Hydrology & Hydraulic Calculations

For

WAKE RIDER BEACH RESORT

15712 Grand Avenue
Lake Elsinore, California

Conditional Use Permit No. 2011-03
Commercial Design Review No. 2011-03
Tentative Parcel Map No. 35869
Zone Change No. 2011-01

Prepared For:

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Prepared by:

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Dated:

February 28, 2014

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Discussion

1. Project Description

The subject of this report, The Wake Rider Beach Resort, is located at 15712 Grand Avenue, Lake Elsinore, California. The project is situated on a 5.35 acre parcel of land, with approximately 168 lineal feet of lake shoreline. The easterly 1.35 acres of the site (depending on the lake water level) is typically covered with water as part of the lake. The project proposes a development consisting of one commercial/professional building, three hotel buildings, and one restaurant building, with associated parking and other improvements.

2. Existing Drainage Conditions

The existing drainage condition is sheetflow runoff through the site from the west to the east, draining directly into Lake Elsinore. Based on a review of existing site conditions, there is no offsite runoff that flows into the site – Grand Avenue intercepts runoff from the west and conveys it into an existing concrete lined flood control channel, owned and maintained by Riverside County Flood Control & Water Conservation District adjacent to the project's southerly boundary. The concrete channel discharges directly into Lake Elsinore.

3. Proposed Development and Facilities

Developed flows will be conveyed via a combination of overland surface flow, curb & gutter, and concrete ribbon gutters routed through a series of porous pavement areas for water quality mitigation purposes. Larger quantity storm flows will be channeled into concrete ribbon gutters and collected by grated catch basins, to be conveyed via underground pipes into Lake Elsinore.

4. Description of Analysis/Methodology

Hydrology: This report incorporates a CivilCADD/Civil Design Computer Program based on the Riverside County Flood Control and Water Conservation Rational Method, Unit Hydrograph, Basin Routing methods. These computer programs require input data for rainfall, soil type, type of development, and topographic data for the study area. A series of 10-yr and 100-yr rational method studies were run for both the existing and developed conditions.

Additionally the site incorporates water quality bmp volumes into the porous pavement detention basins, thereby satisfying Regional Water Quality Control Board requirements.

Rainfall Data: Standard intensity-duration curve data generated from Plate D-4.1 of the Riverside County Flood Control and Water Conservation Rational Hydrology Manual for the Wildomar area was used.

Soil Type Data: The soil type was obtained from the Hydrologic Soils Group Map within the Riverside County Flood Control and Water Conservation Rational Hydrology Manual. A copy of this map is included within this report. The predominant soil type obtained from the Hydrologic Soils Group Map was determined to be type B.

Type of Development: Both existing and ultimate conditions were analyzed. For the existing condition, undeveloped land use was assumed to model current storm discharges.

The project site is planned for commercial facilities. Therefore the hydrology report incorporates factors that generate discharges representing commercial type development throughout the site for the ultimate developed condition.

Runoff Index: Runoff Index factors for undeveloped and developed conditions were obtained from Plate E-6.1 of the Riverside County Flood Control and Water Conservation Hydrology Manual.

Impervious Cover: Impervious cover factors for developed areas were obtained from Plate E-6.3 of the Riverside County Flood Control and Water Conservation Hydrology Manual.

5. Summary & Conclusion

The following table provides a clear comparison of the existing and developed condition rational method storm flows for the 10-year and 100-year storm events. Based on the storm quantities calculated and shown below, there is an increase in storm flow due to the development. In accordance with Riverside County policy for drainage tributary to Lake Elsinore, the increased developed condition runoff quantity will not be retained or detained in order to provide the most quantity of runoff to the lake ('Highest and Best Use' policy).

	10-YEAR EVENT CFS	100-YEAR EVENT CFS
EXISTING	4.42	7.42
DEVELOPED	7.26	11.29
DIFFERENCE	2.84 CFS INCREASE	3.87 CFS INCREASE

6. Water Quality Porous Pavement BMP

The Riverside County Stormwater Quality Best Management Practice Design Handbook was utilized in generating capacity requirements for the project. The design procedure for BMP design volume was applied to calculate the site requirement. The design calculations are located in the Project Specific Water Quality Management Plan (WQMP) for this project. As shown in the WQMP, the total BMP volume required is 6,398 cubic feet. The combined design capacity of the three porous pavement BMPs is 7,097 cubic feet, to satisfy the water quality requirement.

7. Hydraulic Calculations

Hydraulic Calculations show the catch basins and private PVC pipe system convey the developed condition 100-year storm flows.

Rational Method

Existing Condition

100 Year Storm

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2001 Version 6.4
Rational Hydrology Study Date: 03/02/14 File:wr1exist100.out

WAKER RIDER BEACH RESORT
EXISTING CONDITION HYDROLOGY
100-YEAR STORM EVENT

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

English (in-lb) Units used in input data file

Medofer Engineering, Inc., Menifee, CA - S/N 959

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [Elsinore-Wildomar] area used.
10 year storm 10 minute intensity = 2.320(In/Hr)
10 year storm 60 minute intensity = 0.980(In/Hr)
100 year storm 10 minute intensity = 3.540(In/Hr)
100 year storm 60 minute intensity = 1.500(In/Hr)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity = 1.500(In/Hr)
Slope of intensity duration curve = 0.4800

++
Process from Point/Station 1.100 to Point/Station 1.200
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 87.000(Ft.)
Top (of initial area) elevation = 1290.000(Ft.)
Bottom (of initial area) elevation = 1285.000(Ft.)
Difference in elevation = 5.000(Ft.)
Slope = 0.05747 s(percent)= 5.75
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 5.600 min.
Rainfall intensity = 4.682(In/Hr) for a 100.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.833

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 78.00
Pervious area fraction = 1.000; Impervious fraction = 0.000
Initial subarea runoff = 1.443(CFS)
Total initial stream area = 0.370(Ac.)
Pervious area fraction = 1.000

++
Process from Point/Station 1.200 to Point/Station 1.300
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1285.000(Ft.)
Downstream point elevation = 1278.000(Ft.)
Channel length thru subarea = 238.000(Ft.)
Channel base width = 0.000(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 = 3.179(CFS)
Manning's 'N' = 0.100
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 3.179(CFS)
Depth of flow = 0.230(Ft.), Average velocity = 0.602(Ft/s)
Channel flow top width = 45.953(Ft.)
Flow Velocity = 0.60(Ft/s)
Travel time = 6.59 min.
Time of concentration = 12.19 min.

Sub-Channel No. 1 Critical depth = 0.145(Ft.)
' ' ' Critical flow top width = 28.906(Ft.)
' ' ' Critical flow velocity= 1.522(Ft/s)
' ' ' Critical flow area = 2.089(Sq.Ft)

Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.806
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 78.00
Pervious area fraction = 1.000; Impervious fraction = 0.000
Rainfall intensity = 3.224(In/Hr) for a 100.0 year storm
Subarea runoff = 2.313(CFS) for 0.890(Ac.)
Total runoff = 3.756(CFS) Total area = 1.260(Ac.)

++
Process from Point/Station 1.300 to Point/Station 1.400
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1278.000(Ft.)
Downstream point elevation = 1269.000(Ft.)
Channel length thru subarea = 319.000(Ft.)
Channel base width = 0.000(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 = 5.530(CFS)
Manning's 'N' = 0.100
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 5.530(CFS)
Depth of flow = 0.285(Ft.), Average velocity = 0.681(Ft/s)
Channel flow top width = 56.995(Ft.)
Flow Velocity = 0.68(Ft/s)
Travel time = 7.81 min.
Time of concentration = 20.00 min.

Sub-Channel No. 1 Critical depth = 0.180(Ft.)
' ' ' Critical flow top width = 35.938(Ft.)
' ' ' Critical flow velocity= 1.713(Ft/s)
' ' ' Critical flow area = 3.229(Sq.Ft)

Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.784
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 78.00
Pervious area fraction = 1.000; Impervious fraction = 0.000
Rainfall intensity = 2.542(In/Hr) for a 100.0 year storm
Subarea runoff = 2.372(CFS) for 1.190(Ac.)
Total runoff = 6.127(CFS) Total area = 2.450(Ac.)

++
Process from Point/Station 1.400 to Point/Station 1.500
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1269.000(Ft.)
Downstream point elevation = 1263.800(Ft.)
Channel length thru subarea = 159.000(Ft.)
Channel base width = 0.000(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 = 7.015(CFS)
Manning's 'N' = 0.100
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 7.015(CFS)
Depth of flow = 0.303(Ft.), Average velocity = 0.764(Ft/s)
Channel flow top width = 60.613(Ft.)
Flow Velocity = 0.76(Ft/s)

Travel time = 3.47 min.
Time of concentration = 23.46 min.

Sub-Channel No. 1 Critical depth = 0.198(Ft.)
' ' ' Critical flow top width = 39.648(Ft.)
' ' ' Critical flow velocity= 1.785(Ft/s)
' ' ' Critical flow area = 3.930(Sq.Ft)

Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.776
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 78.00
Pervious area fraction = 1.000; Impervious fraction = 0.000
Rainfall intensity = 2.354(In/Hr) for a 100.0 year storm
Subarea runoff = 1.297(CFS) for 0.710(Ac.)
Total runoff = 7.424(CFS) Total area = 3.160(Ac.)
End of computations, total study area = 3.16 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged RI index number = 78.0

Rational Method

Existing Condition

10 Year Storm

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2001 Version 6.4
Rational Hydrology Study Date: 03/02/14 File:WR1EXIST10.out

WAKE RIDER BEACH RESORT
EXISTING HYDROLOGY
10-YEAR STORM

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

English (in-lb) Units used in input data file

Medofer Engineering, Inc., Menifee, CA - S/N 959

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [Elsinore-Wildomar] area used.
10 year storm 10 minute intensity = 2.320(In/Hr)
10 year storm 60 minute intensity = 0.980(In/Hr)
100 year storm 10 minute intensity = 3.540(In/Hr)
100 year storm 60 minute intensity = 1.500(In/Hr)

Storm event year = 10.0
Calculated rainfall intensity data:
1 hour intensity = 0.980(In/Hr)
Slope of intensity duration curve = 0.4800

++

Process from Point/Station 1.100 to Point/Station 1.200
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 87.000(Ft.)
Top (of initial area) elevation = 1290.000(Ft.)
Bottom (of initial area) elevation = 1285.000(Ft.)
Difference in elevation = 5.000(Ft.)
Slope = 0.05747 s(percent)= 5.75
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 5.600 min.
Rainfall intensity = 3.059(In/Hr) for a 10.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.801

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 78.00
Pervious area fraction = 1.000; Impervious fraction = 0.000
Initial subarea runoff = 0.907(CFS)
Total initial stream area = 0.370(Ac.)
Pervious area fraction = 1.000

++
Process from Point/Station 1.200 to Point/Station 1.300
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1285.000(Ft.)
Downstream point elevation = 1278.000(Ft.)
Channel length thru subarea = 238.000(Ft.)
Channel base width = 0.000(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 = 1.998(CFS)
Manning's 'N' = 0.100
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 1.998(CFS)
Depth of flow = 0.193(Ft.), Average velocity = 0.536(Ft/s)
Channel flow top width = 38.609(Ft.)
Flow Velocity = 0.54(Ft/s)
Travel time = 7.40 min.
Time of concentration = 13.00 min.

Sub-Channel No. 1 Critical depth = 0.120(Ft.)
' ' ' Critical flow top width = 24.023(Ft.)
' ' ' Critical flow velocity= 1.385(Ft/s)
' ' ' Critical flow area = 1.443(Sq.Ft)

Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.760
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 78.00
Pervious area fraction = 1.000; Impervious fraction = 0.000
Rainfall intensity = 2.042(In/Hr) for a 10.0 year storm
Subarea runoff = 1.381(CFS) for 0.890(Ac.)
Total runoff = 2.289(CFS) Total area = 1.260(Ac.)

++
Process from Point/Station 1.300 to Point/Station 1.400
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1278.000(Ft.)
Downstream point elevation = 1269.000(Ft.)
Channel length thru subarea = 319.000(Ft.)
Channel base width = 0.000(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 = 3.369(CFS)
Manning's 'N' = 0.100
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 3.369(CFS)
Depth of flow = 0.237(Ft.), Average velocity = 0.602(Ft/s)
Channel flow top width = 47.332(Ft.)
Flow Velocity = 0.60(Ft/s)
Travel time = 8.84 min.
Time of concentration = 21.84 min.

Sub-Channel No. 1 Critical depth = 0.147(Ft.)
' ' ' Critical flow top width = 29.492(Ft.)
' ' ' Critical flow velocity= 1.549(Ft/s)
' ' ' Critical flow area = 2.174(Sq.Ft)

Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.728
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 78.00
Pervious area fraction = 1.000; Impervious fraction = 0.000
Rainfall intensity = 1.592(In/Hr) for a 10.0 year storm
Subarea runoff = 1.379(CFS) for 1.190(Ac.)
Total runoff = 3.668(CFS) Total area = 2.450(Ac.)

++
Process from Point/Station 1.400 to Point/Station 1.500
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1269.000(Ft.)
Downstream point elevation = 1263.800(Ft.)
Channel length thru subarea = 159.000(Ft.)
Channel base width = 0.000(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 = 4.199(CFS)
Manning's 'N' = 0.100
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 4.199(CFS)
Depth of flow = 0.250(Ft.), Average velocity = 0.672(Ft/s)
Channel flow top width = 50.002(Ft.)
Flow Velocity = 0.67(Ft/s)

Travel time = 3.94 min.
Time of concentration = 25.78 min.

Sub-Channel No. 1 Critical depth = 0.161(Ft.)
' ' ' Critical flow top width = 32.227(Ft.)
' ' ' Critical flow velocity= 1.617(Ft/s)
' ' ' Critical flow area = 2.596(Sq.Ft)

Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.717
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 78.00
Pervious area fraction = 1.000; Impervious fraction = 0.000
Rainfall intensity = 1.470(In/Hr) for a 10.0 year storm
Subarea runoff = 0.748(CFS) for 0.710(Ac.)
Total runoff = 4.416(CFS) Total area = 3.160(Ac.)
End of computations, total study area = 3.16 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged RI index number = 78.0

Rational Method

Proposed Condition

100 Year Storm

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2001 Version 6.4
Rational Hydrology Study Date: 03/02/14 File:WR1DEV100.out

WAKE RIDER BEACH RESORT
DEVELOPED HYDROLOGY
100-YEAR STORM

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

English (in-lb) Units used in input data file

Medofer Engineering, Inc., Menifee, CA - S/N 959

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [Elsinore-Wildomar] area used.
10 year storm 10 minute intensity = 2.320(In/Hr)
10 year storm 60 minute intensity = 0.980(In/Hr)
100 year storm 10 minute intensity = 3.540(In/Hr)
100 year storm 60 minute intensity = 1.500(In/Hr)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity = 1.500(In/Hr)
Slope of intensity duration curve = 0.4800

++

Process from Point/Station 2.100 to Point/Station 2.200
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 197.000(Ft.)
Top (of initial area) elevation = 1291.110(Ft.)
Bottom (of initial area) elevation = 1284.330(Ft.)
Difference in elevation = 6.780(Ft.)
Slope = 0.03442 s(percent)= 3.44
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Warning: TC computed to be less than 5 min.; program is assuming the
time of concentration is 5 minutes.
Initial area time of concentration = 5.000 min.
Rainfall intensity = 4.944(In/Hr) for a 100.0 year storm

COMMERCIAL subarea type
Runoff Coefficient = 0.884
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 1.399(CFS)
Total initial stream area = 0.320(Ac.)
Pervious area fraction = 0.100

++
Process from Point/Station 2.200 to Point/Station 2.300
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1281.330(Ft.)
Downstream point/station elevation = 1273.580(Ft.)
Pipe length = 178.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.399(CFS)
Nearest computed pipe diameter = 9.00(In.)
Calculated individual pipe flow = 1.399(CFS)
Normal flow depth in pipe = 3.99(In.)
Flow top width inside pipe = 8.94(In.)
Critical Depth = 6.54(In.)
Pipe flow velocity = 7.40(Ft/s)
Travel time through pipe = 0.40 min.
Time of concentration (TC) = 5.40 min.

++
Process from Point/Station 2.200 to Point/Station 2.300
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 0.320(Ac.)
Runoff from this stream = 1.399(CFS)
Time of concentration = 5.40 min.
Rainfall intensity = 4.765(In/Hr)
Program is now starting with Main Stream No. 2

++
Process from Point/Station 2.310 to Point/Station 2.320
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 175.000(Ft.)
Top (of initial area) elevation = 1291.230(Ft.)
Bottom (of initial area) elevation = 1284.740(Ft.)
Difference in elevation = 6.490(Ft.)
Slope = 0.03709 s(percent)= 3.71

TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Warning: TC computed to be less than 5 min.; program is assuming the
time of concentration is 5 minutes.
Initial area time of concentration = 5.000 min.
Rainfall intensity = 4.944(In/Hr) for a 100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.884
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 1.224(CFS)
Total initial stream area = 0.280(Ac.)
Pervious area fraction = 0.100

++
Process from Point/Station 2.320 to Point/Station 2.330
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1284.740(Ft.)
Downstream point elevation = 1278.400(Ft.)
Channel length thru subarea = 174.000(Ft.)
Channel base width = 0.000(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 = 2.383(CFS)
Manning's 'N' = 0.015
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 2.383(CFS)
Depth of flow = 0.097(Ft.), Average velocity = 2.519(Ft/s)
Channel flow top width = 19.451(Ft.)
Flow Velocity = 2.52(Ft/s)
Travel time = 1.15 min.
Time of concentration = 6.15 min.

Sub-Channel No. 1 Critical depth = 0.129(Ft.)
' ' ' Critical flow top width = 25.781(Ft.)
' ' ' Critical flow velocity= 1.434(Ft/s)
' ' ' Critical flow area = 1.662(Sq.Ft)

Adding area flow to channel
COMMERCIAL subarea type
Runoff Coefficient = 0.883
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Rainfall intensity = 4.476(In/Hr) for a 100.0 year storm

Subarea runoff = 2.095(CFS) for 0.530(Ac.)
Total runoff = 3.319(CFS) Total area = 0.810(Ac.)

++
Process from Point/Station 2.330 to Point/Station 2.300
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1274.400(Ft.)
Downstream point/station elevation = 1273.580(Ft.)
Pipe length = 31.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.319(CFS)
Nearest computed pipe diameter = 12.00(In.)
Calculated individual pipe flow = 3.319(CFS)
Normal flow depth in pipe = 6.51(In.)
Flow top width inside pipe = 11.96(In.)
Critical Depth = 9.36(In.)
Pipe flow velocity = 7.63(Ft/s)
Travel time through pipe = 0.07 min.
Time of concentration (TC) = 6.22 min.

++
Process from Point/Station 2.330 to Point/Station 2.300
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.810(Ac.)
Runoff from this stream = 3.319(CFS)
Time of concentration = 6.22 min.
Rainfall intensity = 4.453(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	1.399	5.40	4.765
2	3.319	6.22	4.453

Largest stream flow has longer time of concentration
Qp = 3.319 + sum of
Qb Ia/Ib
1.399 * 0.935 = 1.307
Qp = 4.626

Total of 2 main streams to confluence:
Flow rates before confluence point:
1.399 3.319
Area of streams before confluence:
0.320 0.810

Results of confluence:
Total flow rate = 4.626(CFS)
Time of concentration = 6.219 min.
Effective stream area after confluence = 1.130(Ac.)

++
Process from Point/Station 2.300 to Point/Station 2.400
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1273.580(Ft.)
Downstream point/station elevation = 1266.100(Ft.)
Pipe length = 326.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 4.626(CFS)
Nearest computed pipe diameter = 12.00(In.)
Calculated individual pipe flow = 4.626(CFS)
Normal flow depth in pipe = 8.55(In.)
Flow top width inside pipe = 10.86(In.)
Critical Depth = 10.73(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.70 min.
Time of concentration (TC) = 6.92 min.

++
Process from Point/Station 2.300 to Point/Station 2.400
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 1.130(Ac.)
Runoff from this stream = 4.626(CFS)
Time of concentration = 6.92 min.
Rainfall intensity = 4.229(In/Hr)
Program is now starting with Main Stream No. 2

++
Process from Point/Station 2.410 to Point/Station 2.420
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 252.000(Ft.)
Top (of initial area) elevation = 1280.860(Ft.)
Bottom (of initial area) elevation = 1276.880(Ft.)
Difference in elevation = 3.980(Ft.)
Slope = 0.01579 s(percent)= 1.58
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 6.280 min.
Rainfall intensity = 4.432(In/Hr) for a 100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.883
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000

Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 1.213(CFS)
Total initial stream area = 0.310(Ac.)
Pervious area fraction = 0.100

++
Process from Point/Station 2.420 to Point/Station 2.430
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1276.880(Ft.)
Downstream point elevation = 1269.320(Ft.)
Channel length thru subarea = 272.000(Ft.)
Channel base width = 0.000(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 = 3.110(CFS)
Manning's 'N' = 0.015
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 3.110(CFS)
Depth of flow = 0.113(Ft.), Average velocity = 2.433(Ft/s)
Channel flow top width = 22.614(Ft.)
Flow Velocity = 2.43(Ft/s)
Travel time = 1.86 min.
Time of concentration = 8.14 min.

Sub-Channel No. 1 Critical depth = 0.143(Ft.)
' ' ' Critical flow top width = 28.516(Ft.)
' ' ' Critical flow velocity= 1.530(Ft/s)
' ' ' Critical flow area = 2.033(Sq.Ft)

Adding area flow to channel
COMMERCIAL subarea type
Runoff Coefficient = 0.881
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Rainfall intensity = 3.912(In/Hr) for a 100.0 year storm
Subarea runoff = 3.343(CFS) for 0.970(Ac.)
Total runoff = 4.556(CFS) Total area = 1.280(Ac.)

++
Process from Point/Station 2.430 to Point/Station 2.400
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1267.920(Ft.)

Downstream point/station elevation = 1266.100(Ft.)
Pipe length = 31.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 4.556(CFS)
Nearest computed pipe diameter = 12.00(In.)
Calculated individual pipe flow = 4.556(CFS)
Normal flow depth in pipe = 6.19(In.)
Flow top width inside pipe = 11.99(In.)
Critical Depth = 10.68(In.)
Pipe flow velocity = 11.14(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 8.19 min.

++
Process from Point/Station 2.430 to Point/Station 2.400
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 1.280(Ac.)
Runoff from this stream = 4.556(CFS)
Time of concentration = 8.19 min.
Rainfall intensity = 3.901(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	4.626	6.92	4.229
2	4.556	8.19	3.901

Largest stream flow has longer or shorter time of concentration
Qp = 4.626 + sum of
Qa Tb/Ta
4.556 * 0.845 = 3.851
Qp = 8.477

Total of 2 main streams to confluence:
Flow rates before confluence point:
4.626 4.556
Area of streams before confluence:
1.130 1.280

Results of confluence:
Total flow rate = 8.477(CFS)
Time of concentration = 6.922 min.
Effective stream area after confluence = 2.410(Ac.)

++
Process from Point/Station 2.400 to Point/Station 2.500
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1266.100(Ft.)
Downstream point/station elevation = 1262.440(Ft.)
Pipe length = 167.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 8.477(CFS)
Nearest computed pipe diameter = 15.00(In.)
Calculated individual pipe flow = 8.477(CFS)
Normal flow depth in pipe = 10.99(In.)
Flow top width inside pipe = 13.27(In.)
Critical Depth = 13.63(In.)
Pipe flow velocity = 8.80(Ft/s)
Travel time through pipe = 0.32 min.
Time of concentration (TC) = 7.24 min.

++
Process from Point/Station 2.400 to Point/Station 2.500
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 2.410(Ac.)
Runoff from this stream = 8.477(CFS)
Time of concentration = 7.24 min.
Rainfall intensity = 4.140(In/Hr)
Program is now starting with Main Stream No. 2

++
Process from Point/Station 2.510 to Point/Station 2.520
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 229.000(Ft.)
Top (of initial area) elevation = 1273.680(Ft.)
Bottom (of initial area) elevation = 1268.670(Ft.)
Difference in elevation = 5.010(Ft.)
Slope = 0.02188 s(percent)= 2.19
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 5.663 min.
Rainfall intensity = 4.657(In/Hr) for a 100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.883
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 1.234(CFS)
Total initial stream area = 0.300(Ac.)
Pervious area fraction = 0.100

++
Process from Point/Station 2.520 to Point/Station 2.530
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1268.670(Ft.)
Downstream point elevation = 1266.920(Ft.)
Channel length thru subarea = 125.000(Ft.)
Channel base width = 0.000(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 = 2.140(CFS)
Manning's 'N' = 0.015
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 2.140(CFS)
Depth of flow = 0.112(Ft.), Average velocity = 1.713(Ft/s)
Channel flow top width = 22.351(Ft.)
Flow Velocity = 1.71(Ft/s)
Travel time = 1.22 min.
Time of concentration = 6.88 min.

Sub-Channel No. 1 Critical depth = 0.123(Ft.)
' ' ' Critical flow top width = 24.609(Ft.)
' ' ' Critical flow velocity= 1.413(Ft/s)
' ' ' Critical flow area = 1.514(Sq.Ft)

Adding area flow to channel
COMMERCIAL subarea type
Runoff Coefficient = 0.882
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Rainfall intensity = 4.242(In/Hr) for a 100.0 year storm
Subarea runoff = 1.647(CFS) for 0.440(Ac.)
Total runoff = 2.881(CFS) Total area = 0.740(Ac.)

++
Process from Point/Station 2.530 to Point/Station 2.500
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1263.920(Ft.)
Downstream point/station elevation = 1262.440(Ft.)
Pipe length = 11.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.881(CFS)
Nearest computed pipe diameter = 9.00(In.)
Calculated individual pipe flow = 2.881(CFS)
Normal flow depth in pipe = 4.37(In.)
Flow top width inside pipe = 9.00(In.)
Critical depth could not be calculated.
Pipe flow velocity = 13.56(Ft/s)

Travel time through pipe = 0.01 min.
Time of concentration (TC) = 6.89 min.

++
Process from Point/Station 2.530 to Point/Station 2.500
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.740(Ac.)
Runoff from this stream = 2.881(CFS)
Time of concentration = 6.89 min.
Rainfall intensity = 4.238(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	8.477	7.24	4.140
2	2.881	6.89	4.238

Largest stream flow has longer time of concentration
Qp = 8.477 + sum of
Qb Ia/Ib
2.881 * 0.977 = 2.814
Qp = 11.291

Total of 2 main streams to confluence:
Flow rates before confluence point:
8.477 2.881
Area of streams before confluence:
2.410 0.740

Results of confluence:
Total flow rate = 11.291(CFS)
Time of concentration = 7.239 min.
Effective stream area after confluence = 3.150(Ac.)

++
Process from Point/Station 2.500 to Point/Station 2.600
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1262.440(Ft.)
Downstream point/station elevation = 1257.000(Ft.)
Pipe length = 141.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 11.291(CFS)
Nearest computed pipe diameter = 15.00(In.)
Calculated individual pipe flow = 11.291(CFS)
Normal flow depth in pipe = 11.02(In.)
Flow top width inside pipe = 13.25(In.)

Critical depth could not be calculated.
Pipe flow velocity = 11.68(Ft/s)
Travel time through pipe = 0.20 min.
Time of concentration (TC) = 7.44 min.
End of computations, total study area = 3.15 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number = 56.0

Rational Method

Proposed Condition

10 Year Storm

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2001 Version 6.4
Rational Hydrology Study Date: 03/02/14 File:WR1DEV10.out

WAKER RIDER BEACH RESORT
DEVELOPED HYDROLOGY
10-YEAR STORM

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

English (in-lb) Units used in input data file

Medofer Engineering, Inc., Menifee, CA - S/N 959

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [Elsinore-Wildomar] area used.
10 year storm 10 minute intensity = 2.320(In/Hr)
10 year storm 60 minute intensity = 0.980(In/Hr)
100 year storm 10 minute intensity = 3.540(In/Hr)
100 year storm 60 minute intensity = 1.500(In/Hr)

Storm event year = 10.0
Calculated rainfall intensity data:
1 hour intensity = 0.980(In/Hr)
Slope of intensity duration curve = 0.4800

++
Process from Point/Station 2.100 to Point/Station 2.200
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 197.000(Ft.)
Top (of initial area) elevation = 1291.110(Ft.)
Bottom (of initial area) elevation = 1284.330(Ft.)
Difference in elevation = 6.780(Ft.)
Slope = 0.03442 s(percent)= 3.44
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Warning: TC computed to be less than 5 min.; program is assuming the
time of concentration is 5 minutes.
Initial area time of concentration = 5.000 min.

Rainfall intensity = 3.230(In/Hr) for a 10.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.878
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 0.908(CFS)
Total initial stream area = 0.320(Ac.)
Pervious area fraction = 0.100

++
Process from Point/Station 2.200 to Point/Station 2.300
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1281.330(Ft.)
Downstream point/station elevation = 1273.580(Ft.)
Pipe length = 178.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.908(CFS)
Nearest computed pipe diameter = 6.00(In.)
Calculated individual pipe flow = 0.908(CFS)
Normal flow depth in pipe = 3.97(In.)
Flow top width inside pipe = 5.68(In.)
Critical Depth = 5.54(In.)
Pipe flow velocity = 6.59(Ft/s)
Travel time through pipe = 0.45 min.
Time of concentration (TC) = 5.45 min.

++
Process from Point/Station 2.200 to Point/Station 2.300
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 0.320(Ac.)
Runoff from this stream = 0.908(CFS)
Time of concentration = 5.45 min.
Rainfall intensity = 3.099(In/Hr)
Program is now starting with Main Stream No. 2

++
Process from Point/Station 2.310 to Point/Station 2.320
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 175.000(Ft.)
Top (of initial area) elevation = 1291.230(Ft.)
Bottom (of initial area) elevation = 1284.740(Ft.)
Difference in elevation = 6.490(Ft.)

Slope = 0.03709 s(percent)= 3.71
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Warning: TC computed to be less than 5 min.; program is assuming the
time of concentration is 5 minutes.
Initial area time of concentration = 5.000 min.
Rainfall intensity = 3.230(In/Hr) for a 10.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.878
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 0.794(CFS)
Total initial stream area = 0.280(Ac.)
Pervious area fraction = 0.100

++
Process from Point/Station 2.320 to Point/Station 2.330
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1284.740(Ft.)
Downstream point elevation = 1278.400(Ft.)
Channel length thru subarea = 174.000(Ft.)
Channel base width = 0.000(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 = 1.546(CFS)
Manning's 'N' = 0.015
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 1.546(CFS)
Depth of flow = 0.083(Ft.), Average velocity = 2.261(Ft/s)
Channel flow top width = 16.537(Ft.)
Flow Velocity = 2.26(Ft/s)
Travel time = 1.28 min.
Time of concentration = 6.28 min.

Sub-Channel No. 1 Critical depth = 0.108(Ft.)
' ' ' Critical flow top width = 21.680(Ft.)
' ' ' Critical flow velocity= 1.315(Ft/s)
' ' ' Critical flow area = 1.175(Sq.Ft)

Adding area flow to channel
COMMERCIAL subarea type
Runoff Coefficient = 0.876
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900

Rainfall intensity = 2.895(In/Hr) for a 10.0 year storm
Subarea runoff = 1.344(CFS) for 0.530(Ac.)
Total runoff = 2.138(CFS) Total area = 0.810(Ac.)

++
Process from Point/Station 2.330 to Point/Station 2.300
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1274.400(Ft.)
Downstream point/station elevation = 1273.580(Ft.)
Pipe length = 31.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.138(CFS)
Nearest computed pipe diameter = 9.00(In.)
Calculated individual pipe flow = 2.138(CFS)
Normal flow depth in pipe = 6.06(In.)
Flow top width inside pipe = 8.44(In.)
Critical Depth = 7.91(In.)
Pipe flow velocity = 6.76(Ft/s)
Travel time through pipe = 0.08 min.
Time of concentration (TC) = 6.36 min.

++
Process from Point/Station 2.330 to Point/Station 2.300
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.810(Ac.)
Runoff from this stream = 2.138(CFS)
Time of concentration = 6.36 min.
Rainfall intensity = 2.878(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	0.908	5.45	3.099
2	2.138	6.36	2.878

Largest stream flow has longer time of concentration
Qp = 2.138 + sum of
Qb Ia/Ib
0.908 * 0.929 = 0.843
Qp = 2.981

Total of 2 main streams to confluence:
Flow rates before confluence point:
0.908 2.138
Area of streams before confluence:
0.320 0.810

Results of confluence:
Total flow rate = 2.981(CFS)
Time of concentration = 6.359 min.
Effective stream area after confluence = 1.130(Ac.)

++
Process from Point/Station 2.300 to Point/Station 2.400
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1273.580(Ft.)
Downstream point/station elevation = 1266.100(Ft.)
Pipe length = 326.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.981(CFS)
Nearest computed pipe diameter = 12.00(In.)
Calculated individual pipe flow = 2.981(CFS)
Normal flow depth in pipe = 6.37(In.)
Flow top width inside pipe = 11.98(In.)
Critical Depth = 8.88(In.)
Pipe flow velocity = 7.04(Ft/s)
Travel time through pipe = 0.77 min.
Time of concentration (TC) = 7.13 min.

++
Process from Point/Station 2.300 to Point/Station 2.400
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 1.130(Ac.)
Runoff from this stream = 2.981(CFS)
Time of concentration = 7.13 min.
Rainfall intensity = 2.724(In/Hr)
Program is now starting with Main Stream No. 2

++
Process from Point/Station 2.410 to Point/Station 2.420
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 252.000(Ft.)
Top (of initial area) elevation = 1280.860(Ft.)
Bottom (of initial area) elevation = 1276.880(Ft.)
Difference in elevation = 3.980(Ft.)
Slope = 0.01579 s(percent)= 1.58
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 6.280 min.
Rainfall intensity = 2.895(In/Hr) for a 10.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.876
Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 0.786(CFS)
Total initial stream area = 0.310(Ac.)
Pervious area fraction = 0.100

++
Process from Point/Station 2.420 to Point/Station 2.430
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1276.880(Ft.)
Downstream point elevation = 1269.320(Ft.)
Channel length thru subarea = 272.000(Ft.)
Channel base width = 0.000(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 = 2.017(CFS)
Manning's 'N' = 0.015
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 2.017(CFS)
Depth of flow = 0.096(Ft.), Average velocity = 2.183(Ft/s)
Channel flow top width = 19.223(Ft.)
Flow Velocity = 2.18(Ft/s)
Travel time = 2.08 min.
Time of concentration = 8.36 min.

Sub-Channel No. 1 Critical depth = 0.120(Ft.)
' ' ' Critical flow top width = 24.023(Ft.)
' ' ' Critical flow velocity= 1.398(Ft/s)
' ' ' Critical flow area = 1.443(Sq.Ft)

Adding area flow to channel
COMMERCIAL subarea type
Runoff Coefficient = 0.874
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Rainfall intensity = 2.524(In/Hr) for a 10.0 year storm
Subarea runoff = 2.139(CFS) for 0.970(Ac.)
Total runoff = 2.925(CFS) Total area = 1.280(Ac.)

++
Process from Point/Station 2.430 to Point/Station 2.400
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1267.920(Ft.)
Downstream point/station elevation = 1266.100(Ft.)
Pipe length = 31.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.925(CFS)
Nearest computed pipe diameter = 9.00(In.)
Calculated individual pipe flow = 2.925(CFS)
Normal flow depth in pipe = 5.71(In.)
Flow top width inside pipe = 8.67(In.)
Critical depth could not be calculated.
Pipe flow velocity = 9.90(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 8.41 min.

++
Process from Point/Station 2.430 to Point/Station 2.400
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 1.280(Ac.)
Runoff from this stream = 2.925(CFS)
Time of concentration = 8.41 min.
Rainfall intensity = 2.517(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	2.981	7.13	2.724
2	2.925	8.41	2.517

Largest stream flow has longer or shorter time of concentration
Qp = 2.981 + sum of
Qa Tb/Ta
2.925 * 0.848 = 2.481
Qp = 5.462

Total of 2 main streams to confluence:
Flow rates before confluence point:
2.981 2.925
Area of streams before confluence:
1.130 1.280

Results of confluence:
Total flow rate = 5.462(CFS)
Time of concentration = 7.131 min.
Effective stream area after confluence = 2.410(Ac.)

++
Process from Point/Station 2.400 to Point/Station 2.500

**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1266.100(Ft.)
Downstream point/station elevation = 1262.440(Ft.)
Pipe length = 167.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 5.462(CFS)
Nearest computed pipe diameter = 15.00(In.)
Calculated individual pipe flow = 5.462(CFS)
Normal flow depth in pipe = 8.12(In.)
Flow top width inside pipe = 14.95(In.)
Critical Depth = 11.36(In.)
Pipe flow velocity = 8.05(Ft/s)
Travel time through pipe = 0.35 min.
Time of concentration (TC) = 7.48 min.

++
Process from Point/Station 2.400 to Point/Station 2.500
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 2.410(Ac.)
Runoff from this stream = 5.462(CFS)
Time of concentration = 7.48 min.
Rainfall intensity = 2.663(In/Hr)
Program is now starting with Main Stream No. 2

++
Process from Point/Station 2.510 to Point/Station 2.520
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 229.000(Ft.)
Top (of initial area) elevation = 1273.680(Ft.)
Bottom (of initial area) elevation = 1268.670(Ft.)
Difference in elevation = 5.010(Ft.)
Slope = 0.02188 s(percent)= 2.19
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 5.663 min.
Rainfall intensity = 3.043(In/Hr) for a 10.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.877
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 0.801(CFS)
Total initial stream area = 0.300(Ac.)
Pervious area fraction = 0.100

++
Process from Point/Station 2.520 to Point/Station 2.530
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1268.670(Ft.)
Downstream point elevation = 1266.920(Ft.)
Channel length thru subarea = 125.000(Ft.)
Channel base width = 0.000(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 = 1.388(CFS)
Manning's 'N' = 0.015
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 1.388(CFS)
Depth of flow = 0.095(Ft.), Average velocity = 1.537(Ft/s)
Channel flow top width = 19.001(Ft.)
Flow Velocity = 1.54(Ft/s)
Travel time = 1.36 min.
Time of concentration = 7.02 min.

Sub-Channel No. 1 Critical depth = 0.104(Ft.)
' ' ' Critical flow top width = 20.703(Ft.)
' ' ' Critical flow velocity= 1.295(Ft/s)
' ' ' Critical flow area = 1.072(Sq.Ft)

Adding area flow to channel
COMMERCIAL subarea type
Runoff Coefficient = 0.875
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Rainfall intensity = 2.745(In/Hr) for a 10.0 year storm
Subarea runoff = 1.057(CFS) for 0.440(Ac.)
Total runoff = 1.858(CFS) Total area = 0.740(Ac.)

++
Process from Point/Station 2.530 to Point/Station 2.500
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1263.920(Ft.)
Downstream point/station elevation = 1262.440(Ft.)
Pipe length = 11.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.858(CFS)
Nearest computed pipe diameter = 6.00(In.)
Calculated individual pipe flow = 1.858(CFS)
Normal flow depth in pipe = 4.46(In.)
Flow top width inside pipe = 5.24(In.)
Critical depth could not be calculated.

Pipe flow velocity = 11.87(Ft/s)
Travel time through pipe = 0.02 min.
Time of concentration (TC) = 7.03 min.

++
Process from Point/Station 2.530 to Point/Station 2.500
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.740(Ac.)
Runoff from this stream = 1.858(CFS)
Time of concentration = 7.03 min.
Rainfall intensity = 2.742(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	5.462	7.48	2.663
2	1.858	7.03	2.742

Largest stream flow has longer time of concentration
Qp = 5.462 + sum of
Qb Ia/Ib
1.858 * 0.971 = 1.804
Qp = 7.266

Total of 2 main streams to confluence:
Flow rates before confluence point:
5.462 1.858
Area of streams before confluence:
2.410 0.740

Results of confluence:
Total flow rate = 7.266(CFS)
Time of concentration = 7.476 min.
Effective stream area after confluence = 3.150(Ac.)

++
Process from Point/Station 2.500 to Point/Station 2.600
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

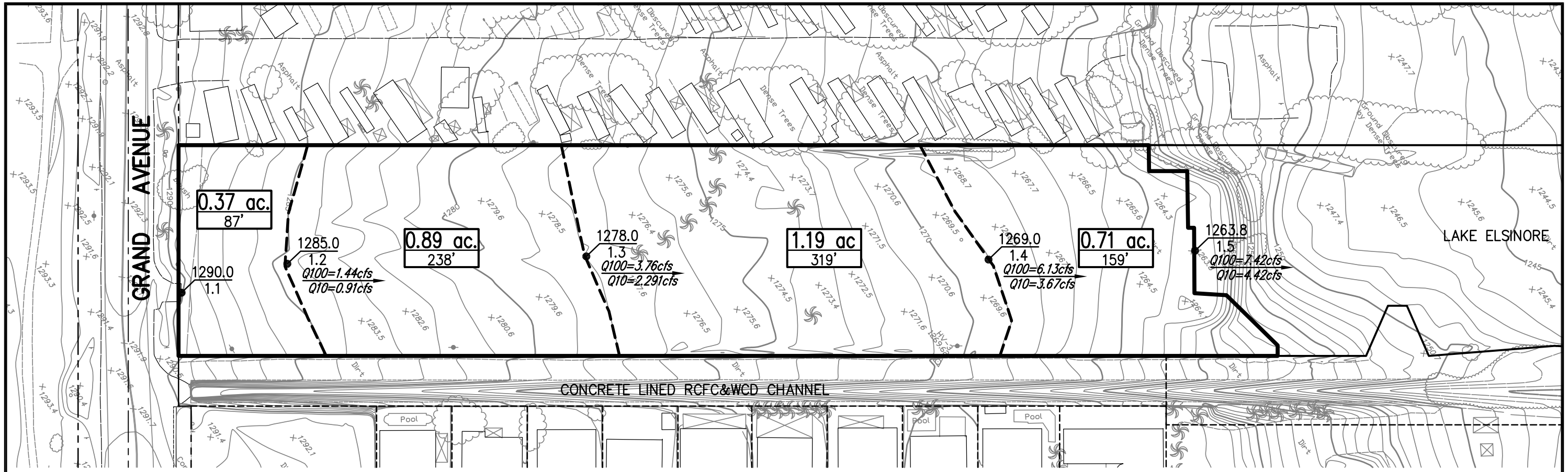
Upstream point/station elevation = 1262.440(Ft.)
Downstream point/station elevation = 1257.000(Ft.)
Pipe length = 141.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 7.266(CFS)
Nearest computed pipe diameter = 15.00(In.)
Calculated individual pipe flow = 7.266(CFS)
Normal flow depth in pipe = 8.13(In.)

Flow top width inside pipe = 14.95(In.)
Critical Depth = 12.91(In.)
Pipe flow velocity = 10.69(Ft/s)
Travel time through pipe = 0.22 min.
Time of concentration (TC) = 7.70 min.
End of computations, total study area = 3.15 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number = 56.0

Hydraulic Calculations

NOT APPLICABLE



N

1" = 80'

LEGEND

DRAINAGE AREA, ACRES — 4.6 ac.

DRAINAGE LENGTH, FT. — 720'

ELEVATION AT NODE — 1561.11

NODE LABEL — 11.3

DRAINAGE AREA BOUNDARY

DRAINAGE SUBAREA BOUNDARY

0 80 160

REGISTERED PROFESSIONAL ENGINEER
MICHAEL A. MEDOFER
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EXP. 12-31-15
CIVIL
STATE OF CALIFORNIA

WAKE RIDER BEACH RESORT
HYDROLOGY EXHIBIT
EXISTING CONDITION

Prepared By:

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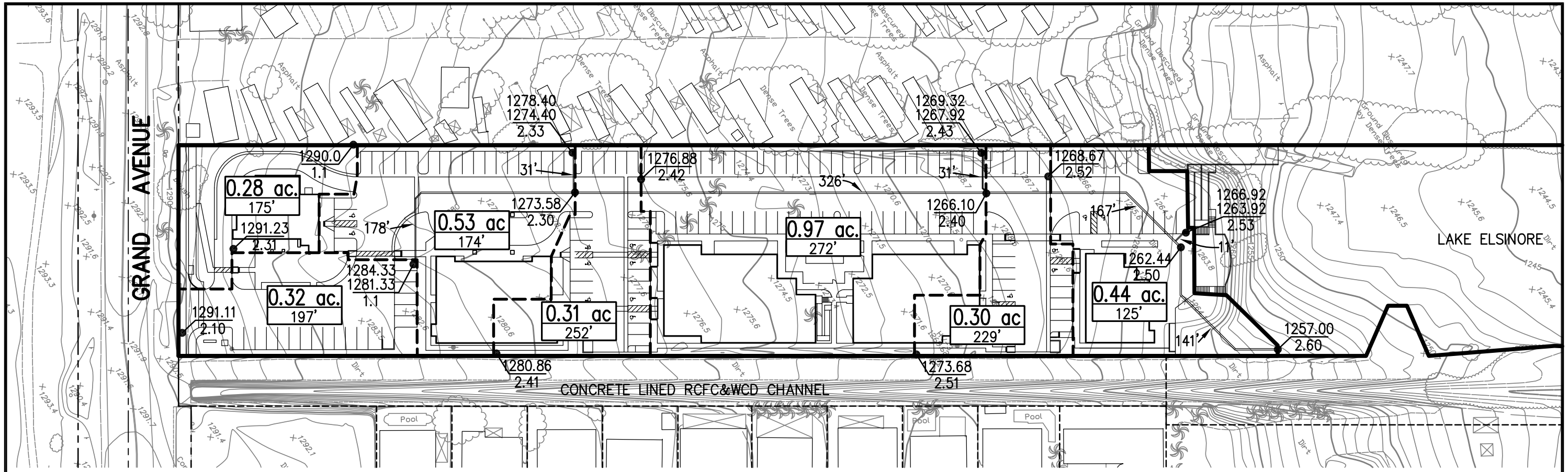

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