liner to avoid infiltration into the subsurface.

Opportunity Criteria

- Open areas are needed for vegetated swales, including, but not limited to, road shoulders, road medians, parks and athletic fields and can be constructed in residential or commercial areas.
- Site slope is less than 10 percent.
- Drainage area is ≤ 5 acres.
- Vegetated swales must not interfere with flood control functions of existing conveyance and detention structures.

OC-Specific Design Criteria and Considerations

☐ Swales should have a minimum bottom width of 2 feet and a maximum bottom width of 10 feet. Swale dividers should be used if the bottom width must exceed 10 feet to promote even distribution of flow across the swale. Local juridictions may require larger minimum widths based on maintenance requirements.

☐ The channel side slope should not exceed 2:1 (H:V) for a total swale depth of 1 foot or less. For deeper swales or mowed grass swales, the maximum channel side slope should be 3:1. Where space is constrained, swales may have vertical concrete or block walls provided that slope

L_F = reduced swale length (ft)

b_F = increased bottom width (ft)

- Recalculate V_{WQ} according to Step 3 using the revised cross-sectional area A_{WQ} based on the increased bottom width (b_F). Revise the design as necessary if the design flow velocity exceeds 1 foot per second.
- Recalculate to ensure that the 10 minute retention time is retained.

Configuration for Use in a Treatment Train

- Vegetated swales can be incorporated in a treatment train to provide enhanced water quality treatment and reductions in runoff volume and rate. For example, if a vegetated swale is placed upgradient of a dry extended detention (ED) basin, the rate and volume of water flowing to the dry ED basin can be reduced and the water quality enhanced. As another example, dry ED basins may be placed upstream a vegetated swale to reduce the size of the vegetated swale.
- Vegetated swales can be used as pretreatment for infiltration BMPs.
- If designed with an infiltration sump, vegetated "bioinfiltration" swales can provide retention and biotreatment capacity.

Additional References for Design Guidance

Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 4: http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850

Santa Barbara BMP Guidance Manual, Chapter 6: http://www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf

- County of San Diego Drainage Design Manual for design criteria, Section 5.5: http://www.co.san-diego.ca.us/dpw/floodcontrol/floodcontrolpdf/drainage-designmanual05.pdf

County of Los Angeles Low Impact Development Standards Manual, Chapter 5: http://dpw.lacounty.gov/wmd/LA_County_LID_Manual.pdf

- Los Angeles County Stormwater BMP Design and Maintenance Manual: http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf

IV.2. SITE DESIGN AND DRAINAGE PLAN

Describe site design and drainage plan including

- A narrative of site design practices utilized or rationale for not using practices;
- A narrative of how site is designed to allow BMPs to be incorporated to the MEP
- A table of DMA characteristics and list of LID BMPs proposed in each DMA.
- Reference to the WQMP plot plan.
- Calculation of Design Capture Volume (DCV) for each drainage area.
- A listing of GIS coordinates for LID and Treatment Control BMPs (unless not required by local jurisdiction).

Refer to Section 2.4.2 in the TGD.

The proposed number and size of the proposed residential lots have been designed in such a way that a detention basin can be constructed without impacting the existing ball fields. The basin also has a public use feature during dry periods. The vegetated swale BMP is located such that minimal disturbance/grading of the existing ball fields is required. Given the infill nature of the project and the lack of any existing storm drain facilities serving the site there are limited options on other LID site design practices. The only DMA that will be treated is the proposed subdivision. The WQMP Map and BMP site plan can be found at the end of this report.

A DCV calculation is not necessary for the project as the soil conditions do not allow for volume based treatment (infilatration). Instead, a flow-based design Q is needed for biotreatment (vegetated swale).

Because the proposed subdivision is less than 5.0 acres, the MWQMP allows for a simplified calculation of the LID Design Q. Per Section III.1.2 Simple Method Runoff Coefficient for Flow-Based BMP Sizing, Equation III.3 states:

Q=C x I x A

Q=Design Flow Rate (cfs)

I= Design Intensity (0.20 in/hr per Figure III.4 (TGD) for a 15 min. Tc and 80% capture efficiency)

C= Runoff Coefficient= (0.75 x % imp + 0.15)

A=Tributary Area (acres): 3.14 acres

Q= ((0.75 x 0.65) + 0.15) x 0.20 in/hr x 3.14 ac

Q= 0.40 cfs

Given the small nature of the project, GIS coordinates are not necessary.

IV.3 LID BMP SELECTION AND PROJECT CONFORMANCE ANALYSIS

Each sub-section below documents that the proposed design features conform to the applicable project performance criteria via check boxes, tables, calculations, narratives, and/or references to worksheets. *Refer to Section 2.4.2.3 in the TGD for selecting LID BMPs and Section 2.4.3 in the TGD for conducting conformance analysis with project performance criteria.*

IV.3.1 Hydrologic Source Controls

If required HSCs are included, fill out applicable check box forms. If the retention criteria are otherwise met with other LID BMPs, include a statement indicating HSCs not required.

Name	Included?
Localized on-lot infiltration	☐
Impervious area dispersion (e.g. roof top disconnection)	☐
Street trees (canopy interception)	☐
Residential rain barrels (not actively managed)	☐
Green roofs/Brown roofs	☐
Blue roofs	☐
Impervious area reduction (e.g. permeable pavers, site design)	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐

HSCs are not required for the project. The full LID requirements can be met without them. The proposed detention basin is only provided for flood control purposes (no water quality)

IV.3.2 Infiltration BMPs

Identify infiltration BMPs to be used in project. If design volume cannot be met state why BMPs cannot be met

Name	Included?
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐
Infiltration basins	☐
Drywells	☐
Subsurface infiltration galleries	☐
French drains	☐
Permeable asphalt	☐
Permeable concrete	☐
Permeable concrete pavers	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Strom Capture Volume can be met with infiltration BMPs. If not document how much can be met with infiltration and document why it is not feasible to meet the full volume with infiltration BMPs.

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, describe any evapotranspiration, rainwater harvesting BMPs.

Name	Included?
All HSCs; *See Section IV.3.1*	☐
Surface-based infiltration BMPs	☐
Biotreatment BMPs	☒
Above-ground cisterns and basins	☐
Underground detention	☐
Other:	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Strom Capture Volume can be met with evapotranspiration, rainwater harvesting BMPs in combination with infiltration BMPs. If not document how much can be met with either infiltration BMPs, evapotranspiration, rainwater harvesting BMPs, or a combination, and document why it is not feasible to meet the full volume with either of these BMPs categories.

See LID Volume calculations.

IV.3.4 Biotreatment BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, and/or evapotranspiration and rainwater harvesting BMPs, describe biotreatment BMPs. Include sections for selection, suitability, sizing, and infeasibility, as applicable.

Name	Included?
Bioretention with underdrains	☐
Stormwater planter boxes with underdrains	☐
Rain gardens with underdrains	☐
Constructed wetlands	☐
Vegetated swales	☒
Vegetated filter strips	☐
Proprietary vegetated biotreatment systems	☐
Wet extended detention basin	☐
Dry extended detention basins	☒
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Strom Capture Volume can be met with infiltration, evapotranspiration, rainwater harvesting and/or biotreatment BMPs. If not document how much can be met with either infiltration BMPs, evapotranspiration, rainwater harvesting BMPs, or a combination, and document why it is not feasible to meet the full volume with either of these BMPs categories.

Same as LID calculation.

IV.3.5 Hydromodification Control BMPs

Describe hydromodification control BMPs. See Section 5 TGD. Include sections for selection, suitability, sizing, and infeasibility, as applicable. Detail compliance with Prior Conditions of Approval.

Hydromodification Control BMPs	
BMP Name	**BMP Description**

IV.3.6 Regional/Sub-Regional LID BMPs

Describe regional/sub-regional LID BMPs in which the project will participate. *Refer to Section 7.II-2.4.3.2 of the Model WQMP*.

Regional/Sub-Regional LID BMPs

IV.3.7 Treatment Control BMPs

Treatment control BMPs can only be considered if the project conformance analysis indicates that it is not feasible to retain the full design capture volume with LID BMPs. Describe treatment control BMPs including sections for selection, sizing, and infeasibility, as applicable.

Treatment Control BMPs	
BMP Name	**BMP Description**
Vegetated Swale	Swale at outlet of detention basin for proposed subdivision. Infiltration not feasible due to soil type and lack of storm drain system in the area.

IV.3.8 Non-structural Source Control BMPs

Fill out non-structural source control check box forms or provide a brief narrative explaining if non-structural source controls were not used **(BMP FACT SHEETS WILL BE PROVIDED WITH FINAL WQMP).**

Non-Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
N1	Education for Property Owners, Tenants and Occupants	☒	☐	
N2	Activity Restrictions	☒	☐	
N3	Common Area Landscape Management	☒	☐	Single Family Residences-HOA for common lots.
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	No hazardous waste management needed
N6	Local Industrial Permit Compliance	☐	☒	Not an industrial project
N7	Spill Contingency Plan	☐	☒	No hazardous materials
N8	Underground Storage Tank Compliance	☐	☒	No storage tanks
N9	Hazardous Materials Disclosure Compliance	☐	☒	No hazardous materials
N10	Uniform Fire Code Implementation	☒	☐	
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☐	☒	No Employees
N13	Housekeeping of Loading Docks	☐	☒	No Loading Docks
N14	Common Area Catch Basin Inspection	☐	☒	No catch basins
N15	Street Sweeping Private Streets and Parking Lots	☐	☒	Public Street-City Sweeping
N16	Retail Gasoline Outlets	☐	☒	Not a proposed facility

IV.3.9 Structural Source Control BMPs

Fill out structural source control check box forms or provide a brief narrative explaining if Structural source controls were not used *(BMP FACT SHEETS WILL BE PROVIDED WITH FINAL WQMP).*

Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
S1	Provide storm drain system stenciling and signage	☐	☒	No Storm Drain System Onsite
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	Not part of development
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☐	☒	Single Family Residences will have individual trash containers
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☐	☒	No slopes and channels exist. No need for energy dissipation.
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☒	☐	
S6	Dock areas	☐	☒	Not a proposed facility
S7	Maintenance bays	☐	☒	Not a proposed facility
S8	Vehicle wash areas	☐	☒	Not a proposed facility
S9	Outdoor processing areas	☐	☒	Not a proposed facility
S10	Equipment wash areas	☐	☒	Not a proposed facility
S11	Fueling areas	☐	☒	Not a proposed facility
S12	Hillside landscaping	☐	☒	No hillsides
S13	Wash water control for food preparation areas	☐	☒	Not a proposed facility
S14	Community car wash racks	☐	☒	Not a proposed facility

IV.4 ALTERNATIVE COMPLIANCE PLAN (IF APPLICABLE)

IV.4.1 Water Quality Credits

Determine if water quality credits are applicable for the project. *Refer to Section 3.1 of the Model WQMP for description of credits and Appendix VI of the TGD for calculation methods for applying water quality credits.*

<table>
<tr><th colspan="6">Description of Proposed Project</th></tr>
<tr><td colspan="6">Project Types that Qualify for Water Quality Credits (Select all that apply):</td></tr>
<tr><td colspan="2">☐Redevelopment projects that reduce the overall impervious footprint of the project site.</td><td colspan="2">☐Brownfield redevelopment, meaning redevelopment, expansion, or reuse of real property which may be complicated by the presence or potential presence of hazardous substances, pollutants or contaminants, and which have the potential to contribute to adverse ground or surface WQ if not redeveloped.</td><td colspan="2">☐ Higher density development projects which include two distinct categories (credits can only be taken for one category): those with more than seven units per acre of development (lower credit allowance); vertical density developments, for example, those with a Floor to Area Ratio (FAR) of 2 or those having more than 18 units per acre (greater credit allowance).</td></tr>
<tr><td colspan="2">☐ Mixed use development, such as a combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that can demonstrate environmental benefits that would not be realized through single use projects (e.g. reduced vehicle trip traffic with the potential to reduce sources of water or air pollution).</td><td colspan="3">☐ Transit-oriented developments, such as a mixed use residential or commercial area designed to maximize access to public transportation; similar to above criterion, but where the development center is within one half mile of a mass transit center (e.g. bus, rail, light rail or commuter train station). Such projects would not be able to take credit for both categories, but may have greater credit assigned</td><td>☐ Redevelopment projects in an established historic district, historic preservation area, or similar significant city area including core City Center areas (to be defined through mapping).</td></tr>
<tr><td>☐Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses.</td><td>☐ Developments in a city center area.</td><td>☐ Developments in historic districts or historic preservation areas.</td><td colspan="2">☐ Live-work developments, a variety of developments designed to support residential and vocational needs together – similar to criteria to mixed use development; would not be able to take credit for both categories.</td><td>☐In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.</td></tr>
<tr><td>Calculation of Water Quality Credits
(if applicable)</td><td colspan="5"></td></tr>
</table>

IV.4.2 Alternative Compliance Plan Information

Describe an alternative compliance plan (if applicable). Include alternative compliance obligations (i.e., gallons, pounds) and describe proposed alternative compliance measures. *Refer to Section 7.II 3.0 in the WQMP.*

Section V Inspection/Maintenance Responsibility for BMPs

Fill out information in table below. Prepare and attach an Operation and Maintenance Plan. Identify the mechanism through which BMPs will be maintained. Inspection and maintenance records must be kept for a minimum of five years for inspection by the regulatory agencies. *Refer to Section 7.II 4.0 in the Model WQMP.*

BMP Inspection/Maintenance			
BMP	**Reponsible Party(s)**	**Inspection/ Maintenance Activities Required**	**Minimum Frequency of Activities**
Vegetated Swale	TBD	Remove excessive sediment, weeds and debris. Keep grass approx. 4”-6” in height (do not over-mow)	Minimum twice yearly Ideally at the beginning and end of the rainy season.
Detention Basin	TBD	Remove excessive sediment, weeds and debris. Ensure outlet structure is not clogged	Minimum twice yearly Ideally at the beginning and end of the rainy season.

BMP Inspection/Maintenance			
BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities

Section VI Site Plan and Drainage Plan

VI.1 SITE PLAN AND DRAINAGE PLAN

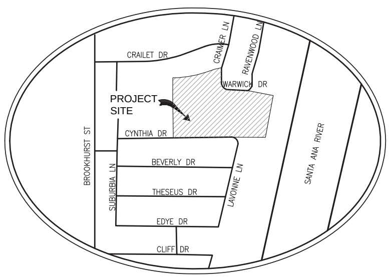
Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural BMP locations
- Drainage delineations and flow information
- Drainage connections
- BMP details

VI.2 ELECTRONIC DATA SUBMITTAL

The minimum requirement is to provide submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open.

If the local jurisdiction requires specialized electronic document formats (CAD, GIS) to be submitted, this section will be used to describe the contents (e.g., layering, nomenclature, georeferencing, etc.) of these documents so that they may be interpreted efficiently and accurately.



VICINITY MAP
NTS

LEGEND

- SITE LIMITS
- RIGHT OF WAY
- PROPERTY LINE
- CENTERLINE
- FLOW LINE
- FLOW DIRECTION
- SUB-DRAINAGE AREA BOUNDARY
- PROJECT STUDY AREA BOUNDARY
- (3) DRAINAGE AREA REACH NUMBER
- (2A / X.XX) SUB-DRAINAGE AREA NUMBER / AREA ACREAGE (AC)
- (A) DRAINAGE AREA

WQMP INFORMATION

SITE AREA: 10.2 ACRE
SOIL GROUP: D
IMPERVIOUS: PER CALCULATIONS
METHOD: ORANGE COUNTY STORMWATER PROGRAM (May 19, 2011)
EXHIBIT 7.II-MODEL WATER QUALITY MANAGEMENT PLAN (WQMP)

POST-DEVELOPMENT STORMWATER QUALITY DESIGN FLOW (LID DESIGN Q) TABLE:

DRAINAGE AREA NO.	SUB-DRAINAGE AREA NO.	AREA A (acre)	IMPERVIOUS NO. (%)	RUNOFF COEFFICIENT C Value***	RAINFALL INTENSITY ** I (in/hr)	LID Design Q (cfs)
A	1A	3.14	65	0.64	0.20	0.40
	2A	2.15	20	0.30	0.20	0.13
	3A	4.93	10	0.23	0.20	0.22

NOTE:
* SQDF - Stormwater Quality Design Flow (Qp), Qp=C*I*A*
** Figure III.4 of OC Stormwater Program Exhibit 7.III WQMP Technical Guidance Document
*** C Values per Equation III.1 of OC Stormwater Program Exhibit 7.III WQMP Technical Guidance Document; C = (.75 x %IMP) + 0.15

POST-DEVELOPMENT STORMWATER QUALITY DESIGN VOLUME (DCV) TABLE:

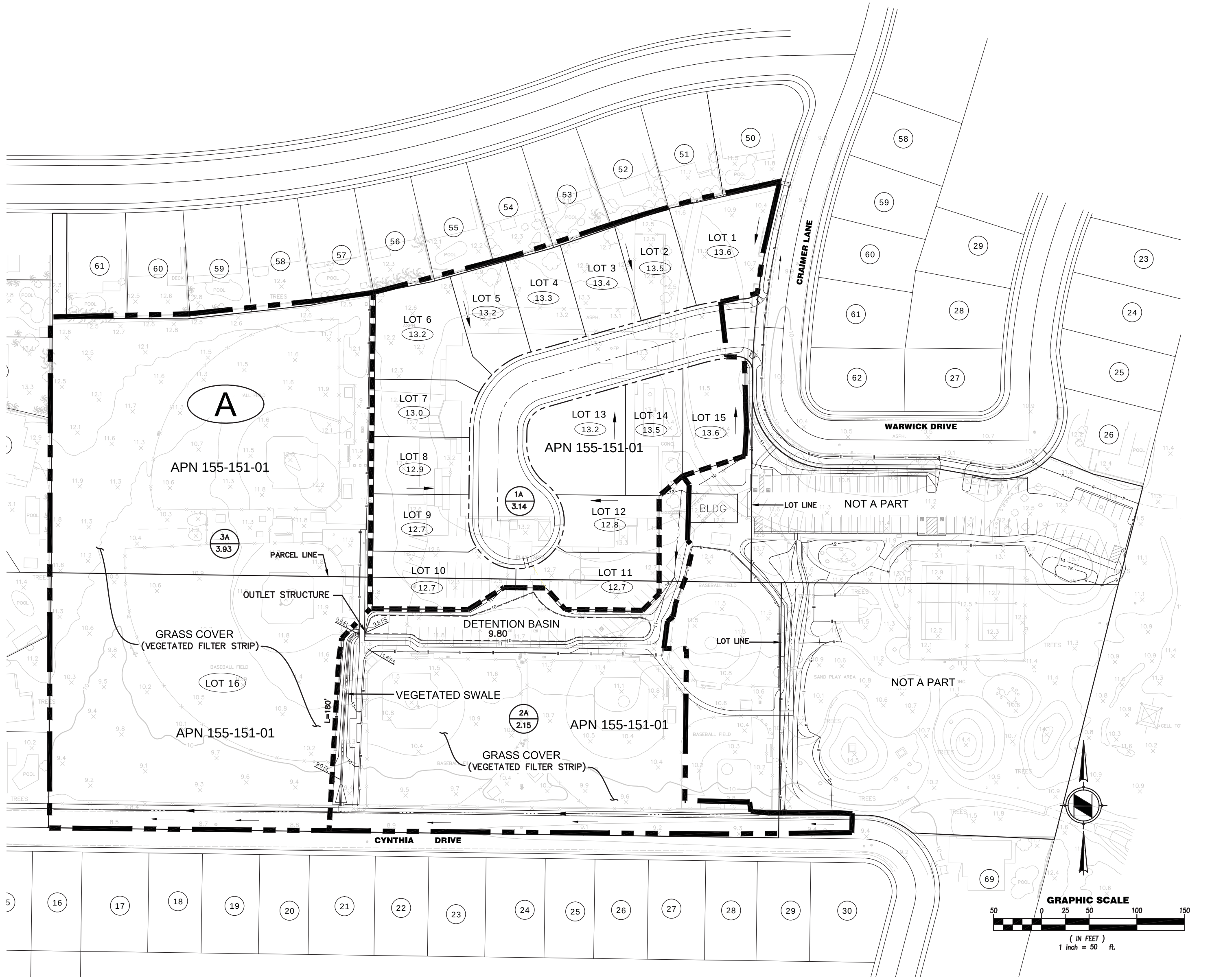
DRAINAGE AREA NO.	SUB-DRAINAGE AREA NO.	AREA A (acre)	IMPERVIOUS NO. (%)	RUNOFF COEFFICIENT C Value***	RAINFALL Zone 1 ** Rainfall - I (in)	DCV* (cft)
A	1A	3.14	65	0.64	0.7	5,086
	2A	2.15	20	0.30	0.7	1,639
	3A	4.93	10	0.23	0.7	2,819

NOTE:
* DCV - Design Capture Volume, DCV=C*I*A* (1/12in)(43,560 ft^2/acre) Section III.3 of TGD
** OC California 24-hour, 85th Percentile Rainfall Map, Fig. XVI-1 of TGD
*** C Values per Equation III.1 of OC Stormwater Program Exhibit 7.III WQMP Technical Guidance Document; C = (.75 x %IMP) + 0.15

BMP DEVICES SUMMERY TABLE:

DRAINAGE AREA NO.	SUB-DRAINAGE AREA NO.	AREA (acre)	IMPERVIOUS NO. (%)	LID Design Q (cfs)	DCV (cft)	BMP DEVICES
A	1A	3.14	65	0.40	5,086	VEGETATED SWALE
	2A	2.15	20	0.13	1,639	GRASS COVER*
	3A	4.93	10	0.22	2,819	GRASS COVER*

NOTE: * EXISTING WELL MAITAINED GRASS COVER TO REMAIN, WHICH SERVES AS VEGETATED FILTER STRIP



REGISTERED PROFESSIONAL ENGINEER
CRAIG HAUSE
NO. 63620
CIVIL
STATE OF CALIFORNIA

NO.	DATE	REVISIONS	APP'D	DATE

JOB NO.: 0214693.00
SCALE: 1" = 50'
DATE: 12/4/2014
DESIGNED BY: C.H.

TTG TMAD TAYLOR & GAINES
901 Via Piemonte, Suite 400
Ontario, California 91764
Phone: 909.477.6915 Fax: 909.477.6916
www.ttgcorp.com
Project No. 0012.059.00

PREPARED UNDER THE SUPERVISION OF:
CRAIG A HAUSE RCE NO. 63620 DATE

LE BARD DEVELOPMENT
CONCEPTUAL WQMP MAP
& BMP EXHIBIT (SCHOOL SITE)

CITY OF HUNTINGTON BEACH

SHEET 1 OF 1 SHEETS

Section VII Educational Materials

Refer to the Orange County Stormwater Program (ocwatersheds.com) for a library of materials available. For the copy submitted to the Permittee, only attach the educational materials specifically applicable to the project. Other materials specific to the project may be included as well and must be attached. **(EDUCATIONAL MATERIAL WILL BE PROVIDED WITH FINAL WQMP)**

Education Materials			
Residential Material (http://www.ocwatersheds.com)	**Check If Applicable**	**Business Material (http://www.ocwatersheds.com)**	**Check If Applicable**
The Ocean Begins at Your Front Door	☐	Tips for the Automotive Industry	☐
Tips for Car Wash Fund-raisers	☐	Tips for Using Concrete and Mortar	☐
Tips for the Home Mechanic	☐	Tips for the Food Service Industry	☐
Homeowners Guide for Sustainable Water Use	☐	Proper Maintenance Practices for Your Business	☐
Household Tips	☐	**Other Material**	**Check If Attached**
Proper Disposal of Household Hazardous Waste	☐		
Recycle at Your Local Used Oil Collection Center (North County)	☐		☐
Recycle at Your Local Used Oil Collection Center (Central County)	☐		☐
Recycle at Your Local Used Oil Collection Center (South County)	☐		☐
Tips for Maintaining a Septic Tank System	☐		☐
Responsible Pest Control	☐		☐
Sewer Spill	☐		☐
Tips for the Home Improvement Projects	☐		☐
Tips for Horse Care	☐		☐
Tips for Landscaping and Gardening	☐		☐
Tips for Pet Care	☐		☐
Tips for Pool Maintenance	☐		☐
Tips for Residential Pool, Landscape and Hardscape Drains	☐		☐
Tips for Projects Using Paint	☐		☐