FOR REVIEW ONLY

534 W. Struck Avenue Redevelopment Project Orange, California

Preliminary Drainage Study

Prepared for:
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Original Date Prepared: February 2021
Revision Date(s):

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TABLE OF CONTENTS

SECTION 1 - SUMMARY

PURPOSE

The purpose of this report is to document the hydrologic and hydraulic analyses performed in support of the 534 W. Struck Avenue Redevelopment Project located in Orange, County of Orange, California. The project is bounded by Struck Avenue to the north, Parker Street to the west, W. Collins Avenue to the south, and the Santa Fe Railroad to the east. The project proposes to build an industrial building on approximately 10.0 acres of currently developed land. This report will summarize the hydrologic and hydraulic analyses that were conducted in order to determine the necessary drainage improvements required to provide flood protection for the proposed building and safely convey the runoff through the site.

The scope of this report will include the following:

- Determine the peak 100-year and 10-year flow rates for the developed condition using the Orange County Flood Control District Rational Method.
- Determine the required storm drain facilities, alignment, and sizes required to flood protect the project site.
- Preparation of a preliminary report summarizing the hydrology and hydraulic results.

DESCRIPTION OF WATERSHED

As previously described, the project is proposing an industrial building on approximately 10.0 acres of previously developed industrial land. Existing elevations across the site vary from 190 to 180 (NAVD88 datum). The site currently slopes down at approximately 1% grade to the west. The existing drainage pattern for the site and the general area is characterized by draining south to north and east to west. For the majority of the existing site, flows drain to a ribbon gutter located on the western side of the project site. The ribbon gutter conveys flows offsite to Struck Avenue without mitigation or treatment. The eastern portion of the site, including the existing railroad, drains from south to north along an existing curb and gutter. This includes the existing railroad facility along the eastern boundary of the project. All flows from this area drain north to Struck Avenue as well. Flows exiting the site are picked up in a set of catch basins located at the intersection of Struck Avenue and N. Batavia Street. At this location, flows are conveyed into the existing 36" storm drain to Collins Channel and ultimately the Santa Ana River. All downstream facilities are stabilized and developed.

PROPOSED CONDITIONS

In the proposed condition, the site shall perpetuate the existing drainage pattern by draining flows from the south to the north, to the northwest corner. The drainage facilities onsite include curb and gutters, ribbon gutters, and storm drain pipes. Ribbon gutters are proposed along the trailer parking on both the south and east sides of the proposed building. Multiple inlets along the eastern ribbon gutter are proposed to collect flows and deposit them into the onsite storm drain facilities. Curb and gutter is proposed along the western trailer parking. All onsite runoff that is captured will be directed towards a proposed outlet structure located in the northwest corner of the site. This outlet structure is designed to divert the minimum water quality flow rate towards proposed Modular Wetlands System (MWS) vaults in order to treat for water quality requirements.

According to the "Basemap of Drainage Facilities in Orange County", the existing storm drain adjacent to the project site in Struck Avenue is a 33" RCP. This pipe transitions into a 36" RCP just west of the site where a lateral connection exists to convey flows from the City Corporation Yard. The 36" RCP continues to the intersection of Batavia Avenue. At this location, a set of catch basins pick up the street flow from Struck Avenue and the adjacent building sites, including the existing drainage of the Struck Redevelopment Project. These storm drain lines were sized to accommodate the Q10 peak flow based

upon review of the plans for the existing storm drain. It was assumed that the facilities were designed to accept flows from the surrounding parcels in their developed condition. The proposed project site will also drain onto Struck Avenue similar to the existing condition and eventually discharge into the existing catch basins near the intersection of Batavia Avenue.

METHODOLOGY

HYDROLOGY

Hydrologic calculations were performed in accordance with the Orange County Hydrology Manual, dated October 1986. The Rational Method was utilized in determining peak flow rates.

The hydrological parameters, including rainfall values and soil types were derived from the Orange County Hydrology Manual. This information has been included in Section 2.

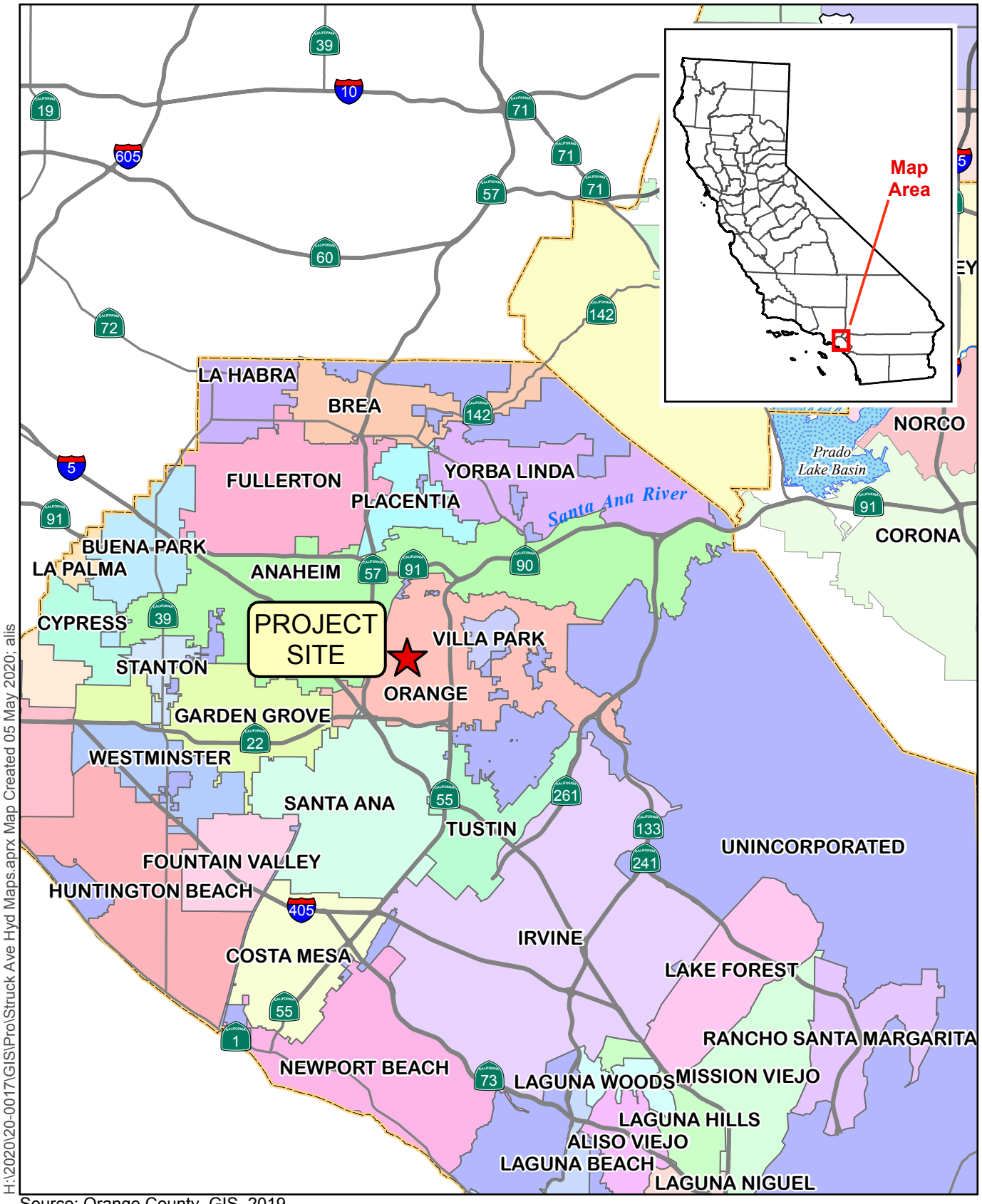
Rational Method calculations were performed using a computer program developed by CivilDesign Corporation and Joseph E. Bonadiman and Associates Inc. The computer program is commonly referred to as CivilD which incorporates the hydrological parameters outlined in the Orange County Hydrology Manual. The program uses the AMC II values as a reference. Calculations are done in accordance with the Orange County Hydrology Manual.

The Rational Method was used to determine the peak flow rates to size and design the drainage facilities needed to convey onsite flows through the site to the proposed basin. The flow rates were computed by generating a hydrologic "link-node" model in which the overall area is divided into separate drainage sub-areas, each tributary to a concentration point (node) determined by the proposed layout and grading.

HYDRAULICS

Water quality calculations were performed using formulas and worksheets included with the Orange County Water Quality Technical Guidance Document. Preliminary calculations and additional details can be found in the Preliminary WQMP.

Hydraulic calculations to determine the required pipe sizes of proposed onsite storm drain facilities will be provided in the Final Drainage Study.



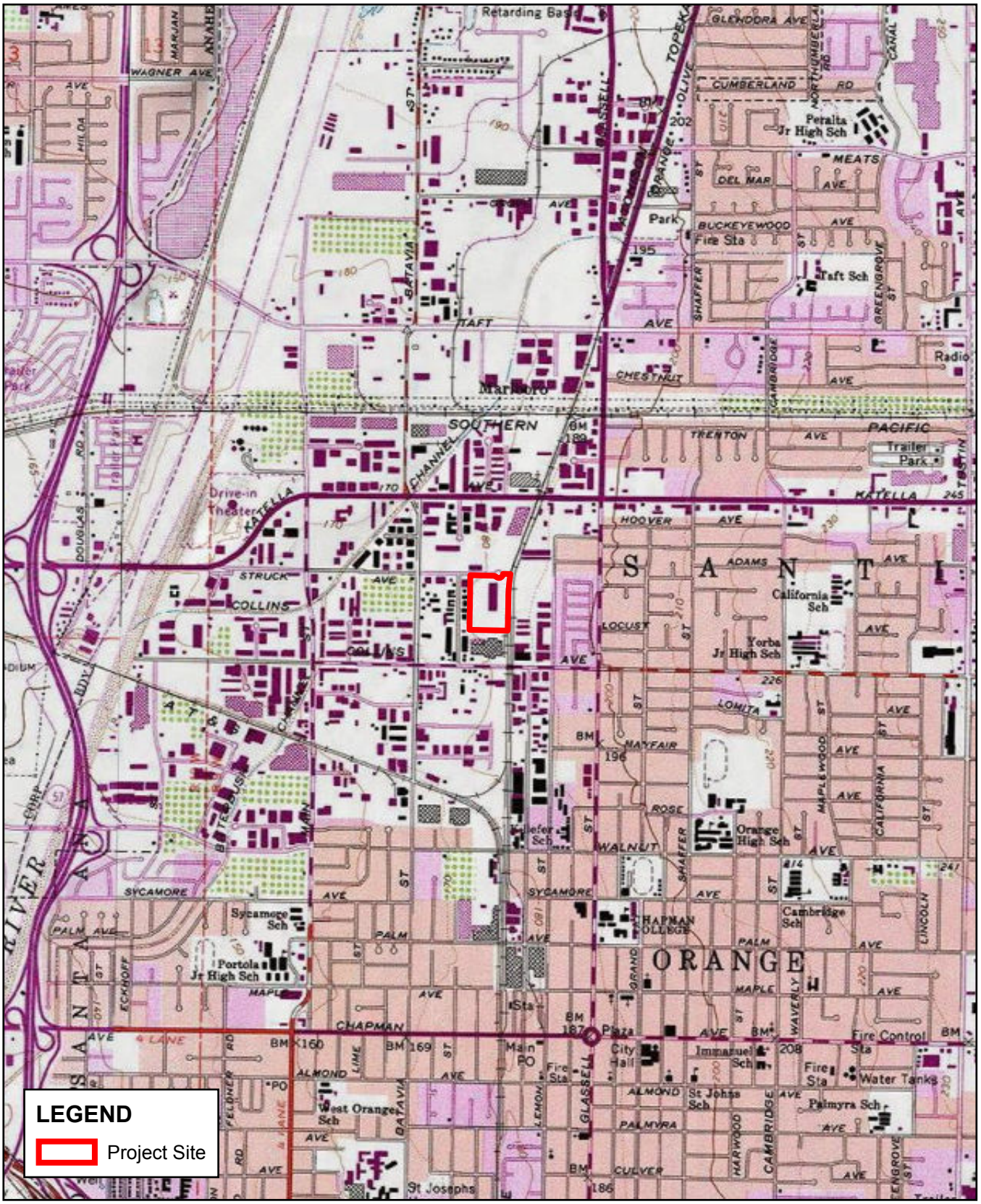
H:\2020\20-0017\GIS\Pro\Struck Ave Hyd Maps.aprx Map Created 05 May 2020; alis

Source: Orange County GIS, 2019

Figure 1 – Vicinity Map

20-0017 W. Struck Ave Redevelopment

ALBERT A. WEBB ASSOCIATES



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Sources: ESRI / USGS 7.5min Quad
DRGs: ANAHEIM / ORANGE

Figure 2 - USGS Map

20-0017 W. Struck Ave Redevelopment

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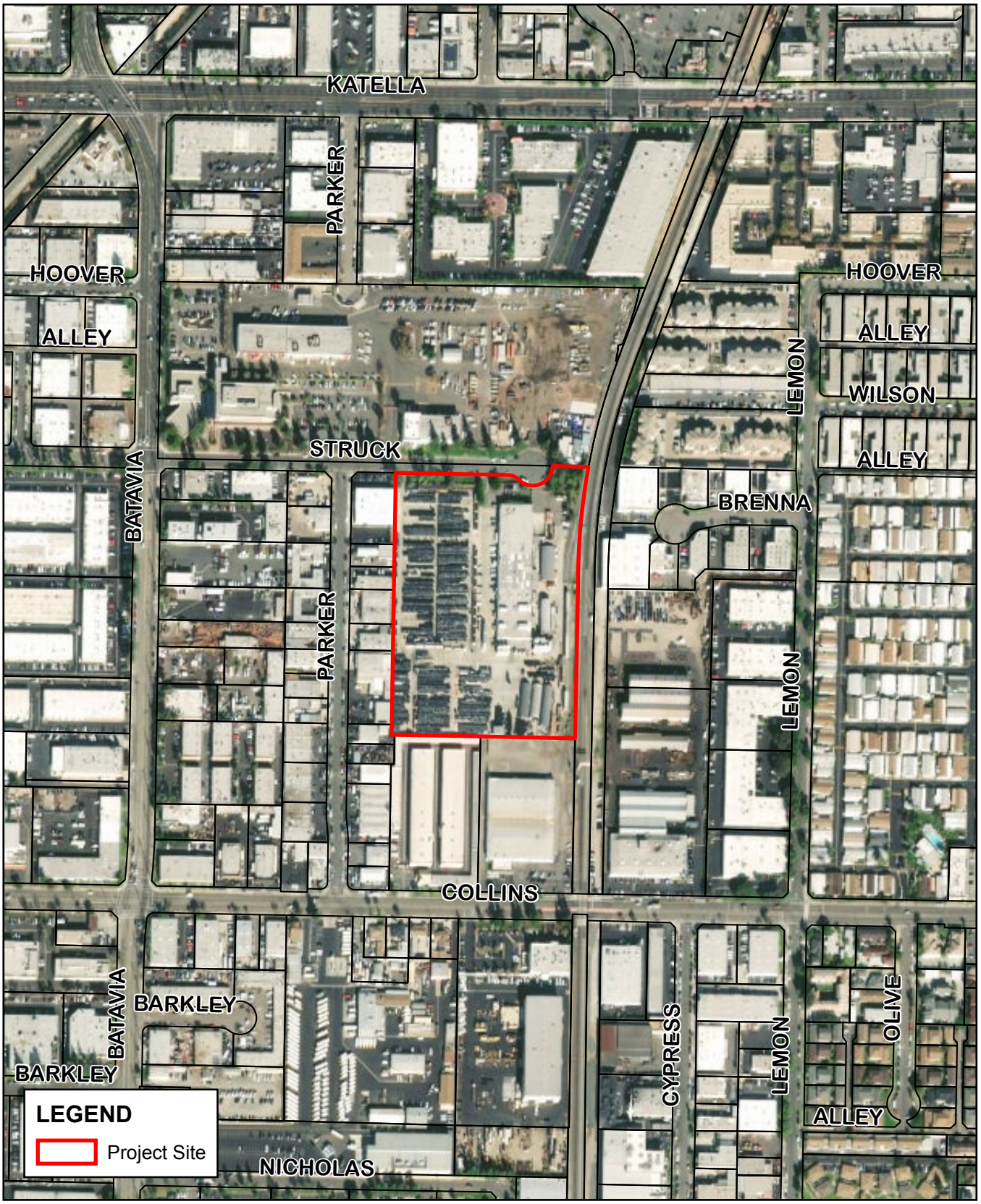

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Sources: ESRI / Orange County GIS, 2019;
USDA NAIP, 2016.

0 500 1,000 1,500 Feet

Figure 3 - Aerial Map

20-0017 W. Struck Ave Redevelopment

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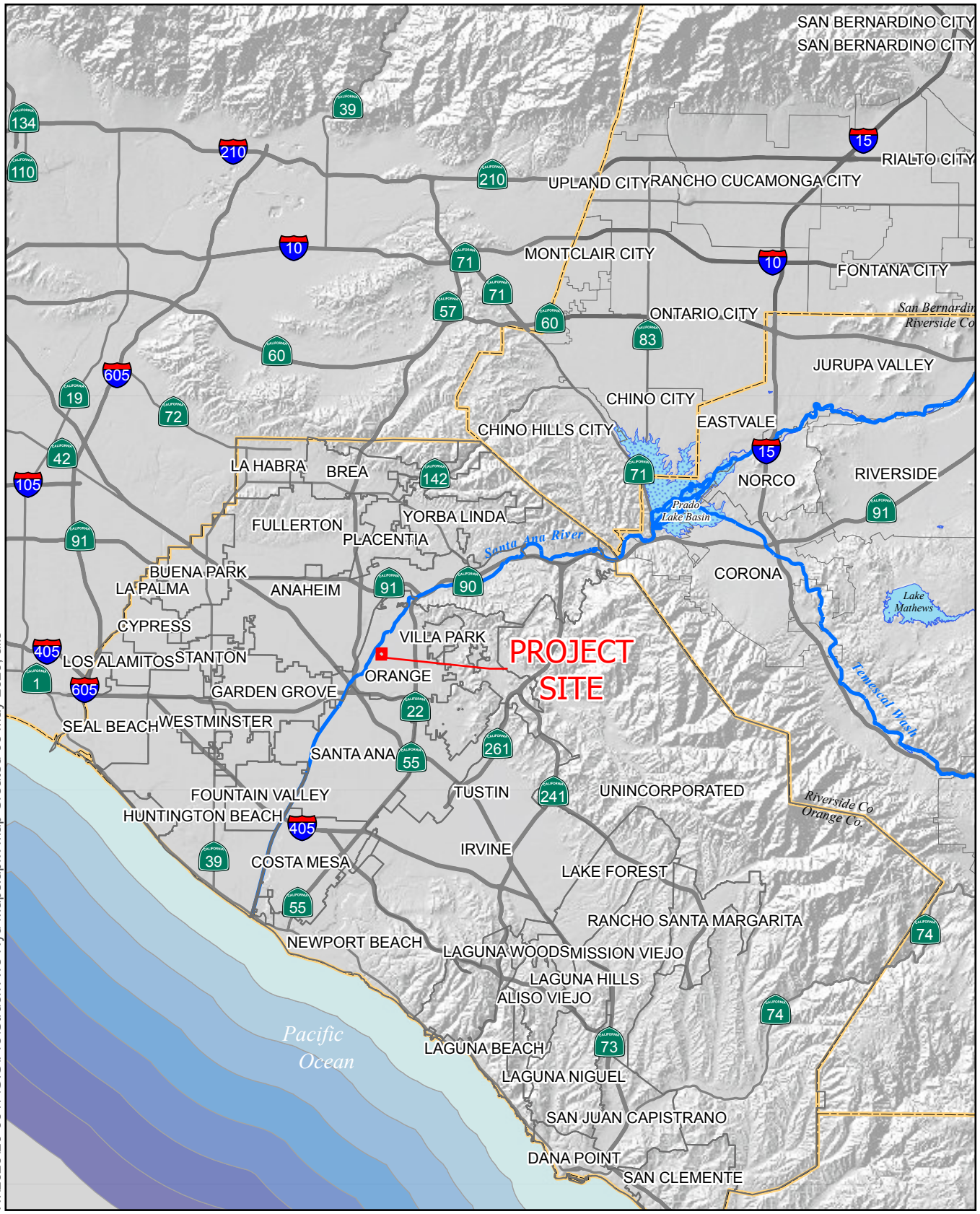


H:\2020\20-0017\GIS\Pro\Struck Ave Hyd Maps.aprx Map Created 05 May 2020; alis

Sources: USGS DLG; USGS 30m DEM

0 2 4 6 8 Miles

Figure 4 – Receiving Waterbodies

20-0017 W. Struck Ave Redevelopment

ALBERT A. WEBB ASSOCIATES

SECTION 2 - HYDROLOGY ANALYSIS

HYDROLOGY PARAMETERS

The Orange County Hydrology Manual was used to determine several of the hydrological parameters. The following rainfall depths were utilized in the hydrology analyses:

TABLE B.2.
ORANGE COUNTY POINT PRECIPITATION DATA (inches)

	DURATION					
T-YR.	5M	30M	1H	3H	6H	24H
100	0.52(.78)	1.09(1.34)	1.45(1.94)	2.43(3.96)	3.36(6.19)	5.63(11.27)
50	0.45(.71)	0.98(1.19)	1.30(1.73)	2.19(3.52)	3.02(5.51)	5.07(10.02)
25	0.40(.63)	0.87(1.04)	1.15(1.51)	1.94(3.08)	2.71(4.81)	4.49(8.76)
10	0.34(.50)	0.72(.84)	0.95(1.22)	1.59(2.48)	2.20(3.87)	3.68(7.05)
5	0.26(.40)	0.59(.68)	0.78(.99)	1.31(2.01)	1.81(3.14)	3.03(5.71)
2	0.19(.26)	0.40(.45)	0.53(.66)	0.89(1.34)	1.22(2.09)	2.05(3.81)

Based on the Plate A (Hydrologic Classification of Soils – Orange County, California) in the Orange County Hydrology Manual, the project site is classified as soil type D. The soils map is included in Appendix A.

The cover type was determined based on the existing land cover and proposed land use of the site. In this case, both the existing and developed conditions used "Commercial" land cover since it produces the highest runoff coefficient and is in line with the industrial type of land use. The table below summarizes the runoff index values from Figure C-3 of the Orange County Hydrology Manual and the imperviousness of the site for each condition:

Table 2 – Cover Type

Cover Type	Soil Group A	Soil Group B	Soil Group C	Soil Group D	Percentage of Impervious Cover
Existing Residential or Commercial	N/A	N/A	N/A	100%	84.1%
Proposed Residential or Commercial	N/A	N/A	N/A	100%	84.0%

ON-SITE RATIONAL METHOD HYDROLOGY

The rational method was used to determine peak flow rates in order to adequately size the proposed subsurface storm drains and associated inlets used to convey on-site flows to the proposed basins.

In the existing condition, the rational method was broken up into two different watercourses. Both watercourses begin at the southeastern corner of the project site. One watercourse drains to the west where flows are picked up in a ribbon gutter and conveyed north. The flows drain offsite through the existing driveway without any mitigation or treatment. The other watercourse drains north along the eastern portion of the site. This includes the existing railroad facilities. An existing curb and gutter drain the flows offsite through another existing driveway without treatment or mitigation. Both watercourses

drain west along Struck Avenue before entering a set of catch basins near the intersection of Struck Avenue and Batavia Street.

In the proposed condition, the rational method was broken up based on the location of proposed inlets throughout the site. Most subareas consist of a combination of parking stalls, concrete walkways, drive aisles, portions of the proposed building, and/or landscape areas. All subareas within the rational method calculations were considered as commercial subarea types. All onsite runoff that is captured will be directed towards the proposed outlet structure in the northwestern corner of the site.

The onsite rational method consists of two main watercourses. The first watercourse consists of the areas east and north of the proposed building. A proposed ribbon gutter conveys the eastern flows northwards to be captured in a series of drainage inlets. A proposed ribbon gutter near the northern boundary of the site convey flows westward to be captured by a catch basin. All captured flows in these areas are conveyed to the northwest corner of the site via underground storm drain pipes towards a proposed outlet structure. The second watercourse consists of the area located south and west of the proposed building. Flows near the southern boundary of the site are conveyed west via a proposed ribbon gutter towards a drainage inlet. Flows west of the proposed building are conveyed north via proposed curb and gutter and captured in a proposed drainage inlet. Roof drain (per architectural plans) locations will be provided in the final engineering stage. The proposed storm drain conveys these collected flows north to combine with the flows of the first watercourse before discharging into the proposed outlet structure. The following table summarizes the rational method results at key points:

Table 3 – Rational Method Results

Point of Interest	10-Year Peak Flow Rate (cfs)	100-Year Peak Flow Rate (cfs)
Node 152 - Flow to basin from eastern/northern portions of site	13.9	21.3
Node 153.5 - Flow to basin from western/southern portions of site	9.1	14.1
Node 155 - Total flow generated onsite	21.7	33.4

A rational method analysis was performed for the 2, 10, and 100-year storm events for both the existing and proposed conditions to determine if any flow mitigation would be required. For all events, the existing condition flows were greater than the proposed developed flows; therefore no increased mitigation is required. The rational method output files and hydrology map have been included in Appendix A.

All captured flows will be directed towards a proposed outlet structure near the northwestern corner of the site. Flows are expected to pond up within the outlet structure before spilling out of the structure and into a concrete-lined u-channel. The u-channel conveys the onsite flows north towards a proposed parkway culvert (type B) that will discharge all flows underneath the sidewalk and onto Struck Avenue.

Within the outlet structure, an internal weir wall is proposed to divert approximately 2.0 cfs of flows east towards the proposed treatment vaults for water quality treatment. Flows that have been treated by the proposed MWS vaults are then directed towards a proposed pump located northeast of the treatment vaults. The pump will discharge the water quality flows into a second concrete-lined u-channel. From there, treated flows are directed towards a second proposed parkway culvert (type B) that will discharge treated flows underneath the sidewalk and onto Struck Avenue.

The following table summarizes the existing and developed conditions:

Table 4 – Rational Method Analysis Results

Storm Event	Existing Condition		Proposed Condition	
	Q (cfs)	Tc (min)	Q (cfs)	Tc (min)
2-Year	12.2	12.35	11.9	9.90
10-Year	22.9	11.54	21.7	9.54
100-Year	35.8	11.00	33.4	9.34

SECTION 3 - HYDRAULIC ANALYSIS

ON-SITE STORM DRAIN FACILITIES

The project proposes to construct private storm drain facilities throughout the project site to convey flows towards the proposed outlet structure near the northwest corner of the site. The storm drain lines will collect flows within the gutters (curb and gutter or ribbon gutter). The onsite proposed storm drain lines will convey the 100-year peak flow rates. The starting water surface elevation for the storm drain shall be set at the top of the outlet structure where flows are proposed to spill out of before discharging onto Struck Avenue. The outlet structure has been designed to bypass approximately 2.0 cfs towards the MWS vaults for compliance with water quality requirements. Treated flows are proposed to enter a pump in order to be discharged off the site and onto Struck Avenue. The proposed outlet structure receives approximately 33.4 cfs of onsite flows from the proposed Line A, Line B, and Line C.

Line A

Line A is proposed along the eastern and northern portion of the proposed site. Line A conveys approximately 21.3 cfs of total runoff towards the proposed outlet structure. The proposed line will collect flows draining through the ribbon gutter along the eastern trailer parking stalls and northern auto parking areas before discharging into Line B. Proposed laterals along Line A are proposed at various drainage inlets. The hydraulic model for Line A will be included with the final engineering design. At this time, the preliminary storm drain sizing has been taken from the rational method normal depth calculations.

Line B

Line B is proposed near the northwestern portion of the proposed site. The proposed line will collect flows generated by the areas west of the proposed building that are conveyed along the curb and gutter. A lateral is also provided near the end of the line to allow for flows within the auto parking stalls in the northwest corner of the site to be collected. Line A and Line C also confluence with Line B before discharging into the proposed outlet structure. Line B conveys the total site runoff of approximately 33.4 cfs of runoff generated onsite. The hydraulic model for Line B will be included with the final engineering design. At this time, the preliminary storm drain sizing has been taken from the rational method normal depth calculations.

Line C

Line C is proposed along the western portion of the site. Flows captured near the southern boundary of the site are conveyed north within Line C. The proposed Line C conveys approximately 4.9 cfs of runoff towards Line B. The hydraulic model for Line C will be included with the final engineering design. At this time, the preliminary storm drain sizing has been taken from the rational method normal depth calculations.

OFF-SITE STORM DRAIN FACILITIES

According to the "Basemap of Drainage Facilities in Orange County", the existing storm drain adjacent to the project site in Struck Avenue is a 33" RCP. This pipe transitions into a 36" RCP just west of the site where a lateral connection exists to convey flows from the City Corporation Yard. The 36" RCP continues to the intersection of Batavia Avenue. At this location, a set of catch basins pick up the street flow from Struck Avenue and the adjacent building sites, including the existing drainage of the Struck Redevelopment Project. These storm drain lines were sized to accommodate the Q10 peak flow based upon review of the plans for the existing storm drain. It was assumed that the facilities were designed to accept flows from the surrounding parcels in their developed condition. At this time, the existing 33" RCP is not sized to accept flows from the Struck Redevelopment project, therefore no connection is being proposed.

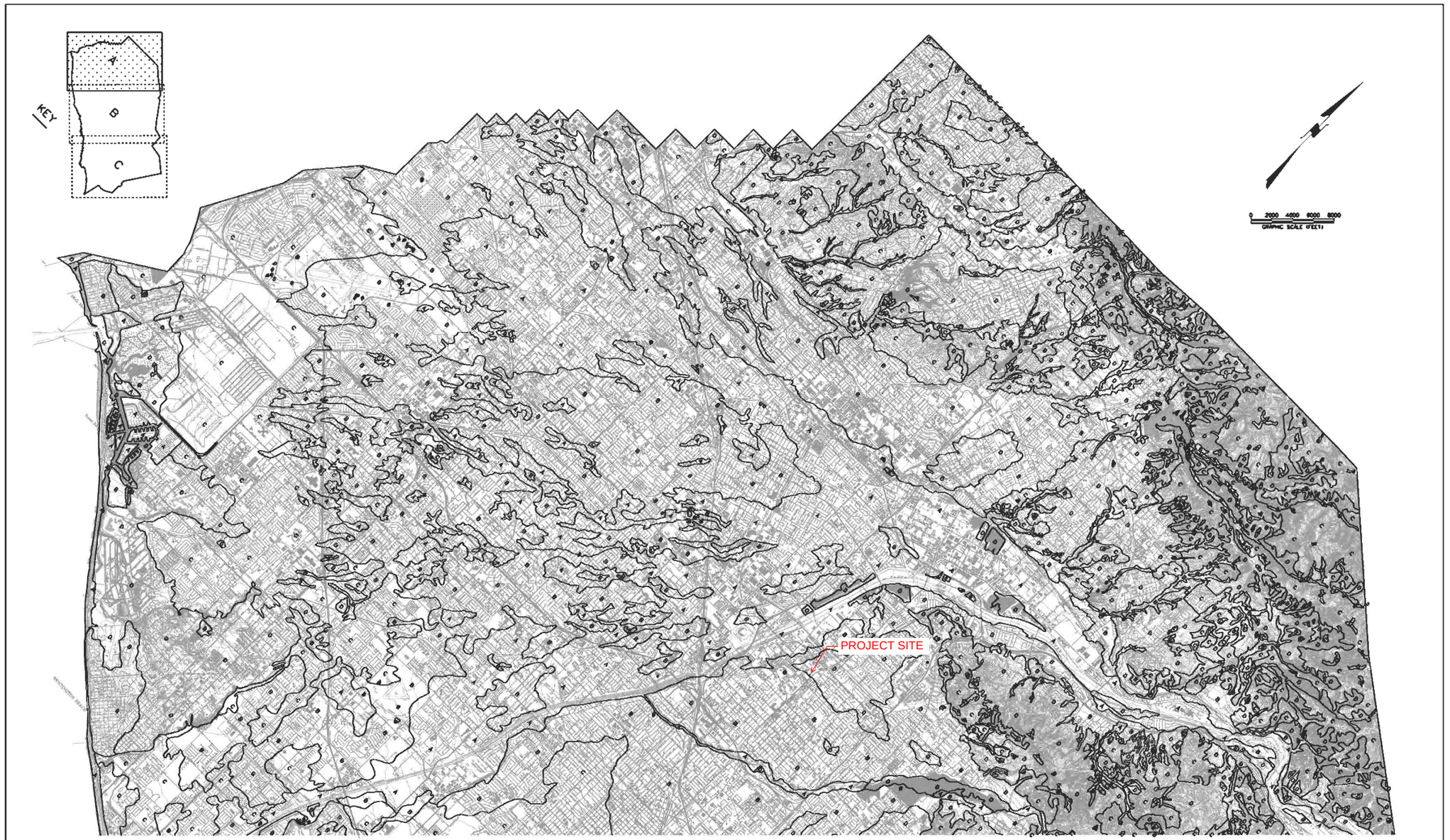
SECTION 4 - CONCLUSION

Based on the analyses and results of this report, the following conclusions were derived from the hydrology and hydraulic results:

- The proposed onsite drainage improvements will adequately convey flows and provide flood protection for the 100-year storm event.
- The proposed biotreatment devices will provide adequate water quality treatment.
- The proposed project will not impact flooding condition to upstream or downstream properties.

APPENDIX A – HYDROLOGY ANALYSIS

HYDROLOGIC SOILS GROUP MAP (PLATE A)



ORANGE COUNTY
HYDROLOGY MANUAL

LEGEND
A B C D HYDROLOGIC SOIL GROUPS
HYDROLOGIC SOIL GROUP BOUNDARY

SOURCES:
BASE MAP - ORANGE COUNTY/RESOURCES & DEVELOPMENT MANAGEMENT DEPT GEOMATICS AND LAND INFORMATION SYSTEMS DIVISION
SOIL GROUPS - SOIL SURVEY OF ORANGE COUNTY AND WESTERN PART OF RIVERSIDE COUNTY, CALIFORNIA, USDA, SOIL CONSERVATION SERVICE, 1978.

HYDROLOGIC CLASSIFICATION OF SOILS
ORANGE COUNTY, CALIFORNIA
PLATE A

2-YEAR ONSITE HYDROLOGY (EXISTING CONDITION RATIONAL METHOD)

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: 01/26/21 File Name: EX.roc

2-YEAR EXISTING CONDITION RATIONAL METHOD HYDROLOGY
534 W. STRUCK AVE REDEVELOPMENT PROJECT
CITY OF ORANGE, CALIFORNIA
WO 20-0017 AYS 01/26/2021

Program License Serial Number 4010

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

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 100.000 to Point/Station 101.000
**** 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 = 305.000(Ft.)
Top (of initial area) elevation = 190.800(Ft.)
Bottom (of initial area) elevation = 185.000(Ft.)
Difference in elevation = 5.800(Ft.)
Slope = 0.01902 s(%)= 1.90
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 6.619 min.
Rainfall intensity = 1.927(In/Hr) for a 2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.891
Subarea runoff = 2.746(CFS)
Total initial stream area = 1.600(Ac.)

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Process from Point/Station 101.000 to Point/Station 102.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 185.000(Ft.)
Downstream point elevation = 182.100(Ft.)
Channel length thru subarea = 230.000(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 = 3.624(CFS)
Manning's 'N' = 0.015
Maximum depth of channel = 1.000(Ft.)
Flow(q) thru subarea = 3.624(CFS)
Depth of flow = 0.139(Ft.), Average velocity = 1.879(Ft/s)
Channel flow top width = 27.776(Ft.)
Flow Velocity = 1.88(Ft/s)
Travel time = 2.04 min.
Time of concentration = 8.66 min.
Critical depth = 0.152(Ft.)
Adding area flow to channel

```
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 =      1.652(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.889
Subarea runoff =      1.659(CFS) for    1.400(Ac.)
Total runoff =      4.406(CFS)       Total area =        3.00(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Depth of flow =   0.149(Ft.), Average velocity =   1.973(Ft/s)
Critical depth =      0.164(Ft.)


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Process from Point/Station      102.000 to Point/Station      103.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =   182.100(Ft.)
Downstream point elevation =   181.000(Ft.)
Channel length thru subarea  =   227.000(Ft.)
Channel base width     =    0.000(Ft.)
Slope or 'Z' of left channel bank =  25.000
Slope or 'Z' of right channel bank =  25.000
Estimated mean flow rate at midpoint of channel =      5.469(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =      5.469(CFS)
Depth of flow =   0.326(Ft.), Average velocity =   2.057(Ft/s)
Channel flow top width =   16.305(Ft.)
Flow Velocity =    2.06(Ft/s)
Travel time  =    1.84 min.
Time of concentration =   10.50 min.
Critical depth =      0.313(Ft.)
 Adding area flow to channel
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 =      1.479(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.888
Subarea runoff =      2.028(CFS) for    1.900(Ac.)
Total runoff =      6.433(CFS)       Total area =        4.90(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Depth of flow =   0.347(Ft.), Average velocity =   2.142(Ft/s)
Critical depth =      0.332(Ft.)


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Process from Point/Station      103.000 to Point/Station      104.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =   181.000(Ft.)
Downstream point elevation =   179.300(Ft.)
Channel length thru subarea  =   272.000(Ft.)
Channel base width     =    0.000(Ft.)
Slope or 'Z' of left channel bank =  25.000
Slope or 'Z' of right channel bank =  25.000
Estimated mean flow rate at midpoint of channel =      7.484(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =      7.484(CFS)
Depth of flow =   0.350(Ft.), Average velocity =   2.448(Ft/s)
Channel flow top width =   17.486(Ft.)
Flow Velocity =    2.45(Ft/s)
Travel time  =    1.85 min.
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Time of concentration =   12.35 min.
Critical depth =      0.355(Ft.)
 Adding area flow to channel
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 =      1.347(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.887
Subarea runoff =      2.047(CFS) for    2.200(Ac.)
Total runoff =      8.480(CFS)       Total area =        7.10(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Depth of flow =   0.366(Ft.), Average velocity =   2.525(Ft/s)
Critical depth =      0.371(Ft.)


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Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      7.100(Ac.)
Runoff from this stream =      8.480(CFS)
Time of concentration =   12.35 min.
Rainfall intensity =     1.347(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      100.000 to Point/Station      105.000
**** 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 =   330.000(Ft.)
Top (of initial area) elevation =   190.800(Ft.)
Bottom (of initial area) elevation =   185.100(Ft.)
Difference in elevation =     5.700(Ft.)
Slope =    0.01727  s(%)=       1.73
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.963 min.
NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
for this Development Type
Rainfall intensity =      1.872(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.890
Subarea runoff =      1.333(CFS)
Total initial stream area =        0.800(Ac.)


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Process from Point/Station      105.000 to Point/Station      106.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------------
Upstream point elevation =   185.100(Ft.)
Downstream point elevation =   181.400(Ft.)
Channel length thru subarea  =   447.000(Ft.)
Channel base width     =    0.000(Ft.)
Slope or 'Z' of left channel bank =  19.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =      2.270(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
```

```
Flow(q) thru subarea =      2.270(CFS)
Depth of flow =   0.289(Ft.), Average velocity =   2.468(Ft/s)
Channel flow top width =    6.360(Ft.)
Flow Velocity =    2.47(Ft/s)
Travel time  =    3.02 min.
Time of concentration =    9.98 min.
Critical depth =      0.305(Ft.)
 Adding area flow to channel
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 =      1.522(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.888
Subarea runoff =      1.776(CFS) for    1.500(Ac.)
Total runoff =      3.110(CFS)       Total area =        2.30(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Depth of flow =   0.325(Ft.), Average velocity =   2.671(Ft/s)
Critical depth =      0.346(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      106.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
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)
Time of concentration =     9.98 min.
Rainfall intensity =      1.522(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.888
Subarea runoff =      0.811(CFS) for    0.600(Ac.)
Total runoff =      3.921(CFS)       Total area =        2.90(Ac.)
Area averaged Fm value =    0.020(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      104.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =   181.400(Ft.)
End of street segment elevation =   179.300(Ft.)
Length of street segment  =   429.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  24.000(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  =   6.000(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 =      3.921(CFS)
Depth of flow =   0.405(Ft.), Average velocity =   1.903(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  13.905(Ft.)
Flow velocity =   1.90(Ft/s)
Travel time =    3.76 min.     TC =   13.74  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 =      1.267(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.886
Subarea runoff =      0.000(CFS) for    0.000(Ac.)
Total runoff =      3.921(CFS)       Total area =        2.90(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Street flow at end of street =      3.921(CFS)
Half street flow at end of street =      3.921(CFS)
Depth of flow =   0.405(Ft.), Average velocity =   1.903(Ft/s)
Flow width (from curb towards crown)=  13.905(Ft.)


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Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.900(Ac.)
Runoff from this stream =      3.921(CFS)
Time of concentration =   13.74 min.
Rainfall intensity =     1.267(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      7.10     8.480     12.35    0.020      1.347
2      2.90     3.921     13.74    0.020      1.267
Qmax(1) =
           1.000 *    1.000 *     8.480) +
           1.064 *    0.899 *     3.921) + =      12.231
Qmax(2) =
           0.940 *    1.000 *     8.480) +
           1.000 *    1.000 *     3.921) + =      11.891

Total of 2 streams to confluence:
Flow rates before confluence point:
       8.480       3.921
Maximum flow rates at confluence using above data:
       12.231       11.891
Area of streams before confluence:
        7.100        2.900
Effective area values after confluence:
        9.707       10.000
Results of confluence:
Total flow rate =     12.231(CFS)
Time of concentration =    12.350 min.
Effective stream area after confluence =      9.707(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =      10.00(Ac.)
End of computations, total study area =           10.00 (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) = 0.100
Area averaged SCS curve number (AMC 2) =  75.0
```

2-YEAR ONSITE HYDROLOGY (DEVELOPED CONDITION RATIONAL METHOD)

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: 01/26/21 File Name: 100.roc

2-YEAR DEVELOPED CONDITION RATIONAL METHOD HYDROLOGY
534 W. STRUCK AVE REDEVELOPMENT PROJECT
CITY OF ORANGE, CALIFORNIA
WO 20-0017 AYS 01/26/2021

Program License Serial Number 4010

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

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 100.000 to Point/Station 101.000
**** 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 = 225.000(Ft.)
Top (of initial area) elevation = 186.900(Ft.)
Bottom (of initial area) elevation = 184.900(Ft.)
Difference in elevation = 2.000(Ft.)
Slope = 0.00889 s(%)= 0.89
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 6.823 min.
Rainfall intensity = 1.894(In/Hr) for a 2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.890
Subarea runoff = 2.361(CFS)
Total initial stream area = 1.400(Ac.)

++
Process from Point/Station 101.000 to Point/Station 150.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 181.500(Ft.)
Downstream point/station elevation = 180.500(Ft.)
Pipe length = 210.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.361(CFS)
Nearest computed pipe diameter = 12.00(In.)
Calculated individual pipe flow = 2.361(CFS)
Normal flow depth in pipe = 9.43(In.)
Flow top width inside pipe = 9.84(In.)
Critical Depth = 7.88(In.)
Pipe flow velocity = 3.56(Ft/s)
Travel time through pipe = 0.98 min.
Time of concentration (TC) = 7.80 min.

++
Process from Point/Station 150.000 to Point/Station 150.000
**** CONFLUENCE OF MINOR STREAMS ****

```
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.400(Ac.)
Runoff from this stream =      2.361(CFS)
Time of concentration =    7.80 min.
Rainfall intensity =     1.753(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      102.000 to Point/Station      103.000
**** 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 =   280.000(Ft.)
Top (of initial area) elevation =   186.200(Ft.)
Bottom (of initial area) elevation =   183.700(Ft.)
Difference in elevation =     2.500(Ft.)
Slope =    0.00893  s(%)=       0.89
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.440 min.
Rainfall intensity =      1.802(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.890
Subarea runoff =      1.924(CFS)
Total initial stream area =        1.200(Ac.)


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Process from Point/Station      103.000 to Point/Station      150.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
----------------------------------------------------------------------
Upstream point/station elevation =   180.600(Ft.)
Downstream point/station elevation =   180.500(Ft.)
Pipe length  =    10.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.924(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     1.924(CFS)
Normal flow depth in pipe =    6.28(In.)
Flow top width inside pipe =   11.99(In.)
Critical Depth =    7.10(In.)
Pipe flow velocity =      4.62(Ft/s)
Travel time through pipe =    0.04 min.
Time of concentration (TC) =     7.48 min.


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Process from Point/Station      150.000 to Point/Station      150.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.200(Ac.)
Runoff from this stream =      1.924(CFS)
Time of concentration =    7.48 min.
Rainfall intensity =     1.797(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      1.40     2.361      7.80    0.020      1.753
2      1.20     1.924      7.48    0.020      1.797
Qmax(1) =
          1.000 *    1.000 *     2.361) +
```

```
          0.975 *    1.000 *     1.924) + =       4.238
Qmax(2) =
          1.025 *    0.958 *     2.361) +
          1.000 *    1.000 *     1.924) + =       4.243

Total of 2 streams to confluence:
Flow rates before confluence point:
       2.361       1.924
Maximum flow rates at confluence using above data:
        4.238        4.243
Area of streams before confluence:
        1.400        1.200
Effective area values after confluence:
        2.600        2.541
Results of confluence:
Total flow rate =      4.243(CFS)
Time of concentration =     7.476 min.
Effective stream area after confluence =      2.541(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       2.60(Ac.)


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Process from Point/Station      150.000 to Point/Station      151.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   180.500(Ft.)
Downstream point/station elevation =   179.300(Ft.)
Pipe length  =   235.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.243(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     4.243(CFS)
Normal flow depth in pipe =   11.33(In.)
Flow top width inside pipe =   12.90(In.)
Critical Depth =   10.01(In.)
Pipe flow velocity =      4.27(Ft/s)
Travel time through pipe =    0.92 min.
Time of concentration (TC) =     8.39 min.


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Process from Point/Station      151.000 to Point/Station      151.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      2.541(Ac.)
Runoff from this stream =      4.243(CFS)
Time of concentration =    8.39 min.
Rainfall intensity =     1.681(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      105.000
**** 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 =   320.000(Ft.)
Top (of initial area) elevation =   185.200(Ft.)
Bottom (of initial area) elevation =   182.000(Ft.)
Difference in elevation =     3.200(Ft.)
Slope =    0.01000  s(%)=       1.00
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.672 min.
Rainfall intensity =      1.770(In/Hr) for a     2.0 year storm
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Effective runoff coefficient used for area (Q=KCIA) is C = 0.890
Subarea runoff =      2.678(CFS)
Total initial stream area =        1.700(Ac.)


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Process from Point/Station      105.000 to Point/Station      151.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   179.400(Ft.)
Downstream point/station elevation =   179.300(Ft.)
Pipe length  =    15.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.678(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     2.678(CFS)
Normal flow depth in pipe =    9.07(In.)
Flow top width inside pipe =   10.30(In.)
Critical Depth =    8.42(In.)
Pipe flow velocity =      4.20(Ft/s)
Travel time through pipe =    0.06 min.
Time of concentration (TC) =     7.73 min.


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Process from Point/Station      151.000 to Point/Station      151.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.700(Ac.)
Runoff from this stream =      2.678(CFS)
Time of concentration =    7.73 min.
Rainfall intensity =     1.763(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      2.54     4.243      8.39    0.020      1.681
2      1.70     2.678      7.73    0.020      1.763
Qmax(1) =
           1.000 *    1.000 *     4.243) +
           0.953 *    1.000 *     2.678) + =       6.797
Qmax(2) =
           1.049 *    0.921 *     4.243) +
           1.000 *    1.000 *     2.678) + =       6.778

Total of 2 streams to confluence:
Flow rates before confluence point:
       4.243       2.678
Maximum flow rates at confluence using above data:
        6.797        6.778
Area of streams before confluence:
        2.541        1.700
Effective area values after confluence:
        4.241        4.041
Results of confluence:
Total flow rate =      6.797(CFS)
Time of concentration =     8.394 min.
Effective stream area after confluence =      4.241(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       4.24(Ac.)


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Process from Point/Station      151.000 to Point/Station      152.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   179.300(Ft.)
Downstream point/station elevation =   177.700(Ft.)
Pipe length  =   315.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.797(CFS)
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```
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     6.797(CFS)
Normal flow depth in pipe =   13.45(In.)
Flow top width inside pipe =   15.65(In.)
Critical Depth =   12.11(In.)
Pipe flow velocity =      4.80(Ft/s)
Travel time through pipe =    1.09 min.
Time of concentration (TC) =     9.49 min.


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Process from Point/Station      152.000 to Point/Station      152.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      4.241(Ac.)
Runoff from this stream =      6.797(CFS)
Time of concentration =    9.49 min.
Rainfall intensity =     1.567(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      107.000
**** 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 =   210.000(Ft.)
Top (of initial area) elevation =   184.100(Ft.)
Bottom (of initial area) elevation =   181.200(Ft.)
Difference in elevation =     2.900(Ft.)
Slope =    0.01381  s(%)=       1.38
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.078 min.
Rainfall intensity =      2.024(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.891
Subarea runoff =      1.082(CFS)
Total initial stream area =        0.600(Ac.)


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Process from Point/Station      107.000 to Point/Station      152.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   178.000(Ft.)
Downstream point/station elevation =   177.700(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.082(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     1.082(CFS)
Normal flow depth in pipe =    5.01(In.)
Flow top width inside pipe =    8.94(In.)
Critical Depth =    5.73(In.)
Pipe flow velocity =      4.28(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =     6.17 min.


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Process from Point/Station      152.000 to Point/Station      152.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.600(Ac.)
Runoff from this stream =      1.082(CFS)
Time of concentration =    6.17 min.
```

```
Rainfall intensity =     2.005(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      4.24     6.797      9.49    0.020      1.567
2      0.60     1.082      6.17    0.020      2.005
Qmax(1) =
          1.000 *    1.000 *     6.797) +
          0.779 *    1.000 *     1.082) + =       7.640
Qmax(2) =
          1.283 *    0.651 *     6.797) +
          1.000 *    1.000 *     1.082) + =       6.758

Total of 2 streams to confluence:
Flow rates before confluence point:
       6.797       1.082
Maximum flow rates at confluence using above data:
        7.640        6.758
Area of streams before confluence:
        4.241        0.600
Effective area values after confluence:
        4.841        3.360
Results of confluence:
Total flow rate =      7.640(CFS)
Time of concentration =     9.488 min.
Effective stream area after confluence =      4.841(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       4.84(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      152.000 to Point/Station      153.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   177.700(Ft.)
Downstream point/station elevation =   177.200(Ft.)
Pipe length  =   100.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.640(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =     7.640(CFS)
Normal flow depth in pipe =   12.72(In.)
Flow top width inside pipe =   20.52(In.)
Critical Depth =   12.29(In.)
Pipe flow velocity =      5.01(Ft/s)
Travel time through pipe =    0.33 min.
Time of concentration (TC) =     9.82 min.


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Process from Point/Station      153.000 to Point/Station      153.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      4.841(Ac.)
Runoff from this stream =      7.640(CFS)
Time of concentration =    9.82 min.
Rainfall intensity =     1.537(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      113.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 0.000
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```
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 =   315.000(Ft.)
Top (of initial area) elevation =   186.900(Ft.)
Bottom (of initial area) elevation =   183.300(Ft.)
Difference in elevation =     3.600(Ft.)
Slope =    0.01143  s(%)=       1.14
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.423 min.
Rainfall intensity =      1.804(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.890
Subarea runoff =      1.766(CFS)
Total initial stream area =        1.100(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      113.000 to Point/Station      153.500
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   180.100(Ft.)
Downstream point/station elevation =   177.300(Ft.)
Pipe length  =   755.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.766(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     1.766(CFS)
Normal flow depth in pipe =    8.22(In.)
Flow top width inside pipe =   11.14(In.)
Critical Depth =    6.79(In.)
Pipe flow velocity =      3.08(Ft/s)
Travel time through pipe =    4.09 min.
Time of concentration (TC) =    11.51 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      153.500 to Point/Station      153.500
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      1.100(Ac.)
Runoff from this stream =      1.766(CFS)
Time of concentration =   11.51 min.
Rainfall intensity =     1.403(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      109.000
**** 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 =   310.000(Ft.)
Top (of initial area) elevation =   186.800(Ft.)
Bottom (of initial area) elevation =   182.400(Ft.)
Difference in elevation =     4.400(Ft.)
Slope =    0.01419  s(%)=       1.42
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.063 min.
Rainfall intensity =      1.857(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.890
Subarea runoff =      2.149(CFS)
Total initial stream area =        1.300(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      109.000 to Point/Station      111.000
**** STREET INLET + AREA  + PIPE  TRAVEL TIME ****
______________________________________________________________________________
Top of street segment elevation =   182.400(Ft.)
End of street segment elevation =   180.500(Ft.)
Length of street segment  =   330.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  = 135.000(Ft.)
Distance from crown to crossfall grade break  =  20.000(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  =   2.000(Ft.)
Slope from curb to property line (v/hz) =   0.300
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

Street Inlet Calculations:
Street flow before street inlet =      2.149(CFS)
Half street flow before street inlet =      2.149(CFS)
Existing pipe flow before street inlet =      0.000(CFS)
Number of street inlets = 1
Depth of flow =   0.331(Ft.), Average velocity =   2.182(Ft/s)
U.S. DOT Hydraulic Engineering Circular No. 12 curb inlet calculations:
 Street flow half width at start of inlet =      9.000(Ft.)
 Flow rate in gutter section of street = Qw =      2.149(CFS)
 Ratio of frontal flow to total flow = E0 =  1.0000
 Given curb inlet length  L =      3.000(Ft.)

Half street cross section data points at curb inlet:
               X-coordinate (Ft.)   Y-coordinate (Ft.)
              0.0000               1.4333 right of way
              2.0000               0.8333 top of curb
              2.0000               0.0000 flow line
             11.0000               0.5000 gutter/depression end
            117.0000               2.6200 grade break
            137.0000               3.0200 crown
 Length required for total flow interception = Lt
 Lt = .6 * Q^0.42 * Slope^.3 * (1/(n*Se)^.6 =     12.201(Ft.)
 where Manning's n = 0.0150 and Slope = street slope =  0.0058
 Se = Equivalent Street x-slope including depression =  0.0570
 Gutter depression depth =      4.000(In.)
 Gutter depression width =      9.000(Ft.)
 Efficiency = 1 - (1-L/Lt)^1.8 =  0.3983

Pipe calculations for under street flow rate of      0.856(CFS)
Using a pipe slope =      0.005 %
Upstream point/station elevation =   182.400(Ft.)
Downstream point/station elevation =   180.500(Ft.)
Pipe length  =   330.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.856(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =     0.856(CFS)
Normal flow depth in pipe =   13.74(In.)
Flow top width inside pipe =   19.97(In.)
Critical depth could not be calculated.
Pipe flow velocity =      0.51(Ft/s)
Travel time through pipe =   10.72 min.
Time of concentration (TC) =    17.78 min.
Maximum flow rate of street inlet(s) =      0.856(CFS)
Maximum pipe flow capacity =      0.856(CFS)
Remaining flow in street below inlet =      1.293(CFS)
 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 =      1.093(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.884
Subarea runoff =      1.424(CFS) for    2.400(Ac.)
Total runoff =      3.572(CFS)       Total area =        3.70(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Street flow at end of street =      2.716(CFS)
Half street flow at end of street =      2.716(CFS)
Depth of flow =   0.358(Ft.), Average velocity =   1.856(Ft/s)
Flow width (from curb towards crown)=  11.562(Ft.)


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Process from Point/Station      111.000 to Point/Station      153.500
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   177.500(Ft.)
Downstream point/station elevation =   177.300(Ft.)
Pipe length  =    50.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.572(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     3.572(CFS)
Normal flow depth in pipe =   10.86(In.)
Flow top width inside pipe =   13.41(In.)
Critical Depth =    9.15(In.)
Pipe flow velocity =      3.75(Ft/s)
Travel time through pipe =    0.22 min.
Time of concentration (TC) =    18.01 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      153.500 to Point/Station      153.500
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      3.700(Ac.)
Runoff from this stream =      3.572(CFS)
Time of concentration =   18.01 min.
Rainfall intensity =     1.085(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      1.10     1.766     11.51    0.020      1.403
2      3.70     3.572     18.01    0.020      1.085
Qmax(1) =
          1.000 *    1.000 *     1.766) +
          1.298 *    0.639 *     3.572) + =       4.731
Qmax(2) =
          0.770 *    1.000 *     1.766) +
          1.000 *    1.000 *     3.572) + =       4.933

Total of 2 streams to confluence:
Flow rates before confluence point:
       1.766       3.572
Maximum flow rates at confluence using above data:
        4.731        4.933
Area of streams before confluence:
        1.100        3.700
Effective area values after confluence:
        3.465        4.800
Results of confluence:
Total flow rate =      4.933(CFS)
Time of concentration =    18.005 min.
Effective stream area after confluence =      4.800(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       4.80(Ac.)
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Process from Point/Station      153.500 to Point/Station      153.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
----------------------------------------------------------------------------
Upstream point/station elevation =   177.300(Ft.)
Downstream point/station elevation =   177.200(Ft.)
Pipe length  =    40.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.933(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     4.933(CFS)
Normal flow depth in pipe =   13.86(In.)
Flow top width inside pipe =   15.15(In.)
Critical Depth =   10.25(In.)
Pipe flow velocity =      3.38(Ft/s)
Travel time through pipe =    0.20 min.
Time of concentration (TC) =    18.20 min.


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Process from Point/Station      153.000 to Point/Station      153.000
**** CONFLUENCE OF MAIN STREAMS ****
----------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      4.800(Ac.)
Runoff from this stream =      4.933(CFS)
Time of concentration =   18.20 min.
Rainfall intensity =     1.078(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      4.84     7.640      9.82    0.020      1.537
2      4.80     4.933     18.20    0.020      1.078
Qmax(1) =
          1.000 *    1.000 *     7.640) +
          1.433 *    0.540 *     4.933) + =      11.454
Qmax(2) =
          0.698 *    1.000 *     7.640) +
          1.000 *    1.000 *     4.933) + =      10.264

Total of 2 main streams to confluence:
Flow rates before confluence point:
       8.640       5.933
Maximum flow rates at confluence using above data:
       11.454       10.264
Area of streams before confluence:
        4.841        4.800
Effective area values after confluence:
        7.431        9.641


Results of confluence:
Total flow rate =     11.454(CFS)
Time of concentration =     9.820 min.
Effective stream area after confluence  =      7.431(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total =       9.64(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      153.000 to Point/Station      154.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
----------------------------------------------------------------------------
Upstream point/station elevation =   177.200(Ft.)
Downstream point/station elevation =   177.100(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    11.454(CFS)
Nearest computed pipe diameter  =     24.00(In.)
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Calculated individual pipe flow  =    11.454(CFS)
Normal flow depth in pipe =   16.25(In.)
Flow top width inside pipe =   22.45(In.)
Critical Depth =   14.57(In.)
Pipe flow velocity =      5.06(Ft/s)
Travel time through pipe =    0.08 min.
Time of concentration (TC) =     9.90 min.


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Process from Point/Station      154.000 to Point/Station      154.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      7.431(Ac.)
Runoff from this stream =     11.454(CFS)
Time of concentration =    9.90 min.
Rainfall intensity =     1.529(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      114.000 to Point/Station      115.000
**** 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 =   175.000(Ft.)
Top (of initial area) elevation =   183.100(Ft.)
Bottom (of initial area) elevation =   179.900(Ft.)
Difference in elevation =     3.200(Ft.)
Slope =    0.01829  s(%)=       1.83
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    5.342 min.
Rainfall intensity =      2.179(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.892
Subarea runoff =      0.583(CFS)
Total initial stream area =        0.300(Ac.)


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Process from Point/Station      115.000 to Point/Station      154.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   177.300(Ft.)
Downstream point/station elevation =   177.100(Ft.)
Pipe length  =    10.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.583(CFS)
Nearest computed pipe diameter  =      6.00(In.)
Calculated individual pipe flow  =     0.583(CFS)
Normal flow depth in pipe =    3.82(In.)
Flow top width inside pipe =    5.77(In.)
Critical Depth =    4.66(In.)
Pipe flow velocity =      4.42(Ft/s)
Travel time through pipe =    0.04 min.
Time of concentration (TC) =     5.38 min.


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Process from Point/Station      154.000 to Point/Station      154.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.300(Ac.)
Runoff from this stream =      0.583(CFS)
Time of concentration =    5.38 min.
Rainfall intensity =     2.171(In/Hr)
```

```
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      7.43    11.454      9.90    0.020      1.529
2      0.30     0.583      5.38    0.020      2.171
Qmax(1) =
          1.000 *    1.000 *    11.454) +
          0.702 *    1.000 *     0.583) + =      11.863
Qmax(2) =
          1.425 *    0.543 *    11.454) +
          1.000 *    1.000 *     0.583) + =       9.449

Total of 2 streams to confluence:
Flow rates before confluence point:
      11.454       0.583
Maximum flow rates at confluence using above data:
       11.863        9.449
Area of streams before confluence:
        7.431        0.300
Effective area values after confluence:
        7.731        4.336
Results of confluence:
Total flow rate =     11.863(CFS)
Time of concentration =     9.903 min.
Effective stream area after confluence =      7.731(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       7.73(Ac.)
End of computations, total study area =           10.00 (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) = 0.100
Area averaged SCS curve number (AMC 2) =  75.0
```

10-YEAR ONSITE HYDROLOGY (EXISTING CONDITION RATIONAL METHOD)

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: 01/26/21 File Name: EX.roc

10-YEAR EXISTING CONDITION RATIONAL METHOD HYDROLOGY
534 W. STRUCK AVE REDEVELOPMENT PROJECT
CITY OF ORANGE, CALIFORNIA
WO 20-0017 AYS 01/26/2021

Program License Serial Number 4010

********* 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 100.000 to Point/Station 101.000
**** 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 = 305.000(Ft.)
Top (of initial area) elevation = 190.800(Ft.)
Bottom (of initial area) elevation = 185.000(Ft.)
Difference in elevation = 5.800(Ft.)
Slope = 0.01902 s(%)= 1.90
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 6.619 min.
Rainfall intensity = 3.457(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.895
Subarea runoff = 4.949(CFS)
Total initial stream area = 1.600(Ac.)

++
Process from Point/Station 101.000 to Point/Station 102.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 185.000(Ft.)
Downstream point elevation = 182.100(Ft.)
Channel length thru subarea = 230.000(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 = 6.564(CFS)
Manning's 'N' = 0.015
Maximum depth of channel = 1.000(Ft.)
Flow(q) thru subarea = 6.564(CFS)
Depth of flow = 0.174(Ft.), Average velocity = 2.180(Ft/s)
Channel flow top width = 34.704(Ft.)
Flow Velocity = 2.18(Ft/s)
Travel time = 1.76 min.
Time of concentration = 8.38 min.
Critical depth = 0.193(Ft.)
Adding area flow to channel

```
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 =      3.020(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.894
Subarea runoff =      3.152(CFS) for    1.400(Ac.)
Total runoff =      8.101(CFS)       Total area =        3.00(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Depth of flow =   0.188(Ft.), Average velocity =   2.298(Ft/s)
Critical depth =      0.210(Ft.)


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Process from Point/Station      102.000 to Point/Station      103.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------------
Upstream point elevation =   182.100(Ft.)
Downstream point elevation =   181.000(Ft.)
Channel length thru subarea  =   227.000(Ft.)
Channel base width     =    0.000(Ft.)
Slope or 'Z' of left channel bank =  25.000
Slope or 'Z' of right channel bank =  25.000
Estimated mean flow rate at midpoint of channel =     10.080(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =     10.080(CFS)
Depth of flow =   0.410(Ft.), Average velocity =   2.397(Ft/s)
Channel flow top width =   20.507(Ft.)
Flow Velocity =    2.40(Ft/s)
Travel time  =    1.58 min.
Time of concentration =    9.96 min.
Critical depth =      0.398(Ft.)
 Adding area flow to channel
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 =      2.736(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.893
Subarea runoff =      3.876(CFS) for    1.900(Ac.)
Total runoff =     11.977(CFS)       Total area =        4.90(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Depth of flow =   0.438(Ft.), Average velocity =   2.502(Ft/s)
Critical depth =      0.426(Ft.)


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Process from Point/Station      103.000 to Point/Station      104.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------------
Upstream point elevation =   181.000(Ft.)
Downstream point elevation =   179.300(Ft.)
Channel length thru subarea  =   272.000(Ft.)
Channel base width     =    0.000(Ft.)
Slope or 'Z' of left channel bank =  25.000
Slope or 'Z' of right channel bank =  25.000
Estimated mean flow rate at midpoint of channel =     14.003(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =     14.003(CFS)
Depth of flow =   0.442(Ft.), Average velocity =   2.863(Ft/s)
Channel flow top width =   22.116(Ft.)
Flow Velocity =    2.86(Ft/s)
Travel time  =    1.58 min.
```

```
Time of concentration =   11.54 min.
Critical depth =      0.453(Ft.)
 Adding area flow to channel
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 =      2.514(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.893
Subarea runoff =      3.960(CFS) for    2.200(Ac.)
Total runoff =     15.936(CFS)       Total area =        7.10(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Depth of flow =   0.464(Ft.), Average velocity =   2.957(Ft/s)
Critical depth =      0.480(Ft.)


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Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      7.100(Ac.)
Runoff from this stream =     15.936(CFS)
Time of concentration =   11.54 min.
Rainfall intensity =     2.514(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      105.000
**** 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 =   330.000(Ft.)
Top (of initial area) elevation =   190.800(Ft.)
Bottom (of initial area) elevation =   185.100(Ft.)
Difference in elevation =     5.700(Ft.)
Slope =    0.01727  s(%)=       1.73
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.963 min.
NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
for this Development Type
Rainfall intensity =      3.358(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.895
Subarea runoff =      2.403(CFS)
Total initial stream area =        0.800(Ac.)


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Process from Point/Station      105.000 to Point/Station      106.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =   185.100(Ft.)
Downstream point elevation =   181.400(Ft.)
Channel length thru subarea  =   447.000(Ft.)
Channel base width     =    0.000(Ft.)
Slope or 'Z' of left channel bank =  19.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =      4.118(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
```

```
Flow(q) thru subarea =      4.118(CFS)
Depth of flow =   0.361(Ft.), Average velocity =   2.865(Ft/s)
Channel flow top width =    7.952(Ft.)
Flow Velocity =    2.86(Ft/s)
Travel time  =    2.60 min.
Time of concentration =    9.56 min.
Critical depth =      0.387(Ft.)
 Adding area flow to channel
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 =      2.800(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.894
Subarea runoff =      3.350(CFS) for    1.500(Ac.)
Total runoff =      5.754(CFS)       Total area =        2.30(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Depth of flow =   0.410(Ft.), Average velocity =   3.115(Ft/s)
Critical depth =      0.441(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      106.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
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)
Time of concentration =     9.56 min.
Rainfall intensity =      2.800(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.894
Subarea runoff =      1.501(CFS) for    0.600(Ac.)
Total runoff =      7.255(CFS)       Total area =        2.90(Ac.)
Area averaged Fm value =    0.020(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      104.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Top of street segment elevation =   181.400(Ft.)
End of street segment elevation =   179.300(Ft.)
Length of street segment  =   429.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  24.000(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  =   6.000(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 =      7.255(CFS)
Depth of flow =   0.482(Ft.), Average velocity =   2.208(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  17.771(Ft.)
Flow velocity =   2.21(Ft/s)
Travel time =    3.24 min.     TC =   12.80  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 =      2.369(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 =      0.000(CFS) for    0.000(Ac.)
Total runoff =      7.255(CFS)       Total area =        2.90(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Street flow at end of street =      7.255(CFS)
Half street flow at end of street =      7.255(CFS)
Depth of flow =   0.482(Ft.), Average velocity =   2.208(Ft/s)
Flow width (from curb towards crown)=  17.771(Ft.)


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Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.900(Ac.)
Runoff from this stream =      7.255(CFS)
Time of concentration =   12.80 min.
Rainfall intensity =     2.369(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      7.10    15.936     11.54    0.020      2.514
2      2.90     7.255     12.80    0.020      2.369
Qmax(1) =
          1.000 *    1.000 *    15.936) +
          1.062 *    0.901 *     7.255) + =      22.880
Qmax(2) =
          0.942 *    1.000 *    15.936) +
          1.000 *    1.000 *     7.255) + =      22.263

Total of 2 streams to confluence:
Flow rates before confluence point:
      15.936       7.255
Maximum flow rates at confluence using above data:
       22.880       22.263
Area of streams before confluence:
        7.100        2.900
Effective area values after confluence:
        9.714       10.000
Results of confluence:
Total flow rate =     22.880(CFS)
Time of concentration =    11.539 min.
Effective stream area after confluence =      9.714(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =      10.00(Ac.)
End of computations, total study area =           10.00 (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) = 0.100
Area averaged SCS curve number (AMC 2) =  75.0
```

10-YEAR ONSITE HYDROLOGY (DEVELOPED CONDITION RATIONAL METHOD)

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: 01/26/21 File Name: 100.roc

10-YEAR DEVELOPED CONDITION RATIONAL METHOD HYDROLOGY
534 W. STRUCK AVE REDEVELOPMENT PROJECT
CITY OF ORANGE, CALIFORNIA
WO 20-0017 AYS 01/26/2021

Program License Serial Number 4010

********* 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 100.000 to Point/Station 101.000
**** 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 = 225.000(Ft.)
Top (of initial area) elevation = 186.900(Ft.)
Bottom (of initial area) elevation = 184.900(Ft.)
Difference in elevation = 2.000(Ft.)
Slope = 0.00889 s(%)= 0.89
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 6.823 min.
Rainfall intensity = 3.397(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.895
Subarea runoff = 4.255(CFS)
Total initial stream area = 1.400(Ac.)

++
Process from Point/Station 101.000 to Point/Station 150.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 181.500(Ft.)
Downstream point/station elevation = 180.500(Ft.)
Pipe length = 210.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 4.255(CFS)
Nearest computed pipe diameter = 15.00(In.)
Calculated individual pipe flow = 4.255(CFS)
Normal flow depth in pipe = 11.72(In.)
Flow top width inside pipe = 12.39(In.)
Critical Depth = 10.02(In.)
Pipe flow velocity = 4.14(Ft/s)
Travel time through pipe = 0.85 min.
Time of concentration (TC) = 7.67 min.

++
Process from Point/Station 150.000 to Point/Station 150.000
**** CONFLUENCE OF MINOR STREAMS ****

```
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.400(Ac.)
Runoff from this stream =      4.255(CFS)
Time of concentration =    7.67 min.
Rainfall intensity =     3.177(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      102.000 to Point/Station      103.000
**** 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 =   280.000(Ft.)
Top (of initial area) elevation =   186.200(Ft.)
Bottom (of initial area) elevation =   183.700(Ft.)
Difference in elevation =     2.500(Ft.)
Slope =    0.00893  s(%)=       0.89
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.440 min.
Rainfall intensity =      3.233(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.894
Subarea runoff =      3.470(CFS)
Total initial stream area =        1.200(Ac.)


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Process from Point/Station      103.000 to Point/Station      150.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   180.600(Ft.)
Downstream point/station elevation =   180.500(Ft.)
Pipe length  =    10.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.470(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     3.470(CFS)
Normal flow depth in pipe =    9.56(In.)
Flow top width inside pipe =    9.65(In.)
Critical Depth =    9.55(In.)
Pipe flow velocity =      5.17(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     7.47 min.


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Process from Point/Station      150.000 to Point/Station      150.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.200(Ac.)
Runoff from this stream =      3.470(CFS)
Time of concentration =    7.47 min.
Rainfall intensity =     3.225(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      1.40     4.255      7.67    0.020      3.177
2      1.20     3.470      7.47    0.020      3.225
Qmax(1) =
          1.000 *    1.000 *     4.255) +
```

```
          0.985 *    1.000 *     3.470) + =       7.673
Qmax(2) =
          1.015 *    0.974 *     4.255) +
          1.000 *    1.000 *     3.470) + =       7.678

Total of 2 streams to confluence:
Flow rates before confluence point:
       4.255       3.470
Maximum flow rates at confluence using above data:
        7.673        7.678
Area of streams before confluence:
        1.400        1.200
Effective area values after confluence:
        2.600        2.564
Results of confluence:
Total flow rate =      7.678(CFS)
Time of concentration =     7.472 min.
Effective stream area after confluence =      2.564(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       2.60(Ac.)


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Process from Point/Station      150.000 to Point/Station      151.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   180.500(Ft.)
Downstream point/station elevation =   179.300(Ft.)
Pipe length  =   235.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.678(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =     7.678(CFS)
Normal flow depth in pipe =   12.68(In.)
Flow top width inside pipe =   20.54(In.)
Critical Depth =   12.32(In.)
Pipe flow velocity =      5.06(Ft/s)
Travel time through pipe =    0.77 min.
Time of concentration (TC) =     8.25 min.


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Process from Point/Station      151.000 to Point/Station      151.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      2.564(Ac.)
Runoff from this stream =      7.678(CFS)
Time of concentration =    8.25 min.
Rainfall intensity =     3.048(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      104.000 to Point/Station      105.000
**** 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 =   320.000(Ft.)
Top (of initial area) elevation =   185.200(Ft.)
Bottom (of initial area) elevation =   182.000(Ft.)
Difference in elevation =     3.200(Ft.)
Slope =    0.01000  s(%)=       1.00
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.672 min.
Rainfall intensity =      3.176(In/Hr) for a    10.0 year storm
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Effective runoff coefficient used for area (Q=KCIA) is C = 0.894
Subarea runoff =      4.829(CFS)
Total initial stream area =        1.700(Ac.)


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Process from Point/Station      105.000 to Point/Station      151.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   179.400(Ft.)
Downstream point/station elevation =   179.300(Ft.)
Pipe length  =    15.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.829(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     4.829(CFS)
Normal flow depth in pipe =   11.29(In.)
Flow top width inside pipe =   12.94(In.)
Critical Depth =   10.70(In.)
Pipe flow velocity =      4.87(Ft/s)
Travel time through pipe =    0.05 min.
Time of concentration (TC) =     7.72 min.


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Process from Point/Station      151.000 to Point/Station      151.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.700(Ac.)
Runoff from this stream =      4.829(CFS)
Time of concentration =    7.72 min.
Rainfall intensity =     3.164(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      2.56     7.678      8.25    0.020      3.048
2      1.70     4.829      7.72    0.020      3.164
Qmax(1) =
          1.000 *    1.000 *     7.678) +
          0.963 *    1.000 *     4.829) + =      12.328
Qmax(2) =
          1.039 *    0.937 *     7.678) +
          1.000 *    1.000 *     4.829) + =      12.297

Total of 2 streams to confluence:
Flow rates before confluence point:
       7.678       4.829
Maximum flow rates at confluence using above data:
       12.328       12.297
Area of streams before confluence:
        2.564        1.700
Effective area values after confluence:
        4.264        4.101
Results of confluence:
Total flow rate =     12.328(CFS)
Time of concentration =     8.247 min.
Effective stream area after confluence =      4.264(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       4.26(Ac.)


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Process from Point/Station      151.000 to Point/Station      152.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   179.300(Ft.)
Downstream point/station elevation =   177.700(Ft.)
Pipe length  =   315.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    12.328(CFS)
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```
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    12.328(CFS)
Normal flow depth in pipe =   15.72(In.)
Flow top width inside pipe =   22.82(In.)
Critical Depth =   15.13(In.)
Pipe flow velocity =      5.65(Ft/s)
Travel time through pipe =    0.93 min.
Time of concentration (TC) =     9.18 min.


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Process from Point/Station      152.000 to Point/Station      152.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      4.264(Ac.)
Runoff from this stream =     12.328(CFS)
Time of concentration =    9.18 min.
Rainfall intensity =     2.867(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      106.000 to Point/Station      107.000
**** 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 =   210.000(Ft.)
Top (of initial area) elevation =   184.100(Ft.)
Bottom (of initial area) elevation =   181.200(Ft.)
Difference in elevation =     2.900(Ft.)
Slope =    0.01381  s(%)=       1.38
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.078 min.
Rainfall intensity =      3.630(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.895
Subarea runoff =      1.949(CFS)
Total initial stream area =        0.600(Ac.)


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Process from Point/Station      107.000 to Point/Station      152.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   178.000(Ft.)
Downstream point/station elevation =   177.700(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.949(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     1.949(CFS)
Normal flow depth in pipe =    6.00(In.)
Flow top width inside pipe =   12.00(In.)
Critical Depth =    7.14(In.)
Pipe flow velocity =      4.97(Ft/s)
Travel time through pipe =    0.08 min.
Time of concentration (TC) =     6.16 min.


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Process from Point/Station      152.000 to Point/Station      152.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.600(Ac.)
Runoff from this stream =      1.949(CFS)
Time of concentration =    6.16 min.
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```
Rainfall intensity =     3.602(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      4.26    12.328      9.18    0.020      2.867
2      0.60     1.949      6.16    0.020      3.602
Qmax(1) =
          1.000 *    1.000 *    12.328) +
          0.795 *    1.000 *     1.949) + =      13.878
Qmax(2) =
          1.258 *    0.672 *    12.328) +
          1.000 *    1.000 *     1.949) + =      12.365

Total of 2 streams to confluence:
Flow rates before confluence point:
      12.328       1.949
Maximum flow rates at confluence using above data:
       13.878       12.365
Area of streams before confluence:
        4.264        0.600
Effective area values after confluence:
        4.864        3.463
Results of confluence:
Total flow rate =     13.878(CFS)
Time of concentration =     9.175 min.
Effective stream area after confluence =      4.864(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       4.86(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      152.000 to Point/Station      153.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   177.700(Ft.)
Downstream point/station elevation =   177.200(Ft.)
Pipe length  =   100.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    13.878(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    13.878(CFS)
Normal flow depth in pipe =   17.27(In.)
Flow top width inside pipe =   21.56(In.)
Critical Depth =   16.11(In.)
Pipe flow velocity =      5.73(Ft/s)
Travel time through pipe =    0.29 min.
Time of concentration (TC) =     9.47 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      153.000 to Point/Station      153.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      4.864(Ac.)
Runoff from this stream =     13.878(CFS)
Time of concentration =    9.47 min.
Rainfall intensity =     2.816(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      113.000
**** 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 =   315.000(Ft.)
Top (of initial area) elevation =   186.900(Ft.)
Bottom (of initial area) elevation =   183.300(Ft.)
Difference in elevation =     3.600(Ft.)
Slope =    0.01143  s(%)=       1.14
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.423 min.
Rainfall intensity =      3.237(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.894
Subarea runoff =      3.185(CFS)
Total initial stream area =        1.100(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      113.000 to Point/Station      153.500
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   180.100(Ft.)
Downstream point/station elevation =   177.300(Ft.)
Pipe length  =   755.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.185(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     3.185(CFS)
Normal flow depth in pipe =   10.24(In.)
Flow top width inside pipe =   13.96(In.)
Critical Depth =    8.63(In.)
Pipe flow velocity =      3.57(Ft/s)
Travel time through pipe =    3.53 min.
Time of concentration (TC) =    10.95 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      153.500 to Point/Station      153.500
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      1.100(Ac.)
Runoff from this stream =      3.185(CFS)
Time of concentration =   10.95 min.
Rainfall intensity =     2.591(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      109.000
**** 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 =   310.000(Ft.)
Top (of initial area) elevation =   186.800(Ft.)
Bottom (of initial area) elevation =   182.400(Ft.)
Difference in elevation =     4.400(Ft.)
Slope =    0.01419  s(%)=       1.42
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.063 min.
Rainfall intensity =      3.330(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.895
Subarea runoff =      3.873(CFS)
Total initial stream area =        1.300(Ac.)
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      109.000 to Point/Station      111.000
**** STREET INLET + AREA  + PIPE  TRAVEL TIME ****
______________________________________________________________________________
Top of street segment elevation =   182.400(Ft.)
End of street segment elevation =   180.500(Ft.)
Length of street segment  =   330.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  = 135.000(Ft.)
Distance from crown to crossfall grade break  =  20.000(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  =   2.000(Ft.)
Slope from curb to property line (v/hz) =   0.300
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

Street Inlet Calculations:
Street flow before street inlet =      3.873(CFS)
Half street flow before street inlet =      3.873(CFS)
Existing pipe flow before street inlet =      0.000(CFS)
Number of street inlets = 1
Depth of flow =   0.413(Ft.), Average velocity =   2.529(Ft/s)
U.S. DOT Hydraulic Engineering Circular No. 12 curb inlet calculations:
 Street flow half width at start of inlet =      9.000(Ft.)
 Flow rate in gutter section of street = Qw =      3.873(CFS)
 Ratio of frontal flow to total flow = E0 =  1.0000
 Given curb inlet length  L =      3.000(Ft.)

Half street cross section data points at curb inlet:
                X-coordinate (Ft.)   Y-coordinate (Ft.)
               0.0000               1.4333 right of way
               2.0000               0.8333 top of curb
               2.0000               0.0000 flow line
              11.0000               0.5000 gutter/depression end
             117.0000               2.6200 grade break
             137.0000               3.0200 crown
 Length required for total flow interception = Lt
 Lt = .6 * Q^0.42 * Slope^.3 * (1/(n*Se)^.6 =     15.627(Ft.)
 where Manning's n = 0.0150 and Slope = street slope =  0.0058
 Se = Equivalent Street x-slope including depression =  0.0570
 Gutter depression depth =      4.000(In.)
 Gutter depression width =      9.000(Ft.)
 Efficiency = 1 - (1-L/Lt)^1.8 =  0.3187

Pipe calculations for under street flow rate of      1.234(CFS)
Using a pipe slope =      0.005 %
Upstream point/station elevation =   182.400(Ft.)
Downstream point/station elevation =   180.500(Ft.)
Pipe length  =   330.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.234(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =     1.234(CFS)
Normal flow depth in pipe =   15.82(In.)
Flow top width inside pipe =   22.75(In.)
Critical depth could not be calculated.
Pipe flow velocity =      0.56(Ft/s)
Travel time through pipe =    9.79 min.
Time of concentration (TC) =    16.85 min.
Maximum flow rate of street inlet(s) =      1.234(CFS)
Maximum pipe flow capacity =      1.234(CFS)
Remaining flow in street below inlet =      2.639(CFS)
 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 =      2.024(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.891
Subarea runoff =      2.799(CFS) for    2.400(Ac.)
Total runoff =      6.672(CFS)       Total area =        3.70(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Street flow at end of street =      5.438(CFS)
Half street flow at end of street =      5.438(CFS)
Depth of flow =   0.434(Ft.), Average velocity =   2.190(Ft/s)
Flow width (from curb towards crown)=  15.351(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      111.000 to Point/Station      153.500
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   177.500(Ft.)
Downstream point/station elevation =   177.300(Ft.)
Pipe length  =    50.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.672(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =     6.672(CFS)
Normal flow depth in pipe =   12.53(In.)
Flow top width inside pipe =   20.61(In.)
Critical Depth =   11.44(In.)
Pipe flow velocity =      4.46(Ft/s)
Travel time through pipe =    0.19 min.
Time of concentration (TC) =    17.04 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      153.500 to Point/Station      153.500
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      3.700(Ac.)
Runoff from this stream =      6.672(CFS)
Time of concentration =   17.04 min.
Rainfall intensity =     2.011(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      1.10     3.185     10.95    0.020      2.591
2      3.70     6.672     17.04    0.020      2.011
Qmax(1) =
          1.000 *    1.000 *     3.185) +
          1.291 *    0.643 *     6.672) + =       8.721
Qmax(2) =
          0.774 *    1.000 *     3.185) +
          1.000 *    1.000 *     6.672) + =       9.138

Total of 2 streams to confluence:
Flow rates before confluence point:
       3.185       6.672
Maximum flow rates at confluence using above data:
        8.721        9.138
Area of streams before confluence:
        1.100        3.700
Effective area values after confluence:
        3.478        4.800
Results of confluence:
Total flow rate =      9.138(CFS)
Time of concentration =    17.038 min.
Effective stream area after confluence =      4.800(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       4.80(Ac.)
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      153.500 to Point/Station      153.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
----------------------------------------------------------------------------
Upstream point/station elevation =   177.300(Ft.)
Downstream point/station elevation =   177.200(Ft.)
Pipe length  =    40.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.138(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =     9.138(CFS)
Normal flow depth in pipe =   16.36(In.)
Flow top width inside pipe =   22.36(In.)
Critical Depth =   12.96(In.)
Pipe flow velocity =      4.01(Ft/s)
Travel time through pipe =    0.17 min.
Time of concentration (TC) =    17.20 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      153.000 to Point/Station      153.000
**** CONFLUENCE OF MAIN STREAMS ****
----------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      4.800(Ac.)
Runoff from this stream =      9.138(CFS)
Time of concentration =   17.20 min.
Rainfall intensity =     2.000(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      4.86    13.878      9.47    0.020      2.816
2      4.80     9.138     17.20    0.020      2.000
Qmax(1) =
          1.000 *    1.000 *    13.878) +
          1.412 *    0.550 *     9.138) + =      20.979
Qmax(2) =
          0.708 *    1.000 *    13.878) +
          1.000 *    1.000 *     9.138) + =      18.964

Total of 2 main streams to confluence:
Flow rates before confluence point:
      14.878      10.138
Maximum flow rates at confluence using above data:
       20.979       18.964
Area of streams before confluence:
        4.864        4.800
Effective area values after confluence:
        7.505        9.664


Results of confluence:
Total flow rate =     20.979(CFS)
Time of concentration =     9.466 min.
Effective stream area after confluence  =      7.505(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total =       9.66(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      153.000 to Point/Station      154.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
----------------------------------------------------------------------------
Upstream point/station elevation =   177.200(Ft.)
Downstream point/station elevation =   177.100(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    20.979(CFS)
Nearest computed pipe diameter  =     30.00(In.)
```

```
Calculated individual pipe flow  =    20.979(CFS)
Normal flow depth in pipe =   20.46(In.)
Flow top width inside pipe =   27.94(In.)
Critical Depth =   18.68(In.)
Pipe flow velocity =      5.88(Ft/s)
Travel time through pipe =    0.07 min.
Time of concentration (TC) =     9.54 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      154.000 to Point/Station      154.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      7.505(Ac.)
Runoff from this stream =     20.979(CFS)
Time of concentration =    9.54 min.
Rainfall intensity =     2.804(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      114.000 to Point/Station      115.000
**** 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 =   175.000(Ft.)
Top (of initial area) elevation =   183.100(Ft.)
Bottom (of initial area) elevation =   179.900(Ft.)
Difference in elevation =     3.200(Ft.)
Slope =    0.01829  s(%)=       1.83
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    5.342 min.
Rainfall intensity =      3.909(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.895
Subarea runoff =      1.050(CFS)
Total initial stream area =        0.300(Ac.)


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Process from Point/Station      115.000 to Point/Station      154.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   177.300(Ft.)
Downstream point/station elevation =   177.100(Ft.)
Pipe length  =    10.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.050(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     1.050(CFS)
Normal flow depth in pipe =    4.23(In.)
Flow top width inside pipe =    8.98(In.)
Critical Depth =    5.65(In.)
Pipe flow velocity =      5.15(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     5.37 min.


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Process from Point/Station      154.000 to Point/Station      154.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.300(Ac.)
Runoff from this stream =      1.050(CFS)
Time of concentration =    5.37 min.
Rainfall intensity =     3.895(In/Hr)
```

```
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      7.50    20.979      9.54    0.020      2.804
2      0.30     1.050      5.37    0.020      3.895
Qmax(1) =
          1.000 *    1.000 *    20.979) +
          0.718 *    1.000 *     1.050) + =      21.733
Qmax(2) =
          1.392 *    0.563 *    20.979) +
          1.000 *    1.000 *     1.050) + =      17.505

Total of 2 streams to confluence:
Flow rates before confluence point:
      20.979       1.050
Maximum flow rates at confluence using above data:
       21.733       17.505
Area of streams before confluence:
        7.505        0.300
Effective area values after confluence:
        7.805        4.529
Results of confluence:
Total flow rate =     21.733(CFS)
Time of concentration =     9.537 min.
Effective stream area after confluence =      7.805(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       7.80(Ac.)
End of computations, total study area =           10.00 (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) = 0.100
Area averaged SCS curve number (AMC 2) =  75.0
```

100-YEAR ONSITE HYDROLOGY (EXISTING CONDITION RATIONAL METHOD)

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: 01/26/21 File Name: EX.roc

100-YEAR EXISTING CONDITION RATIONAL METHOD HYDROLOGY
534 W. STRUCK AVE REDEVELOPMENT PROJECT
CITY OF ORANGE, CALIFORNIA
WO 20-0017 AYS 01/26/2021

Program License Serial Number 4010

********* 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 100.000 to Point/Station 101.000
**** 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 = 305.000(Ft.)
Top (of initial area) elevation = 190.800(Ft.)
Bottom (of initial area) elevation = 185.000(Ft.)
Difference in elevation = 5.800(Ft.)
Slope = 0.01902 s(%)= 1.90
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 6.619 min.
Rainfall intensity = 5.269(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff = 7.558(CFS)
Total initial stream area = 1.600(Ac.)

++
Process from Point/Station 101.000 to Point/Station 102.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 185.000(Ft.)
Downstream point elevation = 182.100(Ft.)
Channel length thru subarea = 230.000(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 = 10.071(CFS)
Manning's 'N' = 0.015
Maximum depth of channel = 1.000(Ft.)
Flow(q) thru subarea = 10.071(CFS)
Depth of flow = 0.204(Ft.), Average velocity = 2.426(Ft/s)
Channel flow top width = 40.748(Ft.)
Flow Velocity = 2.43(Ft/s)
Travel time = 1.58 min.
Time of concentration = 8.20 min.
Critical depth = 0.229(Ft.)
Adding area flow to channel

```
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 =      4.661(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff =      4.971(CFS) for    1.400(Ac.)
Total runoff =     12.530(CFS)       Total area =        3.00(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Depth of flow =   0.221(Ft.), Average velocity =   2.562(Ft/s)
Critical depth =      0.250(Ft.)


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Process from Point/Station      102.000 to Point/Station      103.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =   182.100(Ft.)
Downstream point elevation =   181.000(Ft.)
Channel length thru subarea  =   227.000(Ft.)
Channel base width     =    0.000(Ft.)
Slope or 'Z' of left channel bank =  25.000
Slope or 'Z' of right channel bank =  25.000
Estimated mean flow rate at midpoint of channel =     15.631(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =     15.631(CFS)
Depth of flow =   0.483(Ft.), Average velocity =   2.675(Ft/s)
Channel flow top width =   24.174(Ft.)
Flow Velocity =    2.67(Ft/s)
Travel time  =    1.41 min.
Time of concentration =    9.61 min.
Critical depth =      0.477(Ft.)
 Adding area flow to channel
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 =      4.254(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff =      6.144(CFS) for    1.900(Ac.)
Total runoff =     18.673(CFS)       Total area =        4.90(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Depth of flow =   0.514(Ft.), Average velocity =   2.834(Ft/s)
!!Warning: Water is above left or right bank elevations
ERROR - Channel depth exceeds maximum allowable depth
Critical depth =      0.508(Ft.)


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Process from Point/Station      103.000 to Point/Station      104.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =   181.000(Ft.)
Downstream point elevation =   179.300(Ft.)
Channel length thru subarea  =   272.000(Ft.)
Channel base width     =    0.000(Ft.)
Slope or 'Z' of left channel bank =  25.000
Slope or 'Z' of right channel bank =  25.000
Estimated mean flow rate at midpoint of channel =     21.886(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =     21.886(CFS)
Depth of flow =   0.519(Ft.), Average velocity =   3.259(Ft/s)
!!Warning: Water is above left or right bank elevations
```

```
Channel flow top width =   25.000(Ft.)
Flow Velocity =    3.26(Ft/s)
Travel time  =    1.39 min.
Time of concentration =   11.00 min.
Critical depth =      0.539(Ft.)
ERROR - Channel depth exceeds maximum allowable depth
 Adding area flow to channel
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 =      3.937(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 =      6.358(CFS) for    2.200(Ac.)
Total runoff =     25.032(CFS)       Total area =        7.10(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Depth of flow =   0.541(Ft.), Average velocity =   3.439(Ft/s)
!!Warning: Water is above left or right bank elevations
ERROR - Channel depth exceeds maximum allowable depth
Critical depth =      0.566(Ft.)


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Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      7.100(Ac.)
Runoff from this stream =     25.032(CFS)
Time of concentration =   11.00 min.
Rainfall intensity =     3.937(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      105.000
**** 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 =   330.000(Ft.)
Top (of initial area) elevation =   190.800(Ft.)
Bottom (of initial area) elevation =   185.100(Ft.)
Difference in elevation =     5.700(Ft.)
Slope =    0.01727  s(%)=       1.73
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.963 min.
NOTE: Distance EXCEEDS recommended maximum value of   328.084(Ft.)
for this Development Type
Rainfall intensity =      5.118(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.896
Subarea runoff =      3.670(CFS)
Total initial stream area =        0.800(Ac.)


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Process from Point/Station      105.000 to Point/Station      106.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =   185.100(Ft.)
Downstream point elevation =   181.400(Ft.)
Channel length thru subarea  =   447.000(Ft.)
```

```
Channel base width     =    0.000(Ft.)
Slope or 'Z' of left channel bank =  19.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =      6.330(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      6.330(CFS)
Depth of flow =   0.425(Ft.), Average velocity =   3.190(Ft/s)
Channel flow top width =    9.344(Ft.)
Flow Velocity =    3.19(Ft/s)
Travel time  =    2.34 min.
Time of concentration =    9.30 min.
Critical depth =      0.461(Ft.)
 Adding area flow to channel
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 =      4.336(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff =      5.264(CFS) for    1.500(Ac.)
Total runoff =      8.934(CFS)       Total area =        2.30(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Depth of flow =   0.483(Ft.), Average velocity =   3.477(Ft/s)
Critical depth =      0.527(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      106.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
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)
Time of concentration =     9.30 min.
Rainfall intensity =      4.336(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.896
Subarea runoff =      2.331(CFS) for    0.600(Ac.)
Total runoff =     11.265(CFS)       Total area =        2.90(Ac.)
Area averaged Fm value =    0.020(In/Hr)


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Process from Point/Station      106.000 to Point/Station      104.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =   181.400(Ft.)
End of street segment elevation =   179.300(Ft.)
Length of street segment  =   429.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  24.000(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  =   6.000(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 =     11.265(CFS)
Depth of flow =   0.549(Ft.), Average velocity =   2.460(Ft/s)
```

```
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  21.102(Ft.)
Flow velocity =   2.46(Ft/s)
Travel time =    2.91 min.     TC =   12.21  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 =      3.710(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 =      0.000(CFS) for    0.000(Ac.)
Total runoff =     11.265(CFS)       Total area =        2.90(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Street flow at end of street =     11.265(CFS)
Half street flow at end of street =     11.265(CFS)
Depth of flow =   0.549(Ft.), Average velocity =   2.460(Ft/s)
Flow width (from curb towards crown)=  21.102(Ft.)


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Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.900(Ac.)
Runoff from this stream =     11.265(CFS)
Time of concentration =   12.21 min.
Rainfall intensity =     3.710(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      7.10    25.032     11.00    0.020      3.937
2      2.90    11.265     12.21    0.020      3.710
Qmax(1) =
          1.000 *    1.000 *    25.032) +
          1.061 *    0.902 *    11.265) + =      35.813
Qmax(2) =
          0.942 *    1.000 *    25.032) +
          1.000 *    1.000 *    11.265) + =      34.847

Total of 2 streams to confluence:
Flow rates before confluence point:
      25.032      11.265
Maximum flow rates at confluence using above data:
       35.813       34.847
Area of streams before confluence:
        7.100        2.900
Effective area values after confluence:
        9.715       10.000
Results of confluence:
Total flow rate =     35.813(CFS)
Time of concentration =    11.004 min.
Effective stream area after confluence =      9.715(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =      10.00(Ac.)
End of computations, total study area =           10.00 (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) = 0.100
Area averaged SCS curve number (AMC 2) =  75.0
```

100-YEAR ONSITE HYDROLOGY (DEVELOPED CONDITION RATIONAL METHOD)

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: 01/26/21 File Name: 100.roc

100-YEAR DEVELOPED CONDITION RATIONAL METHOD HYDROLOGY
534 W. STRUCK AVE REDEVELOPMENT PROJECT
CITY OF ORANGE, CALIFORNIA
WO 20-0017 AYS 01/26/2021

Program License Serial Number 4010

********* 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 100.000 to Point/Station 101.000
**** 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 = 225.000(Ft.)
Top (of initial area) elevation = 186.900(Ft.)
Bottom (of initial area) elevation = 184.900(Ft.)
Difference in elevation = 2.000(Ft.)
Slope = 0.00889 s(%)= 0.89
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 6.823 min.
Rainfall intensity = 5.178(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff = 6.499(CFS)
Total initial stream area = 1.400(Ac.)

++
Process from Point/Station 101.000 to Point/Station 150.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 181.500(Ft.)
Downstream point/station elevation = 180.500(Ft.)
Pipe length = 210.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 6.499(CFS)
Nearest computed pipe diameter = 18.00(In.)
Calculated individual pipe flow = 6.499(CFS)
Normal flow depth in pipe = 13.31(In.)
Flow top width inside pipe = 15.80(In.)
Critical Depth = 11.83(In.)
Pipe flow velocity = 4.64(Ft/s)
Travel time through pipe = 0.75 min.
Time of concentration (TC) = 7.58 min.

++
Process from Point/Station 150.000 to Point/Station 150.000
**** CONFLUENCE OF MINOR STREAMS ****

```
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.400(Ac.)
Runoff from this stream =      6.499(CFS)
Time of concentration =    7.58 min.
Rainfall intensity =     4.876(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      102.000 to Point/Station      103.000
**** 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 =   280.000(Ft.)
Top (of initial area) elevation =   186.200(Ft.)
Bottom (of initial area) elevation =   183.700(Ft.)
Difference in elevation =     2.500(Ft.)
Slope =    0.00893  s(%)=       0.89
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.440 min.
Rainfall intensity =      4.927(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.896
Subarea runoff =      5.300(CFS)
Total initial stream area =        1.200(Ac.)


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Process from Point/Station      103.000 to Point/Station      150.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   180.600(Ft.)
Downstream point/station elevation =   180.500(Ft.)
Pipe length  =    10.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.300(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     5.300(CFS)
Normal flow depth in pipe =   10.34(In.)
Flow top width inside pipe =   13.88(In.)
Critical Depth =   11.19(In.)
Pipe flow velocity =      5.87(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     7.47 min.


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Process from Point/Station      150.000 to Point/Station      150.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.200(Ac.)
Runoff from this stream =      5.300(CFS)
Time of concentration =    7.47 min.
Rainfall intensity =     4.916(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      1.40     6.499      7.58    0.020      4.876
2      1.20     5.300      7.47    0.020      4.916
Qmax(1) =
          1.000 *    1.000 *     6.499) +
```

```
          0.992 *    1.000 *     5.300) + =      11.755
Qmax(2) =
          1.008 *    0.986 *     6.499) +
          1.000 *    1.000 *     5.300) + =      11.759

Total of 2 streams to confluence:
Flow rates before confluence point:
       6.499       5.300
Maximum flow rates at confluence using above data:
       11.755       11.759
Area of streams before confluence:
        1.400        1.200
Effective area values after confluence:
        2.600        2.580
Results of confluence:
Total flow rate =     11.759(CFS)
Time of concentration =     7.469 min.
Effective stream area after confluence =      2.580(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       2.60(Ac.)


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Process from Point/Station      150.000 to Point/Station      151.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   180.500(Ft.)
Downstream point/station elevation =   179.300(Ft.)
Pipe length  =   235.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    11.759(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    11.759(CFS)
Normal flow depth in pipe =   15.18(In.)
Flow top width inside pipe =   23.14(In.)
Critical Depth =   14.78(In.)
Pipe flow velocity =      5.61(Ft/s)
Travel time through pipe =    0.70 min.
Time of concentration (TC) =     8.17 min.


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Process from Point/Station      151.000 to Point/Station      151.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      2.580(Ac.)
Runoff from this stream =     11.759(CFS)
Time of concentration =    8.17 min.
Rainfall intensity =     4.671(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      104.000 to Point/Station      105.000
**** 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 =   320.000(Ft.)
Top (of initial area) elevation =   185.200(Ft.)
Bottom (of initial area) elevation =   182.000(Ft.)
Difference in elevation =     3.200(Ft.)
Slope =    0.01000  s(%)=       1.00
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.672 min.
Rainfall intensity =      4.841(In/Hr) for a   100.0 year storm
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Effective runoff coefficient used for area (Q=KCIA) is C = 0.896
Subarea runoff =      7.376(CFS)
Total initial stream area =        1.700(Ac.)


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Process from Point/Station      105.000 to Point/Station      151.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   179.400(Ft.)
Downstream point/station elevation =   179.300(Ft.)
Pipe length  =    15.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.376(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     7.376(CFS)
Normal flow depth in pipe =   12.87(In.)
Flow top width inside pipe =   16.26(In.)
Critical Depth =   12.61(In.)
Pipe flow velocity =      5.46(Ft/s)
Travel time through pipe =    0.05 min.
Time of concentration (TC) =     7.72 min.


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Process from Point/Station      151.000 to Point/Station      151.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.700(Ac.)
Runoff from this stream =      7.376(CFS)
Time of concentration =    7.72 min.
Rainfall intensity =     4.825(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      2.58    11.759      8.17    0.020      4.671
2      1.70     7.376      7.72    0.020      4.825
Qmax(1) =
          1.000 *    1.000 *    11.759) +
          0.968 *    1.000 *     7.376) + =      18.899
Qmax(2) =
          1.033 *    0.945 *    11.759) +
          1.000 *    1.000 *     7.376) + =      18.856

Total of 2 streams to confluence:
Flow rates before confluence point:
      11.759       7.376
Maximum flow rates at confluence using above data:
       18.899       18.856
Area of streams before confluence:
        2.580        1.700
Effective area values after confluence:
        4.280        4.138
Results of confluence:
Total flow rate =     18.899(CFS)
Time of concentration =     8.166 min.
Effective stream area after confluence =      4.280(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       4.28(Ac.)


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Process from Point/Station      151.000 to Point/Station      152.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   179.300(Ft.)
Downstream point/station elevation =   177.700(Ft.)
Pipe length  =   315.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    18.899(CFS)
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Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    18.899(CFS)
Normal flow depth in pipe =   19.23(In.)
Flow top width inside pipe =   24.45(In.)
Critical Depth =   18.25(In.)
Pipe flow velocity =      6.24(Ft/s)
Travel time through pipe =    0.84 min.
Time of concentration (TC) =     9.01 min.


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Process from Point/Station      152.000 to Point/Station      152.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      4.280(Ac.)
Runoff from this stream =     18.899(CFS)
Time of concentration =    9.01 min.
Rainfall intensity =     4.416(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      106.000 to Point/Station      107.000
**** 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 =   210.000(Ft.)
Top (of initial area) elevation =   184.100(Ft.)
Bottom (of initial area) elevation =   181.200(Ft.)
Difference in elevation =     2.900(Ft.)
Slope =    0.01381  s(%)=       1.38
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.078 min.
Rainfall intensity =      5.533(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      2.977(CFS)
Total initial stream area =        0.600(Ac.)


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Process from Point/Station      107.000 to Point/Station      152.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   178.000(Ft.)
Downstream point/station elevation =   177.700(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.977(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     2.977(CFS)
Normal flow depth in pipe =    7.85(In.)
Flow top width inside pipe =   11.42(In.)
Critical Depth =    8.88(In.)
Pipe flow velocity =      5.47(Ft/s)
Travel time through pipe =    0.08 min.
Time of concentration (TC) =     6.15 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      152.000 to Point/Station      152.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.600(Ac.)
Runoff from this stream =      2.977(CFS)
Time of concentration =    6.15 min.
```

```
Rainfall intensity =     5.493(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      4.28    18.899      9.01    0.020      4.416
2      0.60     2.977      6.15    0.020      5.493
Qmax(1) =
          1.000 *    1.000 *    18.899) +
          0.803 *    1.000 *     2.977) + =      21.290
Qmax(2) =
          1.245 *    0.683 *    18.899) +
          1.000 *    1.000 *     2.977) + =      19.052

Total of 2 streams to confluence:
Flow rates before confluence point:
      18.899       2.977
Maximum flow rates at confluence using above data:
       21.290       19.052
Area of streams before confluence:
        4.280        0.600
Effective area values after confluence:
        4.880        3.524
Results of confluence:
Total flow rate =     21.290(CFS)
Time of concentration =     9.008 min.
Effective stream area after confluence =      4.880(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       4.88(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      152.000 to Point/Station      153.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   177.700(Ft.)
Downstream point/station elevation =   177.200(Ft.)
Pipe length  =   100.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    21.290(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    21.290(CFS)
Normal flow depth in pipe =   21.48(In.)
Flow top width inside pipe =   21.78(In.)
Critical Depth =   19.39(In.)
Pipe flow velocity =      6.28(Ft/s)
Travel time through pipe =    0.27 min.
Time of concentration (TC) =     9.27 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      153.000 to Point/Station      153.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      4.880(Ac.)
Runoff from this stream =     21.290(CFS)
Time of concentration =    9.27 min.
Rainfall intensity =     4.343(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      113.000
**** 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 =   315.000(Ft.)
Top (of initial area) elevation =   186.900(Ft.)
Bottom (of initial area) elevation =   183.300(Ft.)
Difference in elevation =     3.600(Ft.)
Slope =    0.01143  s(%)=       1.14
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.423 min.
Rainfall intensity =      4.934(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.896
Subarea runoff =      4.864(CFS)
Total initial stream area =        1.100(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      113.000 to Point/Station      153.500
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   180.100(Ft.)
Downstream point/station elevation =   177.300(Ft.)
Pipe length  =   755.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.864(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     4.864(CFS)
Normal flow depth in pipe =   11.74(In.)
Flow top width inside pipe =   17.14(In.)
Critical Depth =   10.17(In.)
Pipe flow velocity =      3.98(Ft/s)
Travel time through pipe =    3.16 min.
Time of concentration (TC) =    10.58 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      153.500 to Point/Station      153.500
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      1.100(Ac.)
Runoff from this stream =      4.864(CFS)
Time of concentration =   10.58 min.
Rainfall intensity =     4.027(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      109.000
**** 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 =   310.000(Ft.)
Top (of initial area) elevation =   186.800(Ft.)
Bottom (of initial area) elevation =   182.400(Ft.)
Difference in elevation =     4.400(Ft.)
Slope =    0.01419  s(%)=       1.42
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.063 min.
Rainfall intensity =      5.076(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.896
Subarea runoff =      5.916(CFS)
Total initial stream area =        1.300(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      109.000 to Point/Station      111.000
**** STREET INLET + AREA  + PIPE  TRAVEL TIME ****
______________________________________________________________________________
Top of street segment elevation =   182.400(Ft.)
End of street segment elevation =   180.500(Ft.)
Length of street segment  =   330.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  = 135.000(Ft.)
Distance from crown to crossfall grade break  =  20.000(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  =   2.000(Ft.)
Slope from curb to property line (v/hz) =   0.300
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

Street Inlet Calculations:
Street flow before street inlet =      5.916(CFS)
Half street flow before street inlet =      5.916(CFS)
Existing pipe flow before street inlet =      0.000(CFS)
Number of street inlets = 1
Depth of flow =   0.484(Ft.), Average velocity =   2.811(Ft/s)
U.S. DOT Hydraulic Engineering Circular No. 12 curb inlet calculations:
 Street flow half width at start of inlet =      9.000(Ft.)
 Flow rate in gutter section of street = Qw =      5.916(CFS)
 Ratio of frontal flow to total flow = E0 =  1.0000
 Given curb inlet length  L =      3.000(Ft.)

Half street cross section data points at curb inlet:
               X-coordinate (Ft.)   Y-coordinate (Ft.)
              0.0000               1.4333 right of way
              2.0000               0.8333 top of curb
              2.0000               0.0000 flow line
             11.0000               0.5000 gutter/depression end
            117.0000               2.6200 grade break
            137.0000               3.0200 crown
 Length required for total flow interception = Lt
 Lt = .6 * Q^0.42 * Slope^.3 * (1/(n*Se)^.6 =     18.669(Ft.)
 where Manning's n = 0.0150 and Slope = street slope =  0.0058
 Se = Equivalent Street x-slope including depression =  0.0570
 Gutter depression depth =      4.000(In.)
 Gutter depression width =      9.000(Ft.)
 Efficiency = 1 - (1-L/Lt)^1.8 =  0.2705

Pipe calculations for under street flow rate of      1.600(CFS)
Using a pipe slope =      0.005 %
Upstream point/station elevation =   182.400(Ft.)
Downstream point/station elevation =   180.500(Ft.)
Pipe length  =   330.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.600(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =     1.600(CFS)
Normal flow depth in pipe =   19.67(In.)
Flow top width inside pipe =   18.45(In.)
Critical Depth =    5.25(In.)
Pipe flow velocity =      0.58(Ft/s)
Travel time through pipe =    9.48 min.
Time of concentration (TC) =    16.54 min.
Maximum flow rate of street inlet(s) =      1.600(CFS)
Maximum pipe flow capacity =      1.600(CFS)
Remaining flow in street below inlet =      4.316(CFS)
 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 =      3.118(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.894
Subarea runoff =      4.399(CFS) for    2.400(Ac.)
Total runoff =     10.315(CFS)       Total area =        3.70(Ac.)
Area averaged Fm value =    0.020(In/Hr)
Street flow at end of street =      8.715(CFS)
Half street flow at end of street =      8.715(CFS)
Depth of flow =   0.497(Ft.), Average velocity =   2.456(Ft/s)
Flow width (from curb towards crown)=  18.499(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      111.000 to Point/Station      153.500
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   177.500(Ft.)
Downstream point/station elevation =   177.300(Ft.)
Pipe length  =    50.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    10.315(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    10.315(CFS)
Normal flow depth in pipe =   15.09(In.)
Flow top width inside pipe =   23.19(In.)
Critical Depth =   13.80(In.)
Pipe flow velocity =      4.96(Ft/s)
Travel time through pipe =    0.17 min.
Time of concentration (TC) =    16.71 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      153.500 to Point/Station      153.500
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      3.700(Ac.)
Runoff from this stream =     10.315(CFS)
Time of concentration =   16.71 min.
Rainfall intensity =     3.099(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      1.10     4.864     10.58    0.020      4.027
2      3.70    10.315     16.71    0.020      3.099
Qmax(1) =
          1.000 *    1.000 *     4.864) +
          1.301 *    0.633 *    10.315) + =      13.364
Qmax(2) =
          0.769 *    1.000 *     4.864) +
          1.000 *    1.000 *    10.315) + =      14.054

Total of 2 streams to confluence:
Flow rates before confluence point:
       4.864      10.315
Maximum flow rates at confluence using above data:
       13.364       14.054
Area of streams before confluence:
        1.100        3.700
Effective area values after confluence:
        3.444        4.800
Results of confluence:
Total flow rate =     14.054(CFS)
Time of concentration =    16.707 min.
Effective stream area after confluence =      4.800(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       4.80(Ac.)
```

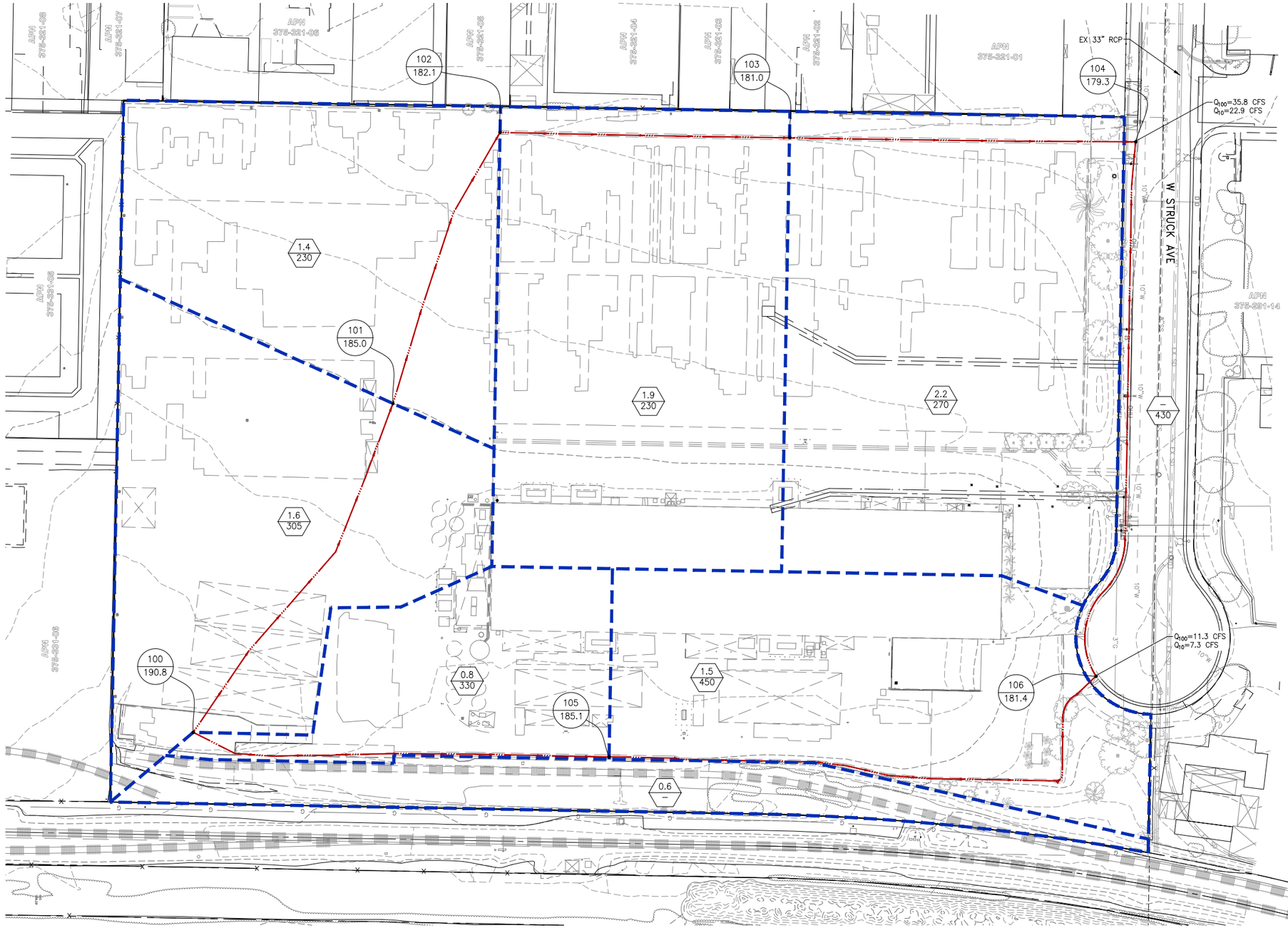
```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      153.500 to Point/Station      153.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   177.300(Ft.)
Downstream point/station elevation =   177.200(Ft.)
Pipe length  =    40.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    14.054(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    14.054(CFS)
Normal flow depth in pipe =   20.17(In.)
Flow top width inside pipe =   23.48(In.)
Critical Depth =   15.63(In.)
Pipe flow velocity =      4.41(Ft/s)
Travel time through pipe =    0.15 min.
Time of concentration (TC) =    16.86 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      153.000 to Point/Station      153.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      4.800(Ac.)
Runoff from this stream =     14.054(CFS)
Time of concentration =   16.86 min.
Rainfall intensity =     3.084(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      4.88    21.290      9.27    0.020      4.343
2      4.80    14.054     16.86    0.020      3.084
Qmax(1) =
          1.000 *    1.000 *    21.290) +
          1.411 *    0.550 *    14.054) + =      32.199
Qmax(2) =
          0.709 *    1.000 *    21.290) +
          1.000 *    1.000 *    14.054) + =      29.141

Total of 2 main streams to confluence:
Flow rates before confluence point:
      22.290      15.054
Maximum flow rates at confluence using above data:
       32.199       29.141
Area of streams before confluence:
        4.880        4.800
Effective area values after confluence:
        7.520        9.680


Results of confluence:
Total flow rate =     32.199(CFS)
Time of concentration =     9.273 min.
Effective stream area after confluence  =      7.520(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total =       9.68(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      153.000 to Point/Station      154.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   177.200(Ft.)
Downstream point/station elevation =   177.100(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    32.199(CFS)
Nearest computed pipe diameter  =     33.00(In.)
```

```
Calculated individual pipe flow  =    32.199(CFS)
Normal flow depth in pipe =   26.00(In.)
Flow top width inside pipe =   26.98(In.)
Critical Depth =   22.66(In.)
Pipe flow velocity =      6.41(Ft/s)
Travel time through pipe =    0.06 min.
Time of concentration (TC) =     9.34 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      154.000 to Point/Station      154.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      7.520(Ac.)
Runoff from this stream =     32.199(CFS)
Time of concentration =    9.34 min.
Rainfall intensity =     4.326(In/Hr)
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      114.000 to Point/Station      115.000
**** 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 =   175.000(Ft.)
Top (of initial area) elevation =   183.100(Ft.)
Bottom (of initial area) elevation =   179.900(Ft.)
Difference in elevation =     3.200(Ft.)
Slope =    0.01829  s(%)=       1.83
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    5.342 min.
Rainfall intensity =      5.957(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.897
Subarea runoff =      1.603(CFS)
Total initial stream area =        0.300(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      115.000 to Point/Station      154.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   177.300(Ft.)
Downstream point/station elevation =   177.100(Ft.)
Pipe length  =    10.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.603(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     1.603(CFS)
Normal flow depth in pipe =    5.47(In.)
Flow top width inside pipe =    8.79(In.)
Critical Depth =    6.99(In.)
Pipe flow velocity =      5.70(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     5.37 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      154.000 to Point/Station      154.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.300(Ac.)
Runoff from this stream =      1.603(CFS)
Time of concentration =    5.37 min.
Rainfall intensity =     5.939(In/Hr)
```

```
Area averaged loss rate (Fm) =    0.0200(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1      7.52    32.199      9.34    0.020      4.326
2      0.30     1.603      5.37    0.020      5.939
Qmax(1) =
          1.000 *    1.000 *    32.199) +
          0.727 *    1.000 *     1.603) + =      33.365
Qmax(2) =
          1.375 *    0.575 *    32.199) +
          1.000 *    1.000 *     1.603) + =      27.060

Total of 2 streams to confluence:
Flow rates before confluence point:
      32.199       1.603
Maximum flow rates at confluence using above data:
       33.365       27.060
Area of streams before confluence:
        7.520        0.300
Effective area values after confluence:
        7.820        4.625
Results of confluence:
Total flow rate =     33.365(CFS)
Time of concentration =     9.338 min.
Effective stream area after confluence =      7.820(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.020(In/Hr)
Study area total (this main stream) =       7.82(Ac.)
End of computations, total study area =           10.00 (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) = 0.100
Area averaged SCS curve number (AMC 2) =  75.0
```

RATIONAL METHOD HYDROLOGY MAPS

EXISTING HYDROLOGY MAP
534 W. STRUCK AVENUE



1" = 40'

40 0 40 80 120

LEGEND

NODE / ELEV	– NODE NUMBER – ELEVATION (FT)
AC / FT	– AREA (AC) – LENGTH (FT)
	– DRAINAGE AREA BOUNDARY
	– FLOWLINE

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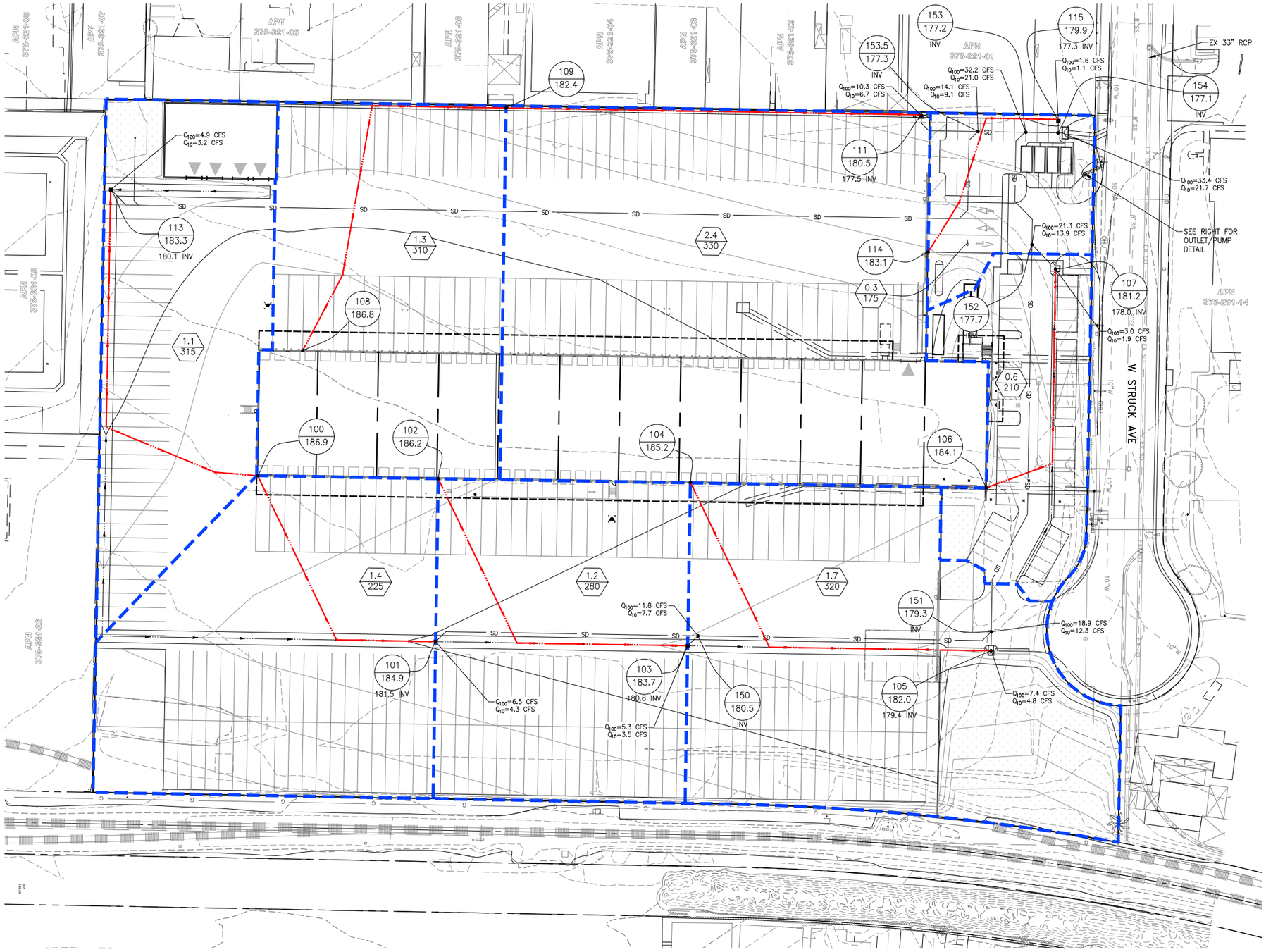
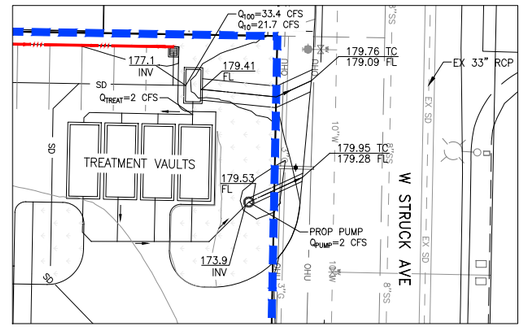
FAX (951) 788-1256

W.O. 20-0017
SHEET 1 OF 2 SHEETS

H:\2020\20-0017\DRAINAGE\P-HYD\DWG FOLDER\20-0017-PRELIM HYDROLOGY MAP (SAVE).DWG 2/9/2021 10:45:03 AM

PROPOSED HYDROLOGY MAP
534 W. STRUCK AVENUE





OUTLET/PUMP DETAIL

SCALE: 1"= 20'

LEGEND

NODE / ELEV	– NODE NUMBER – ELEVATION (FT)
AC / FT	– AREA (AC) – LENGTH (FT)
	– DRAINAGE AREA BOUNDARY
	– FLOWLINE

W S E N WEBB

1" = 40'

40 0 40 80 120

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W.O. 20-0017

SHEET 2 OF 2 SHEETS

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APPENDIX B – HYDRAULIC ANALYSIS

Onsite hydraulic calculations to be provided during final engineering

PRELIMINARY OUTLET STRUCTURE CALCULATIONS

PRELIMINARY OUTLET STRUCTURE
$Q_{TREATMENT}$=1.9 CFS
CONSTRUCT ORIFICE PLATES WITHIN STRUCTURE

ORIFICE CALCULATIONS

EQUATIONS

$Q=Cd*Area*(2*G*H)^{0.5}$

Opening (diam)=	*4*	*in*
# of Orifices=	*3*	
Area (ft2)=	*0.2618*	*ft2*
Cd=	*0.66*	
Orifice Btm =	*177.10*	
Orifice Center=	*177.27*	

ELEVATION	PONDING DEPTH	Q (Orifice)
Ft	Ft	CFS
178.27	1.00	1.4
178.77	1.50	1.7
179.47	2.20	2.1

OUTLET STRUCTURE WEIR CALCULATION
Q100=33.4 CFS
CONSTRUCT 9' x 4' WIDE OUTLET STRUCTURE

WEIR CALCULATIONS

EQUATIONS

Q=CL(h)^(3/2)
where
L= *26 ft*
C= *3*
Invert Elevation = *179.4*

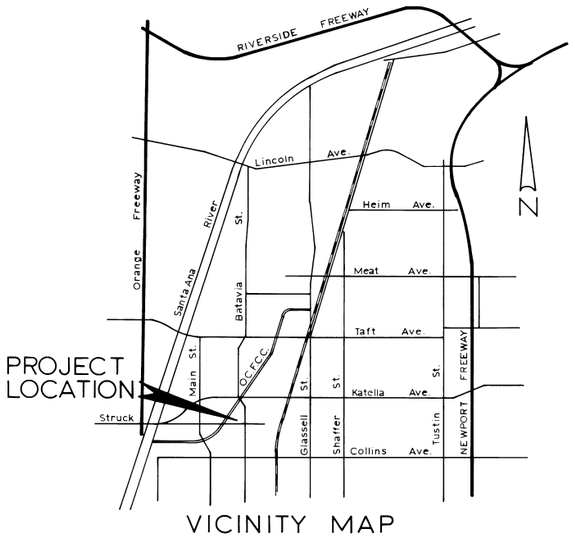
ELEVATION	WEIR HEIGHT	Q (WEIR)	50% CLOGGING
Ft	Ft	CFS	CFS
179.9	0.5	27.6	13.8
180.3	0.9	66.6	33.3
180.9	1.5	143.3	71.6

H:\2020\20-0017\Drainage\P-HYD\Hydrology\Unit Hydrograph\[20-0017 Prelim UH Inputs and Stage Storage.xlsx]Single Weir Calc

NOTE: ***Weir calculations above assume a clogging factor of 0.50. This reduction takes into account the grate bars. Calculations assume water quality orifice plates are totally clogged (not conveying any flows).***

APPENDIX C – REFERENCES

REFERENCE PLANS

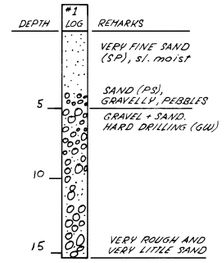


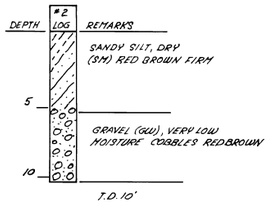
VICINITY MAP

CONSTRUCTION PLANS FOR STRUCK AVENUE STORM DRAIN (E07P06)

ORANGE OLIVE CHANNEL COLLINS DIVERSION (E07) TO BATAVIA STREET

EXPLORATORY BORING LOGS





1. All work shall conform to the City of Orange standard plans and specifications, and the standard specifications of the California State Division of Highways, dated Jan, 1973.

2. Public and private utilities shown hereon are from available record data. The contractor shall be responsible for locating all utilities affecting this work and for any damage to or protection of these structures.

3. The contractor shall notify the following utility companies regarding any problems:

So. Calif. Edison	Mr. Shaeffer	Ph. 835-3833
Pacific Tele. Co.	Mr. Olsen	Ph. 776-0014
Orange City Water Dept.	Mr. Page	Ph. 532-0356
So. Calif. Gas Co.	Mr. Duke	Ph. 538-0211

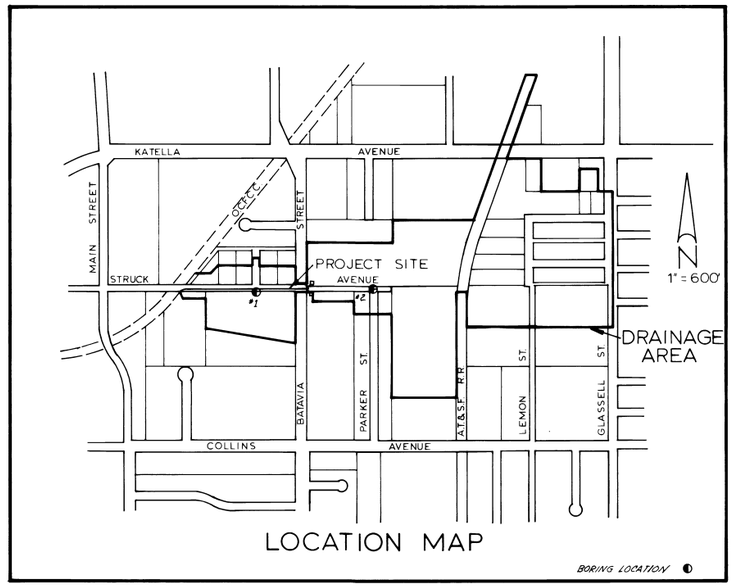
4. For inspection work for this project contact Mr. Don E. Scott, Ph: 532-0311, 48 hrs. prior to the required date.

5. For survey work for this project contact Mr. Warren Repke, Ph: 532-0458, 48 hrs. prior to the required date.

6. The contractor shall notify the City of Orange Fire and Police Dept. prior to construction indicating road closures and detours.

7. All concrete or A.C. pavement to be removed shall be sawcut at indicated line of removal or line of join.

8. The contractor shall notify the Orange County Flood Control District at least 48 hrs. prior to start of construction within the Districts right-of-way for inspection work. Ph. 639-2435

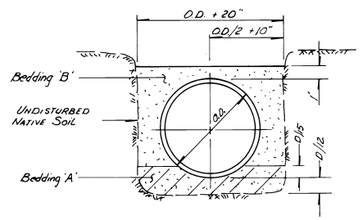


LOCATION MAP

BORING LOCATION ◐

ESTIMATE OF QUANTITIES

ITEM	DESCRIPTION	QUANTITY	
1.	48" R.C.P. (1150-D)	1143	L.F.
2.	36" R.C.P. (1200-D)	8	L.F.
3.	24" R.C.P. (1000-D)	8	L.F.
4.	18" R.C.P. (1150-D)	31	L.F.
5.	INLET TYPE 0L PER STD. 0-302A.	1	Ea.
6.	JUNCTION CHAMBER TYPE 'A' PER STD. 0-308	2	Ea.



SAND BEDDING DETAIL

Utility Legend

Tele.	Pacific Telephone Co.
10"-W	City of Orange Water Dept.
E / E'	Southern California Edison Co.
2"-G	Southern California Gas Co.
8"-S	City of Orange Public Works Dept.

Orange County Flood Control District

All materials used and affecting the Flood Control District Right of Way and facilities shall conform with Districts standard specifications and with the provisions of the construction permit granted by the District. The contractor shall maintain a copy of said permit, specifications, and stamped plans on the job site. Use of District property and conformance with the above shall be subject to inspection and approval by District's duly assigned inspector whose interpretation of decisions shall be final.

Re-Paving Schedule

Sta.	Location	Section
0+00 to 10+15	Struck Ave.	3"Ac./8"Ab. w/SC-70 P.C.
10+15 to 11+40	Struck Ave.	4"Ac./15"Ab. w/SC-70 P.C.

THESE PLANS WERE PREPARED IN THE OFFICE OF: The City Engineer PHONE: 532-0458

UNDER THE SUPERVISION OF: Warren Repke

8/14/74 DATE — Warren W. Repke REGISTERED CIVIL ENGINEER NO. 19442

REVISIONS

DATE	DESCRIPTION
10-1-74	REVISED PIPE GRADES

FOR ENGINEERS USE	NAME	DATE
DRAWN	J.H. R.D.K.	5-74
DESIGNED	R.D.K.	5-74
CHECKED		

FOR CITY USE ONLY	NAME	DATE
STREETS		
SEWER		
DRAINAGE		
WATER		
ST. SUPT.		
TRAFFIC		

CITY OF ORANGE
OFFICE OF THE CITY ENGINEER

Struck Avenue Storm Drain (E07P06)
Orange Olive Channel to Batavia Street

APPROVED: 8-14-74 DATE — CITY ENGINEER

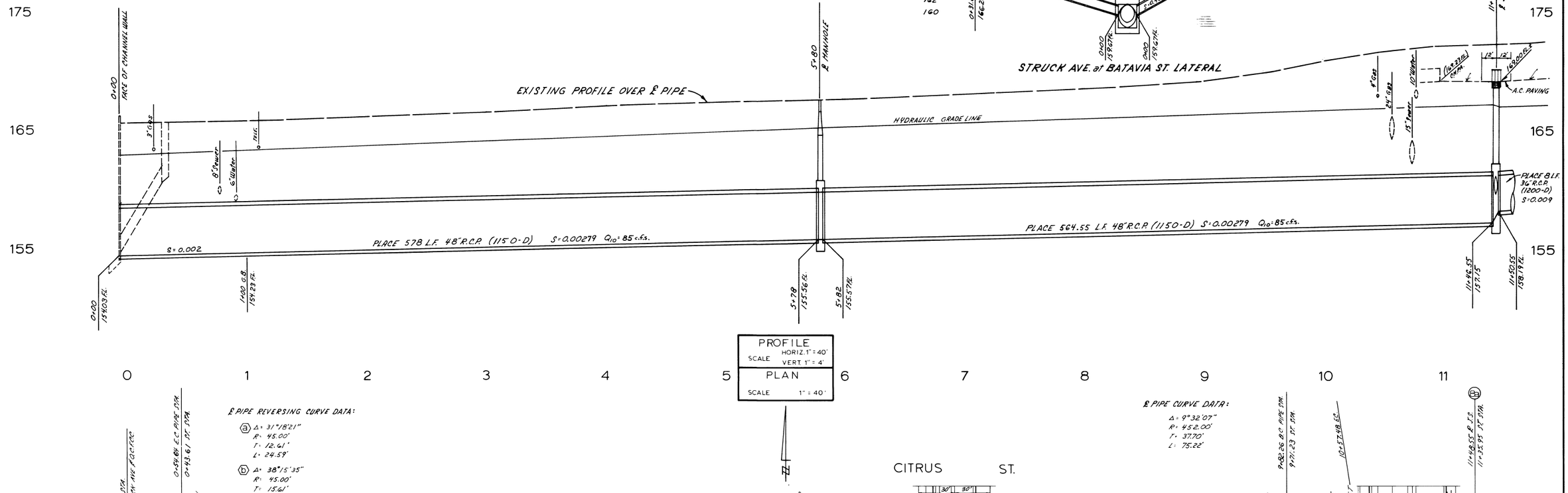
APPROVED: 8-15-74 DATE — DIRECTOR OF PUBLIC WORKS

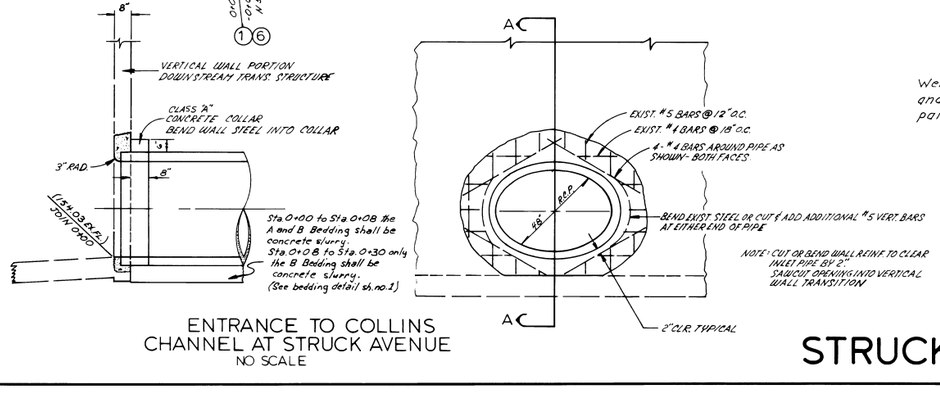
SCALE: HORIZ: 1"=40' VERT: 1"=4' FB. 1002 P.G. 162-168

SHEET 1 OF 2 SHEETS

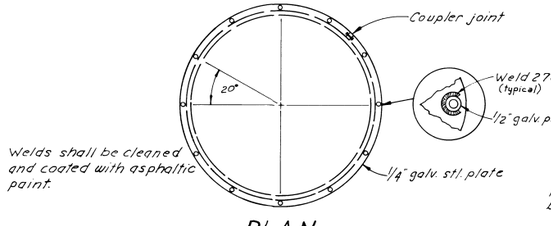
B. M. #217-65 R.C.E. Disk #1655 on top of curb at west side of catch basin 66' east of E of Batavia St. 20.5' south of E of Struck Avenue. Elev. 172.28

D-63



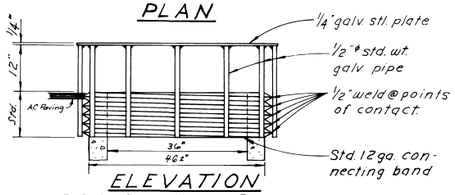


ENTRANCE TO COLLINS CHANNEL AT STRUCK AVENUE
NO SCALE

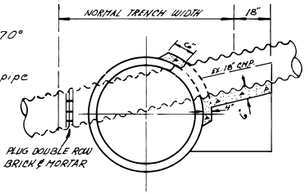


Welds shall be cleaned and coated with asphaltic paint.

PLAN



ELEVATION
PROTECTION GRATING
NO SCALE

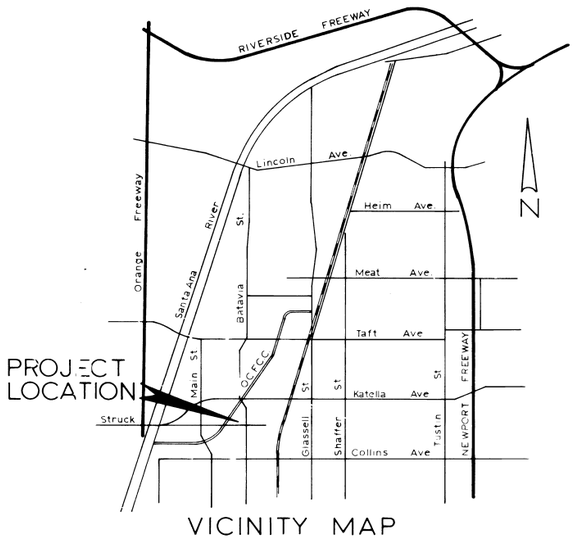


CONNECTION DETAIL
NO SCALE

CONSTRUCTION NOTES

1. PLACE 48" R.C.P. (1150-D)
2. PLACE 36" R.C.P. (1200-D) PLUG END WITH BRICK AND MORTAR.
4. PLACE 24" R.C.P. (1000-D) PLUG END WITH BRICK AND MORTAR.
5. PLACE 18" R.C.P. (1150-D)
6. CONSTRUCT ENTRANCE TO ORANGE OLIVE CHANNEL COLLINS DIVERSION PER DETAIL THIS SHEET.
7. CONSTRUCT CONNECTION OF 18" C.M.P. TO 48" R.C.P. PER DETAIL THIS SHEET.
8. CONSTRUCT JUNCTION CHAMBER TYPE "A" PER STD. PLAN NO. D-308 (S) MODIFIED FOR PROTECTION GRATE PER DETAIL THIS SHEET, IN PLACE OF MANHOLE CONE AND COVER.
10. REMOVE EXISTING 10' INLET AND C.M.P.'S AND CONSTRUCT INLET TYPE-0L PER CITY STD PLAN NO. D-302A, D-305 WITH LOCAL DEPRESSION PER STD. PLAN NO. D307.W-10'
12. CONSTRUCT INLET WITH 2" THICK ASPHALT CONCRETE, 1 to 1 SIDE SLOPES, AND 4 REFLECTOR PADDLE BOARDS PER STD. D-109.
13. PLUG WITH DOUBLE ROW BRICK AND MORTAR.

STRUCK AVENUE



PROJECT LOCATION

VICINITY MAP

CONSTRUCTION PLANS

FOR

STRUCK AVENUE STORM DRAIN

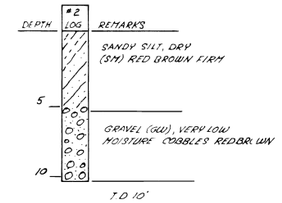
(E07P06)

BATAVIA STREET

TO

A.T.& S.F. R.R. RIGHT OF WAY

EXPLORATORY BORING LOG



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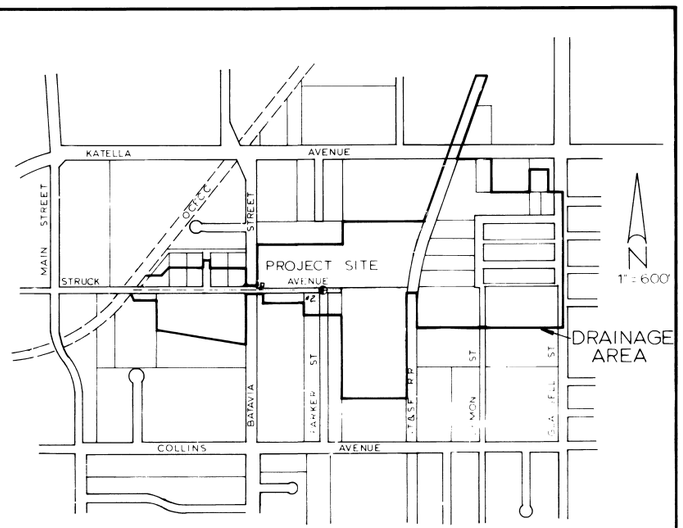
Pacific Tele Co.	Mr. Olsen	Ph. 776-0014
Orange City Water Dept.	Mr. Page	Ph. 532-0356
So. Calif Gas Co.	Mr.	Ph.

4. For inspection work for this project contact Mr. Don E. Scott, Ph. 532-0311, 48 hrs. prior to the required date.

5. For survey work for this project contact Mr. Warren Repke, Ph. 532-0458, 48 hrs. prior to the required date.

6. The contractor shall notify the City of Orange Fire and Police Dept. prior to construction, indicating road closures and detours.

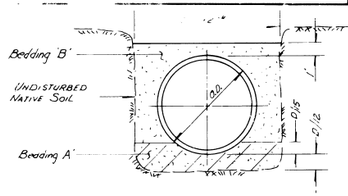
7. All concrete or A.C. pavement to be removed shall be sawcut at indicated line of removal or line of join.



LOCATION MAP

ESTIMATE OF QUANTITIES

ITEM	DESCRIPTION	QUANTITY
1.		279 L.F.
2.		336 L.F.
		852 L.F.
		3 Ea.
		1 Ea.
		7 L.F.
		23 L.F.
		8 L.F.



BEDDING DETAIL

Utility Legend

- Pacific Telephone Co.
- City of Orange Water Dept.
- E — E — Southern California Edison Co.
- Southern California Gas Co.
- City of Orange Public Works Dept.

BEDDING DETAIL S.D.D.P. NO. S-4-1

THESE PLANS WERE PREPARED IN THE OFFICE OF: The City Engineer PHONE: 532-0458

UNDER THE SUPERVISION OF: Warren Repke

DATE: 11-11-74 REGISTERED CIVIL ENGINEER NO. 19442

REVISIONS

DATE	DESCRIPTION

FOR ENGINEERS USE

	NAME	DATE
DRAWN	J.H. RDK	1-74
DESIGNED	R.D.K	1-74
CHECKED		

FOR CITY USE ONLY

	NAME	DATE
STREETS		
SEWER		
DRAINAGE		
WATER		
ST. SU'''.		
TRAFFIC		

B. M. #217-65 R.C.E. Disk #16556 on top of curb at west side of catch basin 66' east of ℄ of Batavia St. 20.5' south of ℄ of Struck Avenue. Elev. 172.28

CITY OF ORANGE

OFFICE OF THE CITY ENGINEER

Struck Avenue Storm Drain (E07P06)

Batavia Street to [illegible] Right of Way

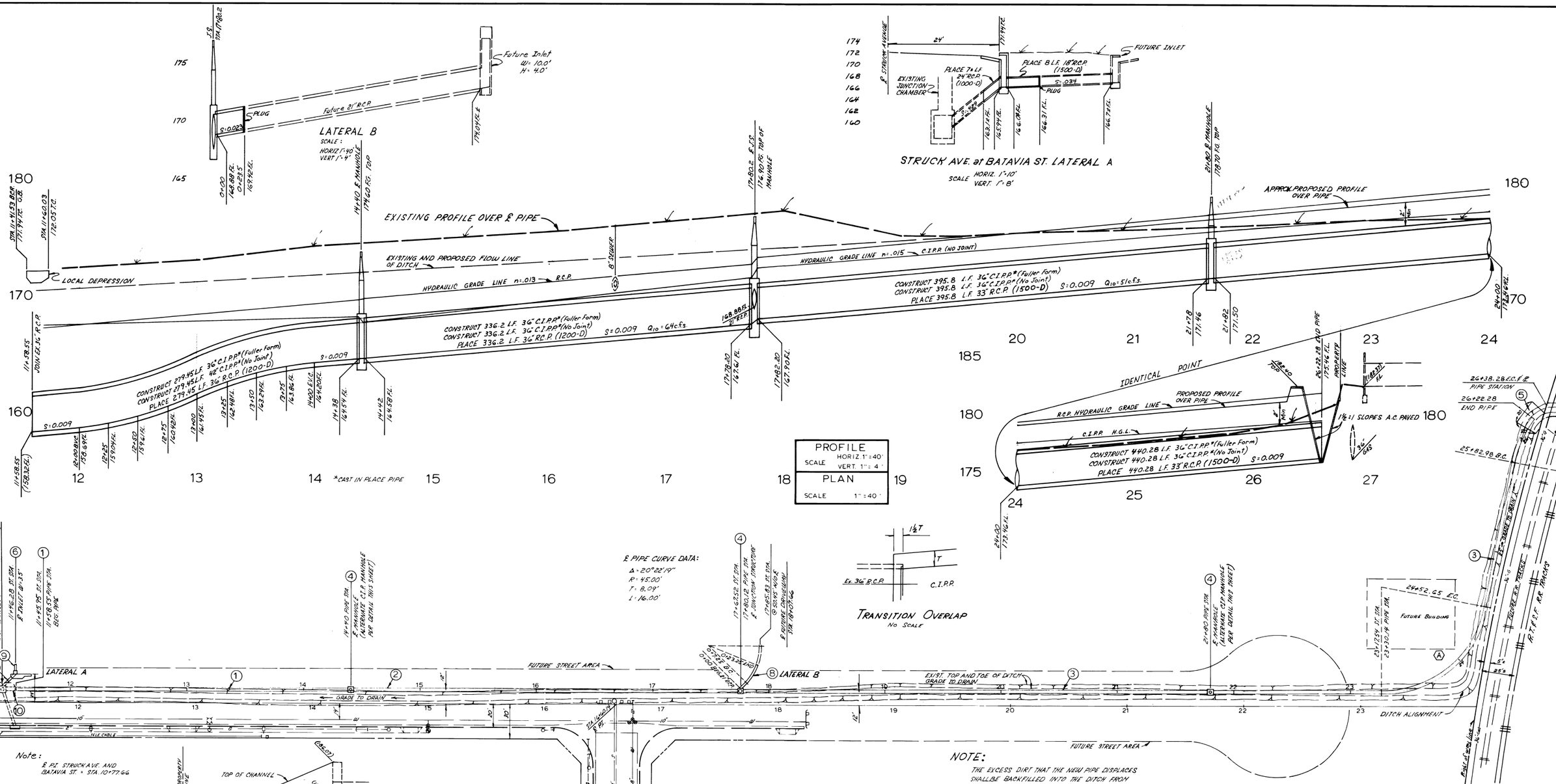
APPROVED: 11-11-74 DATE — CITY ENGINEER

APPROVED: 11/11/74 DATE — DIRECTOR OF PUBLIC WORKS

SCALE: HORIZ: 1"=10' VERT: 1"=1' FB. 1002 P.G. 162-168

SHEET 1 OF 2 SHEETS

D-68



CONSTRUCTION NOTES

1. PLACE 36" R.C.P. (1200-D), 36" C.I.P.P. (FULLER FORM), 42" C.I.P.P. (NO JOINT)
2. PLACE 36" R.C.P. (1200-D), 36" C.I.P.P. (FULLER FORM), 36" C.I.P.P. (NO JOINT)
3. PLACE 33" R.C.P. (1500-D) 36" C.I.P.P. (FULLER FORM) 36" C.I.P.P. (NO JOINT)
4. CONSTRUCT JUNCTION CHAMBER TYPE "A" PER STD. PLAN No. 0-308, OR DETAIL THIS SHEET.
5. CONSTRUCT 2'A.C. OVER NATIVE SOIL INLET
6. CONSTRUCT INLET TYPE 08 PER STD. PLAN NO. 0-301.
7. PLACE 24" R.C.P. (1000-D) REMOVE EXIST. BRICK BULKHEAD
8. PLACE 21" R.C.P. (1500-D) AND PLUG END WITH DOUBLE ROW BRICK AND MORTAR.
9. PLACE 18" R.C.P. (1500-D) AND PLUG END WITH DOUBLE ROW BRICK AND MORTAR.
10. REMOVE EXISTING BRICK BULKHEAD IN EXISTING 36" R.C.P. AND MAKE CONNECTION OF NEW 36" R.C.P. OR 36" C.I.P.P. (FULLER FORM). IF 42" C.I.P.P. (NO JOINT) IS USED MAKE CONNECTION TO EXIST. 36" R.C.P. WITH A 6' TRANSITION AND DETAIL THIS SHEET.

STRUCK AVENUE