Preliminary Water Quality Management Plan (PWQMP)

For compliance with Santa Ana Regional Water Quality Control Board

Order Number R8-2010-0036 (NPDES Permit No. CAS618036)

for

Project Name:	**Merrill Commerce Center Specific Plan**
Ontario Project #:	**TBD**
Project Description:	**Industrial Project**
Applicant Name:	**Prologis, Attn: Thomas Donahue**
Applicant Address:	**3546 Concours Street, Suite 100, Ontario, CA 91764**
Project Address:	**Bounded by Grove Ave to the west, Eucalyptus Ave to the north, Carpenter Ave to the east, and Merrill Ave to the south**
Size of Development:	**388 acres**

Submittal Date: September 17, 2019

Preliminary Water Quality Management Plan (PWQMP)

1. Introduction

The Preliminary Water Quality Management Plan (PWQMP) is a planning tool to improve integration of required water quality elements, stormwater management, water conservation, rainwater harvesting and re-use, and flood management in land use planning and the City's development process. The Preliminary WQMP will assist project applicants and planners in properly designing and laying out project sites so that water quality may be incorporated in the most effective manner and at the lowest cost for the developer.

The San Bernardino County Municipal Separate Storm Sewer System Permit (MS4 Permit) requires project-specific Water Quality Management plans (WQMP) to be prepared for all priority new development and significant redevelopment projects listed in Section 2 of this document. The MS4 Permit stipulates that the City of Ontario require priority project applicants to submit a Preliminary project-specific WQMP, as early as possible, during the environmental review or planning phase of a development project and that the Preliminary WQMP be approved prior to the issuance of land use entitlement.

2. Priority Projects (requiring a Preliminary WQMP)

Land Use entitlement shall not be issued for any of the listed projects, below, until a Preliminary WQMP has been approved by the City's Engineering Department. For construction projects not going through entitlement, a Preliminary and Final project-specific WQMP shall be approved, prior to the issuance of construction permits:

Check the appropriate project category below, for this project:

Check below	**Project Categories**
	1. All significant re-development projects. Significant re-development is defined as the addition or replacement of 5,000 or more square feet of impervious surface on an already developed site subject to discretionary approval of the Permittee. Redevelopment does not include routine maintenance activities that are conducted to maintain original line and grade, hydraulic capacity, original purpose of the facility, or emergency redevelopment activity required to protect public health and safety. Where redevelopment results in an increase of less than fifty percent of the impervious surfaces of a previously existing developed site, and the existing development was not subject to WQMP requirements, the numeric sizing criteria discussed below applies only to the addition or replacement, and not to the entire developed site. Where redevelopment results in an increase of fifty percent or more of the impervious surfaces of a previously existing developed site, the numeric sizing criteria applies to the entire development (new and existing).

Check below	Project Categories
X	2. New development projects that create 10,000 square feet or more of impervious surface (collectively over the entire project site) including commercial, industrial, residential housing subdivisions (i.e., detached single family home subdivisions, multi-family attached subdivisions or townhomes, condominiums, apartments, etc.), mixed-use, and public projects. This category includes development projects on public and private land, which fall under the planning and building authority of the permitting agency.
	3. Automotive repair shops (with SIC codes 5013, 5014, 5541, 7532- 7534, 7536-7539).
	4. Restaurants and Food Service Establishments where the land area of development is 5,000 square feet or more.
	5. Developments of 2,500 square feet of impervious surface or more adjacent to (within 200 feet) or discharging directly into environmentally sensitive areas (ESA's) such as areas designated in the Ocean Plan as areas of special biological significance or waterbodies listed on the CWA Section 303(d) list of impaired waters.
X	6. Parking lots of 5,000 square feet or more exposed to storm water. Parking lot is defined as land area or facility for the temporary storage of motor vehicles.
	7. Retail Gasoline Outlets (RGOs) that are either 5,000 sq ft or more, or have a projected average daily traffic of 100 or more vehicles per day.
	8. *This project is not covered under any of the categories listed above.

* If the development is not covered under any of the project categories listed in Section 2, the project is not required to design and install Site Design/LID BMPs or Treatment Control BMPs to treat the design storm event (Design Capture Volume) described in Section 4.

3. Preliminary WQMP Objectives

Through a combination of Site Design/LID BMPs (where feasible), Source Control, and/or Treatment Control BMPs, project-specific WQMPs shall address all identified pollutants and hydrologic conditions of concern from new development and significant re-development projects for the categories of projects (priority projects) listed in Section 2. Under each type of BMP, listed below, please indicate which BMPs are planned to be implemented and included in the Final WQMP for the project:

A. Site Design/LID (Low Impact Design) for Reducing Stormwater Runoff:

The MS4 Permit requires each priority development project to infiltrate, harvest and use, evapotranspire, or bio-treat the runoff from a 2-yr, 24-hour storm event (Design Capture Volume). If site conditions do not permit infiltration, harvest and use, evapotranspiration, and/or bio-treatment of the entire Design Capture Volume, at the project site, Site Design/LID techniques are required to be implemented to the Maximum Extent Practicable, at the project site, and the remainder of the DCV shall be infiltrated, harvested, bio-treated or treated by alternative measures.

Project applicants shall submit a Preliminary WQMP that documents the LID/Site Design BMPs, proposed for the project. Please indicate, in the table below, which Site Design/LID BMPs will be utilized on this project to accomplish this requirement:

Site Design/LID Practice	Planned	Not Planned
Provide at least the minimum effective area required for LID BMPs, to comply with the WQMP (see Table 3-1 below).		X
Grade parking lot areas/drive aisles/roof drains to sheet flow runoff into landscaped swales, via curb cuts or zero-face curbs or otherwise disconnect direct drainage from MS4.	X	
Design landscaped areas as swales and grade to accept runoff from building roofs, parking lots and project roadways.	X	
Install surface retention basins or infiltration trenches to receive impervious area runoff.	X	
Install pervious pavement in parking stalls, alleys, driveways, gutters, walkways, trails or patios.		X
Install underground stormwater retention chambers where downstream landscaped areas are limited.	X	
Install approved Stormwater Drywells in detention areas.		X
Construct streets, sidewalks, and parking lot stalls to the minimum widths necessary.	X	
Install on-site Biotreatment basins/trenches with underdrains, where soil type is poorly draining.		X
Install “Engineered Soil” to increase uptake/soil storage capacity and/or evapotranspiration.		X
Install Rainwater Harvesting/Use Equipment.		X
Utilize approved off-site retention/infiltration, biotreatment or proprietary treatment, where it is infeasible to install, on-site.		X

Table 3-1 Minimum Effective Area[1] Required for LID BMPs (surface + subsurface facilities) for Project WQMP to Demonstrate Infeasibility[2] (% of site)

Project Type	New Development	Re-Development
SF/MF Residential < 7 du/ac	10%	5%
SF/MF Residential < 7 - 18 du/ac	7%	3.5%
SF/MF Residential > 18 du/ac	5%	2.5%

Mixed Use, Commercial/Industrial w/FAR< 1.0	10%	5%
Mixed Use, Commercial/Industrial w/FAR 1.0-2.0	7%	3.5%
Mixed Use, Commercial/Industrial w/FAR> 2.0	5%	2.5%
Podium (parking under > 75% of project)	3%	1.5%
Zoning allowing development to property lines	2%	1%
Transit Oriented Development[3]	5%	2.5%
Parking	5%	2.5%

[1] "Effective area" is defined as land area which 1) is suitable for a retention/infiltration BMP (based on infeasibility criteria) and 2) is located down-gradient from building roof or paved areas, so that it may receive gravity flow runoff.

[2] Criteria only required if the project WQMP seeks to demonstrate that the full DCV cannot be feasibly managed on-site.

[3] Transit oriented development is defined as a project with development center within one half mile of a mass transit center.

Key: du/ac = dwelling units/acre, FAR = Floor Area Ratio = ratio of gross floor area of building to gross lot area, MF = Multi Family, SF = Single Family

B. Source Control BMPs – The following BMPs are designed to control stormwater pollutants and runoff water at the location where it is generated. Please indicate which of the listed BMPs are planned to be implemented for the project:

Source Control BMPs	Planned	Not Planned
Minimize non-stormwater site runoff through efficient irrigation system design and controllers.	X	
Minimize trash and debris in storm runoff through a regular parking lot, storage yard and roadway sweeping program.	X	
Provide proper covers/roofs and secondary containment for outside material storage & work areas.		X
Provide solid roofs over all trash enclosures.	X	
Site Owner(s)/Property Manager/HOA or POA will be familiar with the project WQMP and stormwater BMPs.	X	
Owner or HOA or POA to provide Education/Training of site occupants and employees on stormwater BMPs.	X	
Install stormwater placards/stenciled messages with a "No Dumping" message on all on-site/off-site storm drain inlets.	X	
Provide contained equipment/vehicle wash rack areas that discharge to sanitary sewer.		X

C. Treatment Control BMPs – The following BMPs are designed to control stormwater pollutants where it is not feasible to install on-site Site Design/LID BMPs, with the requisite capacity to treat the Design Capture Volume for identified Pollutants of Concern or where pretreatment of stormwater runoff is required, ahead of infiltration BMPs. Please indicate which of the listed BMPs are planned to be implemented for the project:

Treatment Control BMP	Planned	Not Planned
Gravity Separator devices for pretreatment of sediment, trash/litter or Oil & Grease	X	
Proprietary Biofiltration vaults/devices		X
Media Cartridge Filtration Vaults		X
Proprietary Filter Inserts for on-site storm drain inlets or retention basin/trench overflow drains		X
Regional Treatment facilities are installed or are planned for installation, off-site, and provide a superior level of treatment or clear advantage to on-site treatment BMPs		X

4. Volume-based calculation (approximate) for sizing on-site or off-site Stormwater Retention/Infiltration, Harvest & Re-Use or Biotreatment facilities

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

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

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

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

i = watershed imperviousness ratio.

3) Determine the area-averaged "6-hour Mean Storm Rainfall", P_6, for the Drainage Area. This is calculated by multiplying the area averaged 2-year 1-hour value (0.55"-0.6") by the appropriate regression coefficient from Table 1 (1.4807). The 2-yr, 1-hr value for southern Ontario is approximately to 0.5" (P_6 = 0.5*1.4807 = 0.74 and northern Ontario is approximately 0.6" in/hr (P_6 = 0.6*1.4807 = 0.89).

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

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

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

where: P_0 = Maximized Detention Volume, in inches

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

C_{BMP} = composite runoff coefficient; and,

P_6 = 6-hour Mean Storm Rainfall, in inches

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

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

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

P_0 = Maximized Detention Volume, in inches; and,

A = BMP Drainage Area, in acres

Project Volume-based calculation (approximate) for planned on-site or off-site Stormwater Retention/Infiltration, Harvest & Re-Use or Biotreatment facilities:

Variable	Factor/Formula	Area A Result	Area B Result	Area C Result	Area D Result	Area E Result	Area F Result
Ratio of impervious surface/total site surface	(i)	0.90	0.90	0.90	0.90	0.90	0.90
C_{BMP}= runoff coefficient	$0.858i^3 - 0.78i^2 + 0.774i + 0.04$ =	0.7303	0.7303	0.7303	0.7303	0.7303	0.7303
P_6	**P_6 = 2-yr,1-hr depth*1.4807 =	0.8366	0.8366	0.8366	0.8366	0.8366	0.8366
Detention Volume-acre inches	P_0 = a * C_{BMP} * P_6 =	1.1993	1.1993	1.1993	1.1993	1.1993	1.1993
Drawdown rate of basin/trench (a)	1.582 for 24-hr drawdown or 1.963 for 48-hr drawdown =	1.963	1.963	1.963	1.963	1.963	1.963
Project Total Area (ac)	(A)	68.05	80	79.96	76.93	66.03	17
Design Capture Volume, cu. ft. (DCV)	V_0 = [(P_0 * A)/12]*43560 =	296252	348276	348101	334911	287458	74009
Water Volume infiltrated in first 3 hrs of storm	Vol= in/hr/12 x ft^2 of infiltration area x 3 hrs	43200	48000	48000	46200	43200	54559

Retention/treatment Volume provided, cu. ft.	Retention capacity of basins, trenches, underground system or biotreatment proposed	562766	625296	625296	601847	562766	178935

**For P_6 value, use site coordinates and NOAA website to determine project's average 2-yr, 1-hr rainfall depth, at: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html .

5. Hydrologic Conditions of Concern (HCOC) and use of the on-line San Bernardino County HCOC Map for determining necessary mitigation steps necessary if there are HCOCs downstream of a project:

Project applicants may access the on-line HCOC Map at: http://sbcounty.permitrack.com/WAP/ . The map will indicate any hydrology concerns with downstream waterways that are hydraulically connected to the project and will indicate if there are any approved regional projects downstream that could be utilized for off-site mitigation of HCOCs. Please indicate here if the project will or will not be able to retain/infilter, harvest and use or biotreat and detain the DCV, on-site, as calculated in Section 4 and if there are HCOCs identified downstream of the project:

Retain or Harvest/Use the DCV on site?	Yes	**X**	No	
Biotreat the DCV but not infilter the runoff?	Yes		No	X
HCOCs identified downstream of site?	Yes	**X**	No	

If the entire DCV will not be retained on site, the DCV is biotreated but not infiltered or additional detention capacity is needed to address identified HCOCs, downstream of the site, please list here, what additional mitigation measures will be utilized (on-site or off-site) to address HCOCs (see Section 4.2.1-4.2.3 of the SB County WQMP Technical Guidance):

_____

_____

_____

_____

6. Site Plan and Conceptual Grading/Drainage Plan requirements for submission with the Preliminary WQMP:

Provide a Site Plan and Conceptual Grading/Drainage Plan along with this Preliminary WQMP, which conceptually shows the proposed locations of buildings, homes, parking lots, parks, new paved roadways, landscaped areas, drainage patterns and drainage sub-areas, methods of conveyance, proposed retention/infiltration, harvest & use or biotreatment facilities that are planned for installation. Where it is determined to be infeasible to capture and detain design storm runoff volumes, on-site, please include other design features, as

described in Section 3, above. Include numbered or lettered notes on the Site Plan with a legend detailing other BMPs, as described in Section 3.

The project site will capture the DCV generated from the project site via sheet flow and subsurface storm drain. Flows will then discharge into one of five subsurface systems, or into the proposed infiltration basin. The DCV will then be treated via infiltration either in the subsurface systems or the infiltration basin. The subsurface systems and infiltration basin will not allow flows to discharge below the depth of the DCV. The majority of the project site is not included in an area identified as “HCOC Exempt Areas” on the Stormwater Facility Mapping Tool, with the exception of the most easterly portion of the project site, therefore the table in Section V indicates that “HCOCs identified downstream of site”. However, once the project constructs the necessary master drainage plan facilities required for the project site, the project will no longer be subject to addressing HCOCs since all facilities downstream of the project will be designed for the tributary peak 100-year flow rate generated by the project site. This will be discussed in more detail in the final WQMP. The storm drain improvements will be designed so that all flows will be conveyed to the subsurface systems or infiltration basin. Flows in excess of the required Design Capture Volume will be conveyed via outlet pipes from the BMPs to the Master Drainage Plan facilities surrounding the project site. The BMPs have been sized to accommodate the Design Capture Volume, while allowing peak flows to bypass. The site plan depicts the location of the proposed BMPs and the tributary DMA areas.

TECHNICAL MEMORANDUM
BORBA II PROJECT
HYDROLOGY & HYDRAULIC ASSESSMENT

Date: **September 19, 2019**

To: **Siara MacKinney, P.E.**

From: **Joseph L. Castaneda, P.E.**

Re: **Re: Hydrology & Hydraulic Assessment for Borba II Project**

A. INTRODUCTION

The Borba II Project is an Industrial Project that is roughly bounded by Eucalyptus Avenue to the north, Merrill Avenue to the south, Grove Avenue to the west, and Carpenter Avenue to the east. The total project area plans to improve approximately 390 acres of land that is currently used for agricultural and dairy farm purposes. The project is within the City of Ontario Master Drainage Plan (MDP) defined as the "New Model Colony West (NMC-West). The NMC-West is divided into a total of 5 watershed areas which are defined as Zone XI, XII, XIII, XIV, and XV, which have been identified in Figure A. Based on Figure B, the NMC-West Drainage Area Map, the project has been planned to discharge runoff into watershed areas XII and XIII. Approximately 350 acres are planned to drain into the MDP storm drain systems defined within watershed XII and 40 acres are planned to drain into MDP storm drain defined in watershed XIII. As part of the development the project will plan to construct the necessary MDP storm drain facilities that will provide the necessary flood protection the project requires and to meet the street design criteria outlined in the City of Ontario design policies. Additionally, the project plans to connect to the Walker XII-1 Storm Drain east of the project site, which is a double 10 foot High x 12 Foot Wide Reinforced Concrete Box structure. The improvement plans for Walker XII-1 Storm Drain indicate that the system will connect to Cucamonga Creek Channel, which is a regional flood control channel that is designed for a Standard Project Flood (SPF). The SPF yields a flow rate that is in excess of the 100 year storm event and is based on an assessment which implements the most severe combination of meteorological and hydrological conditions that can be characterized within the watershed area. Moreover, the 40 acre portion of the project within watershed area XIII is planned to drain into the existing Grove Avenue Storm Drain located south of Merrill Avenue.

B. HYDROLOGY

The Ontario MDP includes the ultimate condition hydrology based on the future land use associated with the overall watershed area. Volume II of the City of Ontario MDP includes the hydrology analyses performed for the overall drainage area.

Watershed Area XII is an area that is 1,472 acres and consists of residential and commercial land uses. Based on Figure B - MDP Watershed Map, the proposed easterly portion of the project, which consists of approximately 350 acres is within a drainage area that is planned as commercial land use. The hydrological assumption is that the drainage area will consist of 90% impervious area and 10% pervious area. This assumption will result in runoff from the project site that will yield high flow rates. The hydrology calculations for area XII have been included as Appendix A. The project area is defined within Nodes 102.1 to Node 1722 within the hydrology analysis. The proposed industrial land use for the project will meet the hydrological assumptions that have been planned for the watershed area and will not adversely impact the MDP facilities that have been planned for the area.

Watershed Area XIII is an area that is 704 acres and consists of residential and commercial land uses. Based on Figure B – MDP Watershed Map, the proposed westerly portion of the project, which consists of approximately 40 acres is within a drainage area that is planned as commercial land use. The hydrology analyses for the proposed project area assumed a 90% impervious area and 10% pervious area. This assumption is associated with high runoff potential from the project site and will yield high flow rates similar to Watershed Area XII. The hydrology calculations for area XIII have been included as Appendix B. The project area is defined within Nodes 68 to Node 68 within the hydrology analysis. The proposed industrial land use for the project will meet the hydrological assumptions that have been used in the hydrological calculations.

The proposed project is within the City of Ontario Master Drainage Plan. The hydrology analyses and the planned storm drain facilities for the area indicate that the development land use is consistent with the Master Drainage Plan. The runoff potential from the project would not adversely impact the regional area since the land use characteristics are consistent with the City of Ontario MDP.

C. STORM DRAIN INFRASTRUCURE

The proposed project will be required to construct regional storm drain systems that have been identified in the City of Ontario Master Drainage Plan. Figure C identifies the project site and the local drainage infrastructure required for the project. In order to

mitigate regional flooding the project will be required to construct the following storm drain facilities:

1. Construct and extend the Wlkr-XII-1 storm drain system which is a Double 10 foot high x 12 foot wide Reinforced Concrete Box (RCB) from Merrill Avenue and Vineyard Avenue to the intersection of Walker Avenue ad Eucalyptus Avenue. This storm drain system will intercept runoff north of the project and from the project area to provide the necessary flood protection.
2. Construct the Merl-XII-1 Storm Drain along Merrill Avenue. This storm drain system will extend approximately 5,000 feet west of Carpenter Avenue. The proposed storm drain is a RCB system that ranges in size from 4 foot high x 8 foot wide RCB to 3 foot high x 6 foot wide RCB.
3. Construct the Grov-XIII-1 a proposed 120-inch Storm Drain system. The system will connect to the existing concrete channel south of Merrill Avenue and extend to Eucalyptus Avenue.

It should be noted that additional offsite storm drain system such as catch basins, storm drain laterals, connector pipes, and roadway channel will be required infrastructure to intercept the watershed runoff and direct the flows into the regional storm drain systems outlined above. Moreover, the project will be required to implement the City of Ontario's Water Quality Management provisions to be consistent with the Clean Water Act and the policies implemented by the Santa Ana Regional Water Quality Board.

D. CONCLUSIONS

Based on the assessment performed for this project, the following conclusions have been developed:

1. The proposed project land use is consistent with the hydrology calculations and analyses included in Appendix A and Appendix B.
2. The project must implement the necessary regional storm drain infrastructure shown on Figure C to provide the necessary flood protection and to mitigate adverse impacts to upstream and downstream property owners.
3. The project will be required to construct ancillary storm drain systems, such as but not limited to catch basin, storm drain laterals, and roadway channels to intercept local and regional runoff. These system will direct the intercepted runoff into a regional storm drain system.
4. The project will be required to meet the City of Ontario Water Quality guidelines.

In closing, the proposed storm drain improvements outlined in Figure C to flood protect the project meet the intent of the Master Drainage Plan. During final engineering, the final alignments and storm drain sizes may change due to unforeseen constraints such as utility conflicts and available right-of-way. However, if storm drain system do to

change the project must demonstrate that the system is AN acceptable equivalent to the proposed system shown on Figure C.

The technical memorandum also includes the following attachments:

Figure A – City of Ontario MDP Drainage Area Map

Figure B – City of Ontario MDP Hydrology Map

Figure C – Borba II Storm Drain Infrastructure

Appendix A – 100 Year Hydrology Calculation for Area XII

Appendix B - 100 Year Hydrology Calculation for Area XIII

FIGURE A – CITY OF ONTARIO MDP DRAINAGE AREA MAP

CITY OF ONTARIO

UPLAND
8TH ST STORM DRAIN
8th ST BASINS
8TH ST INTERCEPT
8TH ST
RANCHO CUCAMONGA
TO CITY OF MONTCLAIR PROPOSED STORM DRAIN
TO CITY OF MONTCLAIR SAN BERNARDINO AVE STORM DRAIN
GROVE AVE
6TH ST
VINEYARD AVE
DEER CREEK CHANNEL
MILLIKEN AVE
S.B. COUNTY
PRINCETON LI BASIN
4TH ST
SR83
10
MONTCLAIR
VI
II
TURNER BASINS
CUCAMONGA-GUASTI REGIONAL PARK
EUCLID AVE
ARCHIBALD AVE
HAVEN AVE
WEST STATE ST STORM DRAIN
V
AIRPORT DR
IV
ONTARIO INTERNATIONAL AIRPORT
CUCAMONGA CHANNEL
III
I
EAST STATE ST STORM DRAIN
S.B. COUNTY
IX
MISSION BLVD
PHILLIPS ST
VII
JURUPA ST
COMMERCE CENTER STORM DRAIN
DAY CREEK CHANNEL
FONTANA
SAN SEVAINE CHANNEL
WINEVILLE BASIN
LOWER ETIWANDA CREEK CHANNEL
TO CITY OF CHINO MASTER PLAN STORM DRAIN SYSTEM 28
FRANCIS ST STORM DRAIN
WEST CUCAMONGA CHANNEL
MISSION BLVD
FRANCIS ST
BENSON AVE
ELY BASINS
15
WINEVILLE AVE
ETIWANDA AVE
CHINO
PHILADELPHIA ST
JURUPA VALLEY
RIVERSIDE BASIN
CHINO STORM DRAIN
SR60
VIII
SR83
SAN ANTONIO AVE
SULTANA CYPRESS STORM DRAIN
MAGNOLIA STORM DRAIN
RIVERSIDE DR STORM DRAIN 2
GROVE AVE BASIN
SAN BERNARDINO/ RIVERSIDE COUNTY LINE
RIVERSIDE DR
RIVERSIDE DR STORM DRAIN 1
RIVERSIDE DR STORM DRAIN
CHINO
MOUNTAIN AVE
CYPRESS CHANNEL
LOWER DEER CREEK CHANNEL
TURNER AVE
CHINO AVE
GROVE AVE BASIN DRAIN
XIV
RIVERSIDE DR STORM DRAIN 2
LOWER CUCAMONGA SPREADING GROUNDS
XII
S MILLIKEN AVE
EASTVALE
SCHAEFER AVE
CHINO BASIN
XIII
XI
X
EDISON AVE
EUCLID AVE
BON VIEW AVE
GROVE AVE
WALKER AVE
CUCAMONGA CHANNEL
ARCHIBALD AVE
EUCALYPTUS AVE
MERRILL AVE
BELLGRAVE AVE
COUNTY LINE CHANNEL
EASTVALE
XV
AIRPORT CHANNEL
TO CITY OF CHINO MASTER PLANNED LINE I EUCLID AVE STORM DRAIN
OPEN CHANNEL
CHINO AIRPORT
TO CITY OF CHINO MASTER PLANNED LINE J GROVE AVE STORM DRAIN
CHINO
FUTURE CHINO LINE A
REMINGTON AVE

DRAINAGE AREAS

I	(3,906 AC)	
II	(236 AC)	
III	(5,174 AC)	
IV	(4,937 AC)	
V	(4,105 AC)	
VI	(1,307 AC)	
VII	(2,501 AC)	
VIII	(1,286 AC)	
IX	(572 AC)	
X	~~(2,903 AC)~~	
XI	~~(1,471 AC)~~	(941 AC)
XII	~~(1,255 AC)~~	(1,476 AC)
XIII	(681 AC)	
XIV	~~(1,758 AC)~~	
XV	(120 AC)	1

LEGEND

- PLANNED STORM DRAIN
- EXISTING COUNTY OPEN CHANNEL
- EXISTING COUNTY STORM DRAIN
- CITY LIMIT LINE
- COUNTY LIMIT LINE
- EXISTING DETENTION BASIN
- OFF-SITE AREAS TRIBUTARY TO CITY OF ONTARIO

DATE	REV.	DESCRIPTION
06-2017	1	REVISIONS TO DRAINAGE AREA XI AND XII TO MATCH APPROVED "MASTER PLAN OF DRAINAGE REVISION WLKR-XII-1 REALIGNMENT" MEMO DATED DECEMBER 2016

GRAPHIC SCALE
0 2,500 5,000 10,000
(FEET)

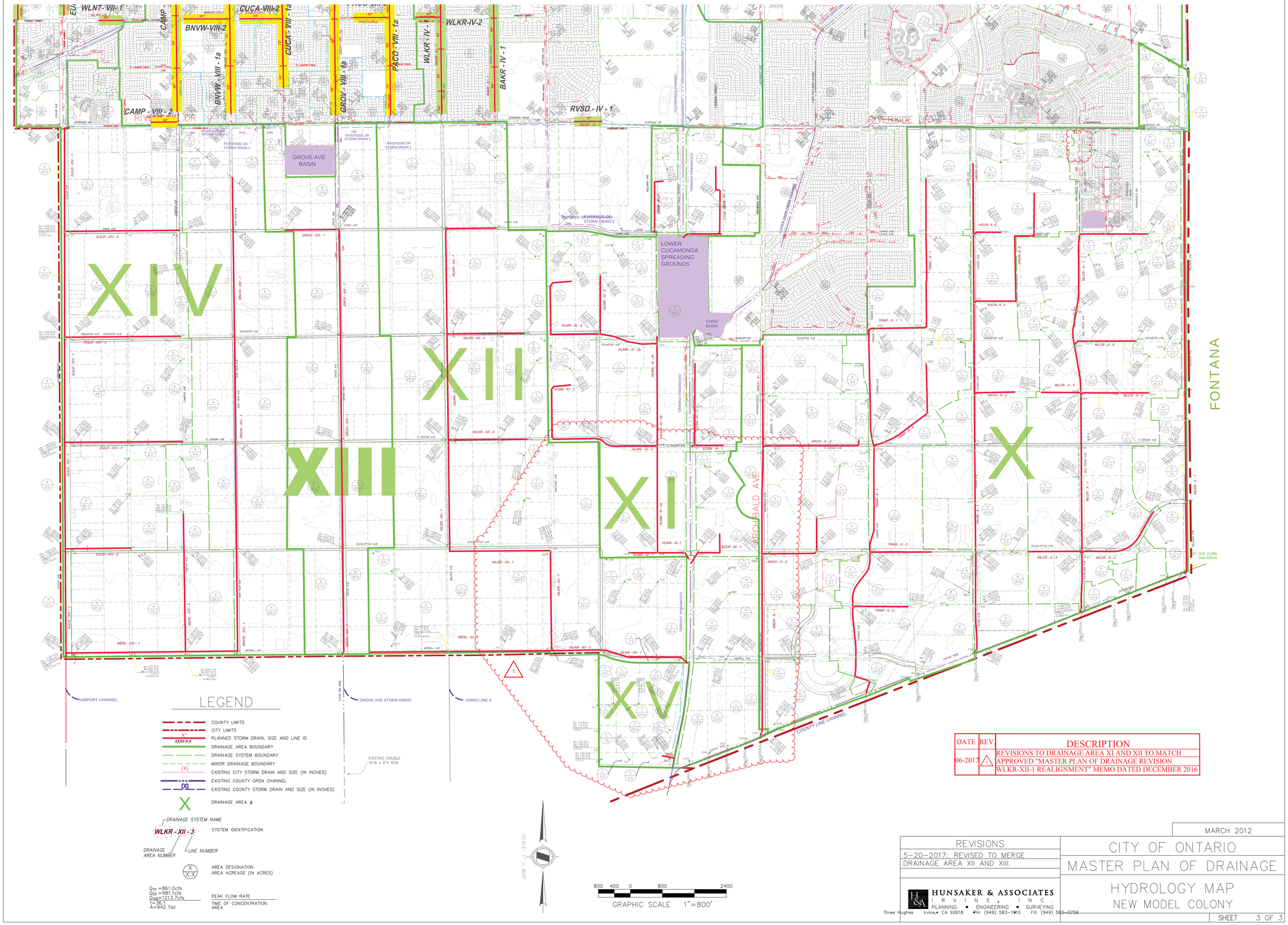
EXHIBIT 7
MARCH 2012
CITY OF ONTARIO
MASTER PLAN OF DRAINAGE

DRAINAGE AREA MAP

03/10/2012

F:\0641\Engineering\SY_SD Master Plan\Rpt_SD Master Plan\Exh 7 - DRAINAGE AREAS.dwg 3/15/2012 12:07 PM Joanna Swiatkowska

FIGURE B – CITY OF ONTARIO MDP HYDROLOGY MAP



LEGEND

- COUNTY LIMITS
- CITY LIMITS
- XXXX-X-X — PLANNED STORM DRAIN, SIZE AND LINE ID
- DRAINAGE AREA BOUNDARY
- DRAINAGE SYSTEM BOUNDARY
- MINOR DRAINAGE BOUNDARY
- (X) — EXISTING CITY STORM DRAIN AND SIZE (IN INCHES)
- EXISTING COUNTY OPEN CHANNEL
- (XX) — EXISTING COUNTY STORM DRAIN AND SIZE (IN INCHES)
- X — DRAINAGE AREA #
- DRAINAGE SYSTEM NAME
- WLKR - XII - 3 — SYSTEM IDENTIFICATION
- DRAINAGE AREA NUMBER
- LINE NUMBER
- X / XX — AREA DESIGNATION / AREA ACREAGE (IN ACRES)
- Q10 =861.0cfs, Q25 =981.1cfs, Q100=1213.7cfs — PEAK FLOW RATE
- t=36.1, A=942.7ac — TIME OF CONCENTRATION / AREA

SCALE: 1" = 800'

800 400 0 800 2400
GRAPHIC SCALE 1"=800'

DATE	REV.	DESCRIPTION
06-2017	1	REVISIONS TO DRAINAGE AREA XI AND XII TO MATCH APPROVED "MASTER PLAN OF DRAINAGE REVISION WLKR-XII-1 REALIGNMENT" MEMO DATED DECEMBER 2016

MARCH 2012

REVISIONS
5-20-2017: REVISED TO MERGE DRAINAGE AREA XII AND XIII.

CITY OF ONTARIO
MASTER PLAN OF DRAINAGE
HYDROLOGY MAP
NEW MODEL COLONY

HUNSAKER & ASSOCIATES
I R V I N E , I N C
PLANNING ▪ ENGINEERING ▪ SURVEYING
Three Hughes Irvine, CA 92618 PH: (949) 583-1910 FX: (949) 583-0759

SHEET 3 OF 3

PLOTTED 12/12/2017 1:53 PM

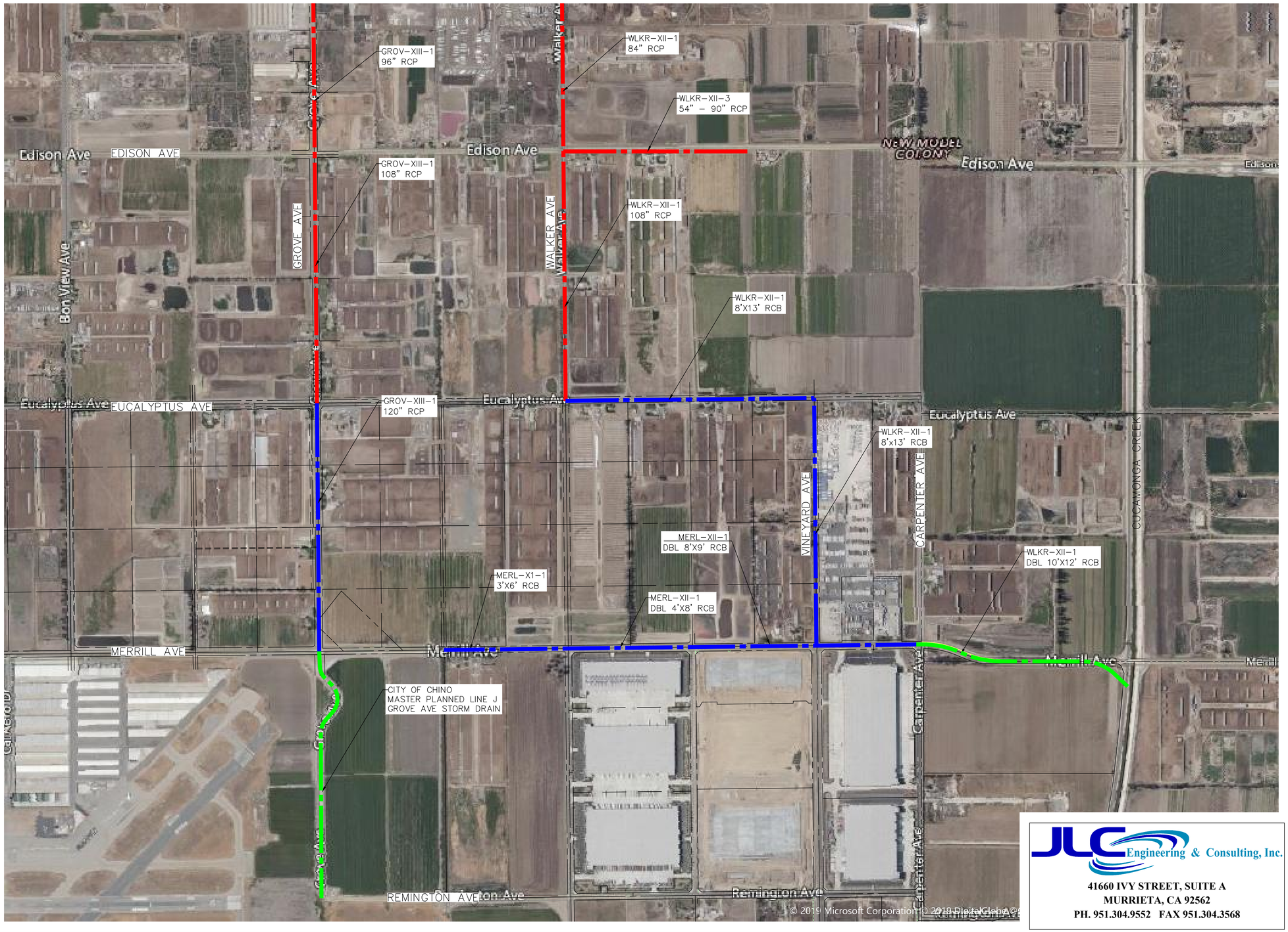
\\TUSFS1\HF\Project\140152\Eng\140152-0000\Hm\Hydrology Report\MPD Update\Civil 3D Files\New Model Hydrology Map Update.dwg

FIGURE C – BORBA II STORM DRAIN INFRASTRUCTURE

BORBA II

IN THE CITY OF ONTARIO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA

CITY OF ONTARIO MASTER DRAINAGE PLAN



LEGEND:

- BORBA II REQUIRED MDP STORM DRAIN
- FUTURE MDP STORM DRAIN
- EXISTSING MDP STORM DRAIN

N

GRAPHIC SCALE
500' 0 250' 500' 1,000'
1" = 500'

FIGURE C

BORBA II

CITY OF ONTARIO MASTER DRAINAGE PLAN

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

Drawing Name: C:\265.08.19\Engineering\Hydrology_Plan\Exhibits\MDP Figure.dwg
Last Opened: Sep 18, 2019 8:58am by jforver

APPENDIX A – 100 YEAR HYDROLOGY CALCULATIONS FOR AREA XII

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)
CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2014 Version 9.0
Rational Hydrology Study Date: 05/18/17

City of Ontario Master Plan of Drainage
100-Yr Study
Area C

Program License Serial Number 6385

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

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.200 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 81.000 to Point/Station 82.000
**** INITIAL AREA EVALUATION ****

RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.590
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.410
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 47.17
Pervious ratio(Ap) = 0.5000 Max loss rate(Fm)= 0.421(In/Hr)
Initial subarea data:
Initial area flow distance = 998.000(Ft.)
Top (of initial area) elevation = 775.000(Ft.)
Bottom (of initial area) elevation = 767.000(Ft.)
Difference in elevation = 8.000(Ft.)
Slope = 0.00802 s(%)= 0.80
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 16.174 min.
Rainfall intensity = 2.635(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.756
Subarea runoff = 19.326(CFS)
Total initial stream area = 9.700(Ac.)
Pervious area fraction = 0.500
Initial area Fm value = 0.421(In/Hr)

++
Process from Point/Station 82.000 to Point/Station 83.000

**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 767.000(Ft.)
End of street segment elevation = 750.000(Ft.)
Length of street segment = 1686.000(Ft.)
Height of curb above gutter flowline = 8.0(In.)
Width of half street (curb to crown) = 65.000(Ft.)
Distance from crown to crossfall grade break = 60.000(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 [2] side(s) of the street
Distance from curb to property line = 10.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0150
Estimated mean flow rate at midpoint of street = 29.610(CFS)
Depth of flow = 0.535(Ft.), Average velocity = 3.455(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 20.393(Ft.)
Flow velocity = 3.45(Ft/s)
Travel time = 8.13 min. TC = 24.31 min.
Adding area flow to street
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.790
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.210
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 39.77
Pervious ratio(Ap) = 0.5000 Max loss rate(Fm)= 0.459(In/Hr)
Rainfall intensity = 2.064(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.706
Subarea runoff = 20.423(CFS) for 17.600(Ac.)
Total runoff = 39.749(CFS)
Effective area this stream = 27.30(Ac.)
Total Study Area (Main Stream No. 1) = 27.30(Ac.)
Area averaged Fm value = 0.446(In/Hr)
Street flow at end of street = 39.749(CFS)
Half street flow at end of street = 19.874(CFS)
Depth of flow = 0.584(Ft.), Average velocity = 3.714(Ft/s)
Flow width (from curb towards crown)= 22.856(Ft.)

++
Process from Point/Station 83.000 to Point/Station 84.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 750.000(Ft.)
Downstream point/station elevation = 747.700(Ft.)
Pipe length = 1333.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 39.749(CFS)
Nearest computed pipe diameter = 42.00(In.)
Calculated individual pipe flow = 39.749(CFS)

```
Normal flow depth in pipe =   32.72(In.)
Flow top width inside pipe =   34.85(In.)
Critical Depth =   23.53(In.)
Pipe flow velocity =      4.94(Ft/s)
Travel time through pipe =    4.49 min.
Time of concentration (TC) =    28.80 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       84.000 to Point/Station       84.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.489(In/Hr)
Time of concentration =    28.80 min.
Rainfall intensity =      1.864(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.670
Subarea runoff =     84.317(CFS) for   72.100(Ac.)
Total runoff =    124.066(CFS)
Effective area this stream =       99.40(Ac.)
Total Study Area (Main Stream No. 1) =       99.40(Ac.)
Area averaged Fm value =    0.477(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       84.000 to Point/Station       84.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.4700     Max loss rate(Fm)=     0.460(In/Hr)
Time of concentration =    28.80 min.
Rainfall intensity =      1.864(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.674
Subarea runoff =    127.148(CFS) for  100.600(Ac.)
Total runoff =    251.214(CFS)
Effective area this stream =      200.00(Ac.)
Total Study Area (Main Stream No. 1) =      200.00(Ac.)
Area averaged Fm value =    0.468(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       84.000 to Point/Station       85.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   747.700(Ft.)
Downstream point/station elevation =   722.700(Ft.)
Pipe length  =  2630.00(Ft.)   Manning's N = 0.013
```

```
No. of pipes = 1  Required pipe flow  =   251.214(CFS)
Nearest computed pipe diameter  =     60.00(In.)
Calculated individual pipe flow  =   251.214(CFS)
Normal flow depth in pipe =   48.56(In.)
Flow top width inside pipe =   47.14(In.)
Critical Depth =   53.16(In.)
Pipe flow velocity =     14.74(Ft/s)
Travel time through pipe =    2.97 min.
Time of concentration (TC) =    31.77 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       85.000 to Point/Station       85.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.5900     Max loss rate(Fm)=     0.577(In/Hr)
Time of concentration =    31.77 min.
Rainfall intensity =      1.757(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.642
Subarea runoff =     87.022(CFS) for  100.000(Ac.)
Total runoff =    338.236(CFS)
Effective area this stream =      300.00(Ac.)
Total Study Area (Main Stream No. 1) =      300.00(Ac.)
Area averaged Fm value =    0.504(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       85.000 to Point/Station       85.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.5200     Max loss rate(Fm)=     0.508(In/Hr)
Time of concentration =    31.77 min.
Rainfall intensity =      1.757(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.642
Subarea runoff =     10.002(CFS) for    8.900(Ac.)
Total runoff =    348.239(CFS)
Effective area this stream =      308.90(Ac.)
Total Study Area (Main Stream No. 1) =      308.90(Ac.)
Area averaged Fm value =    0.505(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       85.000 to Point/Station       85.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =    308.900(Ac.)
Runoff from this stream =    348.239(CFS)
```

```
Time of concentration =   31.77 min.
Rainfall intensity =     1.757(In/Hr)
Area averaged loss rate (Fm) =    0.5046(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5199


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       86.000 to Point/Station       87.000
**** INITIAL AREA EVALUATION ****
----------------------------------------------------------------------------
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.240
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.760
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 60.12
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.339(In/Hr)
Initial subarea data:
Initial area flow distance =   764.000(Ft.)
Top (of initial area) elevation =   750.000(Ft.)
Bottom (of initial area) elevation =   740.000(Ft.)
Difference in elevation =    10.000(Ft.)
Slope =    0.01309  s(%)=       1.31
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   13.177 min.
Rainfall intensity =      2.980(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.798
Subarea runoff =     22.579(CFS)
Total initial stream area =        9.500(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.339(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       87.000 to Point/Station       88.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------------
Top of street segment elevation =   740.000(Ft.)
End of street segment elevation =   724.700(Ft.)
Length of street segment  =  1880.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =  13.000(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 [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     42.202(CFS)
Depth of flow =   0.599(Ft.), Average velocity =   3.913(Ft/s)
Note:  depth of flow exceeds top of street crown.
```

```
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  18.000(Ft.)
Flow velocity =   3.91(Ft/s)
Travel time =    8.01 min.     TC =   21.18  min.
 Adding area flow to street
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 69.00
Pervious ratio(Ap) = 0.3900     Max loss rate(Fm)=     0.214(In/Hr)
Rainfall intensity =      2.241(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.800
Subarea runoff =     39.120(CFS) for   24.900(Ac.)
Total runoff =     61.699(CFS)
Effective area this stream =       34.40(Ac.)
Total Study Area (Main Stream No. 1) =      343.30(Ac.)
Area averaged Fm value =    0.248(In/Hr)
Street flow at end of street =     61.699(CFS)
Half street flow at end of street =     30.849(CFS)
Depth of flow =   0.682(Ft.), Average velocity =   4.475(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    0.78(Ft.)
Flow width (from curb towards crown)=  18.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       88.000 to Point/Station       89.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   724.700(Ft.)
Downstream point/station elevation =   724.000(Ft.)
Pipe length  =   695.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    61.699(CFS)
Nearest computed pipe diameter  =     54.00(In.)
Calculated individual pipe flow  =    61.699(CFS)
Normal flow depth in pipe =   43.69(In.)
Flow top width inside pipe =   42.45(In.)
Critical Depth =   27.38(In.)
Pipe flow velocity =      4.47(Ft/s)
Travel time through pipe =    2.59 min.
Time of concentration (TC) =    23.77 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       89.000 to Point/Station       89.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 64.14
Pervious ratio(Ap) = 0.5200     Max loss rate(Fm)=     0.323(In/Hr)
Time of concentration =    23.77 min.
Rainfall intensity =      2.091(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.776
```

```
Subarea runoff =     58.392(CFS) for   39.600(Ac.)
Total runoff =    120.091(CFS)
Effective area this stream =       74.00(Ac.)
Total Study Area (Main Stream No. 1) =      382.90(Ac.)
Area averaged Fm value =    0.288(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       89.000 to Point/Station       90.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   724.000(Ft.)
Downstream point/station elevation =   722.900(Ft.)
Pipe length  =  1105.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   120.091(CFS)
Nearest computed pipe diameter  =     72.00(In.)
Calculated individual pipe flow  =   120.091(CFS)
Normal flow depth in pipe =   53.34(In.)
Flow top width inside pipe =   63.09(In.)
Critical Depth =   35.49(In.)
Pipe flow velocity =      5.35(Ft/s)
Travel time through pipe =    3.44 min.
Time of concentration (TC) =    27.22 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       90.000 to Point/Station       90.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 34.05
Pervious ratio(Ap) = 0.6800     Max loss rate(Fm)=     0.656(In/Hr)
Time of concentration =    27.22 min.
Rainfall intensity =      1.928(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.681
Subarea runoff =     70.543(CFS) for   71.100(Ac.)
Total runoff =    190.634(CFS)
Effective area this stream =      145.10(Ac.)
Total Study Area (Main Stream No. 1) =      454.00(Ac.)
Area averaged Fm value =    0.468(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       90.000 to Point/Station       85.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   722.900(Ft.)
Downstream point/station elevation =   722.700(Ft.)
Pipe length  =   200.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   190.634(CFS)
Nearest computed pipe diameter  =     84.00(In.)
Calculated individual pipe flow  =   190.634(CFS)
Normal flow depth in pipe =   64.97(In.)
Flow top width inside pipe =   70.33(In.)
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Critical Depth =   43.12(In.)
Pipe flow velocity =      5.97(Ft/s)
Travel time through pipe =    0.56 min.
Time of concentration (TC) =    27.78 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       85.000 to Point/Station       85.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =    145.100(Ac.)
Runoff from this stream =    190.634(CFS)
Time of concentration =   27.78 min.
Rainfall intensity =     1.905(In/Hr)
Area averaged loss rate (Fm) =    0.4685(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5748
Summary of stream data:

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


1    348.24   308.900     31.77    0.505      1.757
2    190.63   145.100     27.78    0.468      1.905
Qmax(1) =
         1.000 *    1.000 *   348.239) +
         0.897 *    1.000 *   190.634) + =     519.270
Qmax(2) =
         1.118 *    0.874 *   348.239) +
         1.000 *    1.000 *   190.634) + =     530.938

Total of 2 streams to confluence:
Flow rates before confluence point:
     348.239     190.634
Maximum flow rates at confluence using above data:
      519.270      530.938
Area of streams before confluence:
      308.900      145.100
Effective area values after confluence:
      454.000      415.120
Results of confluence:
Total flow rate =    530.938(CFS)
Time of concentration =    27.775 min.
Effective stream area after confluence =    415.120(Ac.)
Study area average Pervious fraction(Ap) =  0.537
Study area average soil loss rate(Fm) =    0.493(In/Hr)
Study area total (this main stream) =     454.00(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       85.000 to Point/Station       91.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   722.700(Ft.)
Downstream point/station elevation =   697.000(Ft.)
```

```
Pipe length  =  2645.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   530.938(CFS)
Nearest computed pipe diameter  =     81.00(In.)
Calculated individual pipe flow  =   530.938(CFS)
Normal flow depth in pipe =   61.78(In.)
Flow top width inside pipe =   68.92(In.)
Critical Depth =   71.70(In.)
Pipe flow velocity =     18.14(Ft/s)
Travel time through pipe =    2.43 min.
Time of concentration (TC) =    30.21 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       91.000 to Point/Station       91.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.4600     Max loss rate(Fm)=     0.450(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =    503.705(CFS)
therefore the upstream flow rate of Q =    530.938(CFS) is being used
Time of concentration =    30.21 min.
Rainfall intensity =      1.811(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.655
Subarea runoff =      0.000(CFS) for    9.100(Ac.)
Total runoff =    530.938(CFS)
Effective area this stream =      424.22(Ac.)
Total Study Area (Main Stream No. 1) =      463.10(Ac.)
Area averaged Fm value =    0.492(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       91.000 to Point/Station       91.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.4500     Max loss rate(Fm)=     0.440(In/Hr)
Time of concentration =    30.21 min.
Rainfall intensity =      1.811(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.660
Subarea runoff =     77.558(CFS) for   84.900(Ac.)
Total runoff =    608.495(CFS)
Effective area this stream =      509.12(Ac.)
Total Study Area (Main Stream No. 1) =      548.00(Ac.)
Area averaged Fm value =    0.483(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       91.000 to Point/Station       91.000
**** CONFLUENCE OF MINOR STREAMS ****
```

```
Along Main Stream number: 1 in normal stream number 1
Stream flow area =    509.120(Ac.)
Runoff from this stream =    608.495(CFS)
Time of concentration =   30.21 min.
Rainfall intensity =     1.811(In/Hr)
Area averaged loss rate (Fm) =    0.4834(In/Hr)
Area averaged Pervious ratio (Ap) = 0.5215


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       92.000 to Point/Station       93.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 0.050
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.950
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 67.15
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.288(In/Hr)
Initial subarea data:
Initial area flow distance =   780.000(Ft.)
Top (of initial area) elevation =   730.000(Ft.)
Bottom (of initial area) elevation =   720.000(Ft.)
Difference in elevation =    10.000(Ft.)
Slope =    0.01282  s(%)=       1.28
TC = k(0.389)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   13.342 min.
Rainfall intensity =      2.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.812
Subarea runoff =     22.345(CFS)
Total initial stream area =        9.300(Ac.)
Pervious area fraction = 0.500
Initial area Fm value =    0.288(In/Hr)


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Process from Point/Station       93.000 to Point/Station       94.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Top of street segment elevation =   720.000(Ft.)
End of street segment elevation =   701.000(Ft.)
Length of street segment  =  1920.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =  13.000(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 [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
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 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     42.026(CFS)
Depth of flow =   0.581(Ft.), Average velocity =   4.144(Ft/s)
Note:  depth of flow exceeds top of street crown.
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  18.000(Ft.)
Flow velocity =   4.14(Ft/s)
Travel time =    7.72 min.     TC =   21.06  min.
 Adding area flow to street
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 49.51
Pervious ratio(Ap) = 0.4100     Max loss rate(Fm)=     0.334(In/Hr)
Rainfall intensity =      2.249(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.771
Subarea runoff =     39.213(CFS) for   26.200(Ac.)
Total runoff =     61.557(CFS)
Effective area this stream =       35.50(Ac.)
Total Study Area (Main Stream No. 1) =      583.50(Ac.)
Area averaged Fm value =    0.322(In/Hr)
Street flow at end of street =     61.557(CFS)
Half street flow at end of street =     30.779(CFS)
Depth of flow =   0.654(Ft.), Average velocity =   4.820(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  18.000(Ft.)


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Process from Point/Station       94.000 to Point/Station       95.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   701.000(Ft.)
Downstream point/station elevation =   699.000(Ft.)
Pipe length  =   700.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    61.557(CFS)
Nearest computed pipe diameter  =     45.00(In.)
Calculated individual pipe flow  =    61.557(CFS)
Normal flow depth in pipe =   35.06(In.)
Flow top width inside pipe =   37.33(In.)
Critical Depth =   28.93(In.)
Pipe flow velocity =      6.66(Ft/s)
Travel time through pipe =    1.75 min.
Time of concentration (TC) =    22.81 min.


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Process from Point/Station       95.000 to Point/Station       95.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 69.00
Pervious ratio(Ap) = 0.4600     Max loss rate(Fm)=     0.252(In/Hr)
Time of concentration =    22.81 min.
Rainfall intensity =      2.144(In/Hr) for a   100.0 year storm
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Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.781
Subarea runoff =     68.139(CFS) for   42.000(Ac.)
Total runoff =    129.697(CFS)
Effective area this stream =       77.50(Ac.)
Total Study Area (Main Stream No. 1) =      625.50(Ac.)
Area averaged Fm value =    0.284(In/Hr)


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Process from Point/Station       95.000 to Point/Station       96.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   699.000(Ft.)
Downstream point/station elevation =   697.200(Ft.)
Pipe length  =  1100.00(Ft.)   Manning's N = 0.015
No. of pipes = 1  Required pipe flow  =   129.697(CFS)
Nearest computed pipe diameter  =     69.00(In.)
Calculated individual pipe flow  =   129.697(CFS)
Normal flow depth in pipe =   55.31(In.)
Flow top width inside pipe =   55.03(In.)
Critical Depth =   37.46(In.)
Pipe flow velocity =      5.82(Ft/s)
Travel time through pipe =    3.15 min.
Time of concentration (TC) =    25.97 min.


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Process from Point/Station       96.000 to Point/Station       96.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 41.47
Pervious ratio(Ap) = 0.3600     Max loss rate(Fm)=     0.325(In/Hr)
Time of concentration =    25.97 min.
Rainfall intensity =      1.984(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.762
Subarea runoff =     95.559(CFS) for   71.500(Ac.)
Total runoff =    225.256(CFS)
Effective area this stream =      149.00(Ac.)
Total Study Area (Main Stream No. 1) =      697.00(Ac.)
Area averaged Fm value =    0.304(In/Hr)


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Process from Point/Station       96.000 to Point/Station       91.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   697.200(Ft.)
Downstream point/station elevation =   697.000(Ft.)
Pipe length  =   200.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   225.256(CFS)
Nearest computed pipe diameter  =     90.00(In.)
Calculated individual pipe flow  =   225.256(CFS)
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Normal flow depth in pipe =   68.53(In.)
Flow top width inside pipe =   76.71(In.)
Critical Depth =   46.05(In.)
Pipe flow velocity =      6.24(Ft/s)
Travel time through pipe =    0.53 min.
Time of concentration (TC) =    26.50 min.


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Process from Point/Station       91.000 to Point/Station       91.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =    149.000(Ac.)
Runoff from this stream =    225.256(CFS)
Time of concentration =   26.50 min.
Rainfall intensity =     1.959(In/Hr)
Area averaged loss rate (Fm) =    0.3037(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4057
Summary of stream data:

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


1    608.50   509.120     30.21    0.483      1.811
2    225.26   149.000     26.50    0.304      1.959
Qmax(1) =
         1.000 *    1.000 *   608.495) +
         0.911 *    1.000 *   225.256) + =     813.615
Qmax(2) =
         1.111 *    0.877 *   608.495) +
         1.000 *    1.000 *   225.256) + =     818.589

Total of 2 streams to confluence:
Flow rates before confluence point:
     608.495     225.256
Maximum flow rates at confluence using above data:
      813.615      818.589
Area of streams before confluence:
      509.120      149.000
Effective area values after confluence:
      658.120      595.656
Results of confluence:
Total flow rate =    818.589(CFS)
Time of concentration =    26.500 min.
Effective stream area after confluence =    595.656(Ac.)
Study area average Pervious fraction(Ap) =  0.495
Study area average soil loss rate(Fm) =    0.443(In/Hr)
Study area total (this main stream) =     658.12(Ac.)


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Process from Point/Station       91.000 to Point/Station       97.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
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Upstream point/station elevation =   697.000(Ft.)
Downstream point/station elevation =   685.000(Ft.)
Pipe length  =  2637.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   818.589(CFS)
Nearest computed pipe diameter  =    108.00(In.)
Calculated individual pipe flow  =   818.589(CFS)
Normal flow depth in pipe =   85.88(In.)
Flow top width inside pipe =   87.18(In.)
Critical Depth =   84.80(In.)
Pipe flow velocity =     15.09(Ft/s)
Travel time through pipe =    2.91 min.
Time of concentration (TC) =    29.41 min.


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Process from Point/Station       97.000 to Point/Station       97.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 45.69
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.344(In/Hr)
Time of concentration =    29.41 min.
Rainfall intensity =      1.841(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.689
Subarea runoff =     43.263(CFS) for   83.500(Ac.)
Total runoff =    861.852(CFS)
Effective area this stream =      679.16(Ac.)
Total Study Area (Main Stream No. 1) =      780.50(Ac.)
Area averaged Fm value =    0.431(In/Hr)


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Process from Point/Station       97.000 to Point/Station       97.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.5300     Max loss rate(Fm)=     0.518(In/Hr)
Time of concentration =    29.41 min.
Rainfall intensity =      1.841(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.685
Subarea runoff =     93.423(CFS) for   78.500(Ac.)
Total runoff =    955.274(CFS)
Effective area this stream =      757.66(Ac.)
Total Study Area (Main Stream No. 1) =      859.00(Ac.)
Area averaged Fm value =    0.440(In/Hr)


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Process from Point/Station       97.000 to Point/Station     1708.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
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Upstream point/station elevation =   685.000(Ft.)
Downstream point/station elevation =   650.000(Ft.)
Pipe length  =  2549.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   955.274(CFS)
Nearest computed pipe diameter  =     93.00(In.)
Calculated individual pipe flow  =   955.274(CFS)
Normal flow depth in pipe =   74.06(In.)
Flow top width inside pipe =   74.90(In.)
Critical Depth =   87.99(In.)
Pipe flow velocity =     23.72(Ft/s)
Travel time through pipe =    1.79 min.
Time of concentration (TC) =    31.20 min.


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Process from Point/Station     1708.000 to Point/Station     1708.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =    757.656(Ac.)
Runoff from this stream =    955.274(CFS)
Time of concentration =   31.20 min.
Rainfall intensity =     1.776(In/Hr)
Area averaged loss rate (Fm) =    0.4396(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4884


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Process from Point/Station     1700.000 to Point/Station     1701.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.890
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.110
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 36.07
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.095(In/Hr)
Initial subarea data:
Initial area flow distance =   907.000(Ft.)
Top (of initial area) elevation =   697.500(Ft.)
Bottom (of initial area) elevation =   693.100(Ft.)
Difference in elevation =     4.400(Ft.)
Slope =    0.00485  s(%)=       0.49
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   13.451 min.
Rainfall intensity =      2.943(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.871
Subarea runoff =     20.071(CFS)
Total initial stream area =        7.830(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.095(In/Hr)


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Process from Point/Station     1701.000 to Point/Station     1702.000
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**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Top of street segment elevation =   693.100(Ft.)
End of street segment elevation =   689.120(Ft.)
Length of street segment  =   382.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  30.000(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 [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     30.694(CFS)
Depth of flow =   0.538(Ft.), Average velocity =   3.529(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  20.549(Ft.)
Flow velocity =   3.53(Ft/s)
Travel time =    1.80 min.     TC =   15.25  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.630
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.370
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 45.69
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.086(In/Hr)
Rainfall intensity =      2.729(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.870
Subarea runoff =     21.139(CFS) for    9.520(Ac.)
Total runoff =     41.210(CFS)
Effective area this stream =       17.35(Ac.)
Total Study Area (Main Stream No. 1) =      876.35(Ac.)
Area averaged Fm value =    0.090(In/Hr)
Street flow at end of street =     41.210(CFS)
Half street flow at end of street =     20.605(CFS)
Depth of flow =   0.587(Ft.), Average velocity =   3.794(Ft/s)
Flow width (from curb towards crown)=  23.030(Ft.)


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Process from Point/Station     1702.000 to Point/Station     1704.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Top of street segment elevation =   689.120(Ft.)
End of street segment elevation =   685.500(Ft.)
Length of street segment  =   817.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  30.000(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 [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     56.262(CFS)
Depth of flow =   0.746(Ft.), Average velocity =   2.853(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    3.96(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  30.000(Ft.)
Flow velocity =   2.85(Ft/s)
Travel time =    4.77 min.     TC =   20.03  min.
 Adding area flow to street
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.4200     Max loss rate(Fm)=     0.411(In/Hr)
Rainfall intensity =      2.318(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.797
Subarea runoff =     29.918(CFS) for   21.170(Ac.)
Total runoff =     71.128(CFS)
Effective area this stream =       38.52(Ac.)
Total Study Area (Main Stream No. 1) =      897.52(Ac.)
Area averaged Fm value =    0.266(In/Hr)
Street flow at end of street =     71.128(CFS)
Half street flow at end of street =     35.564(CFS)
Depth of flow =   0.797(Ft.), Average velocity =   3.045(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    6.54(Ft.)
Flow width (from curb towards crown)=  30.000(Ft.)


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Process from Point/Station     1704.000 to Point/Station     1706.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   679.500(Ft.)
Downstream point/station elevation =   671.500(Ft.)
Pipe length  =   611.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    71.128(CFS)
Nearest computed pipe diameter  =     36.00(In.)
Calculated individual pipe flow  =    71.128(CFS)
Normal flow depth in pipe =   27.52(In.)
Flow top width inside pipe =   30.56(In.)
Critical Depth =   32.06(In.)
Pipe flow velocity =     12.27(Ft/s)
Travel time through pipe =    0.83 min.
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Time of concentration (TC) =    20.86 min.


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Process from Point/Station     1706.000 to Point/Station     1706.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.4800     Max loss rate(Fm)=     0.469(In/Hr)
Time of concentration =    20.86 min.
Rainfall intensity =      2.262(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.770
Subarea runoff =     24.075(CFS) for   16.120(Ac.)
Total runoff =     95.202(CFS)
Effective area this stream =       54.64(Ac.)
Total Study Area (Main Stream No. 1) =      913.64(Ac.)
Area averaged Fm value =    0.326(In/Hr)


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Process from Point/Station     1706.000 to Point/Station     1708.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   671.500(Ft.)
Downstream point/station elevation =   666.500(Ft.)
Pipe length  =   970.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    95.202(CFS)
Nearest computed pipe diameter  =     48.00(In.)
Calculated individual pipe flow  =    95.202(CFS)
Normal flow depth in pipe =   36.38(In.)
Flow top width inside pipe =   41.13(In.)
Critical Depth =   35.51(In.)
Pipe flow velocity =      9.31(Ft/s)
Travel time through pipe =    1.74 min.
Time of concentration (TC) =    22.59 min.


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Process from Point/Station     1708.000 to Point/Station     1708.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Time of concentration =    22.59 min.
Rainfall intensity =      2.156(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.787
Subarea runoff =     27.785(CFS) for   17.810(Ac.)
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Total runoff =    122.987(CFS)
Effective area this stream =       72.45(Ac.)
Total Study Area (Main Stream No. 1) =      931.45(Ac.)
Area averaged Fm value =    0.270(In/Hr)


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Process from Point/Station     1708.000 to Point/Station     1708.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =     72.450(Ac.)
Runoff from this stream =    122.987(CFS)
Time of concentration =   22.59 min.
Rainfall intensity =     2.156(In/Hr)
Area averaged loss rate (Fm) =    0.2700(In/Hr)
Area averaged Pervious ratio (Ap) = 0.2781


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Process from Point/Station     1710.000 to Point/Station     1711.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   787.000(Ft.)
Top (of initial area) elevation =   702.500(Ft.)
Bottom (of initial area) elevation =   698.500(Ft.)
Difference in elevation =     4.000(Ft.)
Slope =    0.00508  s(%)=       0.51
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.591 min.
Rainfall intensity =      3.062(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.871
Subarea runoff =     13.474(CFS)
Total initial stream area =        5.050(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


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Process from Point/Station     1711.000 to Point/Station     1712.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
________________________________________________________________________
Top of street segment elevation =   698.500(Ft.)
End of street segment elevation =   694.900(Ft.)
Length of street segment  =   239.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  30.000(Ft.)
Distance from crown to crossfall grade break  =  20.000(Ft.)
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Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     25.950(CFS)
Depth of flow =   0.485(Ft.), Average velocity =   3.892(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  17.907(Ft.)
Flow velocity =   3.89(Ft/s)
Travel time =    1.02 min.     TC =   13.61  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Rainfall intensity =      2.922(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.870
Subarea runoff =     24.831(CFS) for   10.020(Ac.)
Total runoff =     38.305(CFS)
Effective area this stream =       15.07(Ac.)
Total Study Area (Main Stream No. 1) =      946.52(Ac.)
Area averaged Fm value =    0.098(In/Hr)
Street flow at end of street =     38.305(CFS)
Half street flow at end of street =     19.153(CFS)
Depth of flow =   0.544(Ft.), Average velocity =   4.282(Ft/s)
Flow width (from curb towards crown)=  20.848(Ft.)


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Process from Point/Station     1712.000 to Point/Station     1714.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   688.900(Ft.)
Downstream point/station elevation =   684.300(Ft.)
Pipe length  =   723.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    38.305(CFS)
Nearest computed pipe diameter  =     33.00(In.)
Calculated individual pipe flow  =    38.305(CFS)
Normal flow depth in pipe =   24.66(In.)
Flow top width inside pipe =   28.69(In.)
Critical Depth =   24.72(In.)
Pipe flow velocity =      8.05(Ft/s)
Travel time through pipe =    1.50 min.
Time of concentration (TC) =    15.11 min.
```

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Process from Point/Station     1714.000 to Point/Station     1714.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Time of concentration =    15.11 min.
Rainfall intensity =      2.745(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.868
Subarea runoff =     50.169(CFS) for   22.070(Ac.)
Total runoff =     88.474(CFS)
Effective area this stream =       37.14(Ac.)
Total Study Area (Main Stream No. 1) =      968.59(Ac.)
Area averaged Fm value =    0.098(In/Hr)


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Process from Point/Station     1714.000 to Point/Station     1716.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
----------------------------------------------------------------------
Upstream point/station elevation =   684.300(Ft.)
Downstream point/station elevation =   681.800(Ft.)
Pipe length  =   689.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    88.474(CFS)
Nearest computed pipe diameter  =     51.00(In.)
Calculated individual pipe flow  =    88.474(CFS)
Normal flow depth in pipe =   36.80(In.)
Flow top width inside pipe =   45.72(In.)
Critical Depth =   33.67(In.)
Pipe flow velocity =      8.08(Ft/s)
Travel time through pipe =    1.42 min.
Time of concentration (TC) =    16.53 min.


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Process from Point/Station     1716.000 to Point/Station     1716.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.4700     Max loss rate(Fm)=     0.460(In/Hr)
Time of concentration =    16.53 min.
Rainfall intensity =      2.600(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.821
Subarea runoff =     35.433(CFS) for   20.890(Ac.)
Total runoff =    123.907(CFS)
Effective area this stream =       58.03(Ac.)
Total Study Area (Main Stream No. 1) =      989.48(Ac.)
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Area averaged Fm value =    0.228(In/Hr)


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Process from Point/Station     1716.000 to Point/Station     1708.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   681.800(Ft.)
Downstream point/station elevation =   666.500(Ft.)
Pipe length  =  1015.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   123.907(CFS)
Nearest computed pipe diameter  =     45.00(In.)
Calculated individual pipe flow  =   123.907(CFS)
Normal flow depth in pipe =   31.41(In.)
Flow top width inside pipe =   41.32(In.)
Critical Depth =   40.04(In.)
Pipe flow velocity =     15.04(Ft/s)
Travel time through pipe =    1.12 min.
Time of concentration (TC) =    17.66 min.


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Process from Point/Station     1708.000 to Point/Station     1708.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Time of concentration =    17.66 min.
Rainfall intensity =      2.500(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.831
Subarea runoff =     43.038(CFS) for   22.340(Ac.)
Total runoff =    166.945(CFS)
Effective area this stream =       80.37(Ac.)
Total Study Area (Main Stream No. 1) =     1011.82(Ac.)
Area averaged Fm value =    0.192(In/Hr)


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Process from Point/Station     1708.000 to Point/Station     1708.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 3
Stream flow area =     80.370(Ac.)
Runoff from this stream =    166.945(CFS)
Time of concentration =   17.66 min.
Rainfall intensity =     2.500(In/Hr)
Area averaged loss rate (Fm) =    0.1918(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1962
Summary of stream data:
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Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1    955.27   757.656     31.20    0.440      1.776
2    122.99    72.450     22.59    0.270      2.156
3    166.94    80.370     17.66    0.192      2.500
Qmax(1) =
         1.000 *    1.000 *   955.274) +
         0.799 *    1.000 *   122.987) +
         0.687 *    1.000 *   166.945) + =    1168.120
Qmax(2) =
         1.284 *    0.724 *   955.274) +
         1.000 *    1.000 *   122.987) +
         0.851 *    1.000 *   166.945) + =    1153.236
Qmax(3) =
         1.541 *    0.566 *   955.274) +
         1.182 *    0.782 *   122.987) +
         1.000 *    1.000 *   166.945) + =    1113.691

Total of 3 streams to confluence:
Flow rates before confluence point:
     955.274     122.987     166.945
Maximum flow rates at confluence using above data:
     1168.120     1153.236     1113.691
Area of streams before confluence:
      757.656       72.450       80.370
Effective area values after confluence:
      910.476      701.405      565.747
Results of confluence:
Total flow rate =   1168.120(CFS)
Time of concentration =    31.203 min.
Effective stream area after confluence =    910.476(Ac.)
Study area average Pervious fraction(Ap) =  0.446
Study area average soil loss rate(Fm) =    0.404(In/Hr)
Study area total (this main stream) =     910.48(Ac.)


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Process from Point/Station     1708.000 to Point/Station     1722.100
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   666.500(Ft.)
Downstream point/station elevation =   643.400(Ft.)
Pipe length  =  2500.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =  1168.120(CFS)
Nearest computed pipe diameter  =    108.00(In.)
Calculated individual pipe flow  =  1168.120(CFS)
Normal flow depth in pipe =   86.06(In.)
Flow top width inside pipe =   86.90(In.)
Critical Depth =   97.79(In.)
Pipe flow velocity =     21.50(Ft/s)
Travel time through pipe =    1.94 min.
Time of concentration (TC) =    33.14 min.
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Process from Point/Station     1708.000 to Point/Station     1722.100
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =    910.476(Ac.)
Runoff from this stream =   1168.120(CFS)
Time of concentration =   33.14 min.
Rainfall intensity =     1.713(In/Hr)
Area averaged loss rate (Fm) =    0.4043(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4459
Summary of stream data:

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


1   1168.12   910.476     33.14    0.404      1.713
Qmax(1) =
         1.000 *    1.000 *  1168.120) + =    1168.120

Total of 1 main streams to confluence:
Flow rates before confluence point:
    1169.120
Maximum flow rates at confluence using above data:
     1168.120
Area of streams before confluence:
      910.476
Effective area values after confluence:
      910.476


Results of confluence:
Total flow rate =   1168.120(CFS)
Time of concentration =    33.141 min.
Effective stream area after confluence  =    910.476(Ac.)
Study area average Pervious fraction(Ap) =  0.446
Study area average soil loss rate(Fm) =    0.404(In/Hr)
Study area total =     910.48(Ac.)


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Process from Point/Station      102.100 to Point/Station      102.200
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   550.000(Ft.)
Top (of initial area) elevation =   677.000(Ft.)
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Bottom (of initial area) elevation =   667.000(Ft.)
Difference in elevation =    10.000(Ft.)
Slope =    0.01818  s(%)=       1.82
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.455 min.
Rainfall intensity =      3.889(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.877
Subarea runoff =     33.778(CFS)
Total initial stream area =        9.900(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


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Process from Point/Station      102.200 to Point/Station      102.300
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
________________________________________________________________________
Top of street segment elevation =   667.000(Ft.)
End of street segment elevation =   655.000(Ft.)
Length of street segment  =  1850.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  22.000(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 [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     61.991(CFS)
Depth of flow =   0.710(Ft.), Average velocity =   3.799(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    2.15(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  22.000(Ft.)
Flow velocity =   3.80(Ft/s)
Travel time =    8.12 min.     TC =   16.57  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.338
Decimal fraction soil group B = 0.251
Decimal fraction soil group C = 0.411
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 53.23
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.077(In/Hr)
Rainfall intensity =      2.597(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.872
Subarea runoff =     56.306(CFS) for   29.900(Ac.)
Total runoff =     90.084(CFS)
Effective area this stream =       39.80(Ac.)
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Total Study Area (Main Stream No. 1) =     1051.62(Ac.)
Area averaged Fm value =    0.082(In/Hr)
Street flow at end of street =     90.084(CFS)
Half street flow at end of street =     45.042(CFS)
Depth of flow =   0.817(Ft.), Average velocity =   4.080(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    7.52(Ft.)
Flow width (from curb towards crown)=  22.000(Ft.)


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Process from Point/Station      102.300 to Point/Station      102.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   647.450(Ft.)
Downstream point/station elevation =   646.100(Ft.)
Pipe length  =  1340.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    90.084(CFS)
Nearest computed pipe diameter  =     63.00(In.)
Calculated individual pipe flow  =    90.084(CFS)
Normal flow depth in pipe =   49.31(In.)
Flow top width inside pipe =   51.96(In.)
Critical Depth =   31.84(In.)
Pipe flow velocity =      4.95(Ft/s)
Travel time through pipe =    4.51 min.
Time of concentration (TC) =    21.08 min.


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Process from Point/Station      102.300 to Point/Station      102.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.824
Decimal fraction soil group B = 0.020
Decimal fraction soil group C = 0.156
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 38.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.093(In/Hr)
Time of concentration =    21.08 min.
Rainfall intensity =      2.248(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.864
Subarea runoff =    136.990(CFS) for   77.100(Ac.)
Total runoff =    227.074(CFS)
Effective area this stream =      116.90(Ac.)
Total Study Area (Main Stream No. 1) =     1128.72(Ac.)
Area averaged Fm value =    0.089(In/Hr)


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Process from Point/Station      102.000 to Point/Station      101.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   646.100(Ft.)
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Downstream point/station elevation =   644.900(Ft.)
Pipe length  =  1190.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   227.074(CFS)
Nearest computed pipe diameter  =     90.00(In.)
Calculated individual pipe flow  =   227.074(CFS)
Normal flow depth in pipe =   68.81(In.)
Flow top width inside pipe =   76.37(In.)
Critical Depth =   46.34(In.)
Pipe flow velocity =      6.27(Ft/s)
Travel time through pipe =    3.16 min.
Time of concentration (TC) =    24.24 min.


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Process from Point/Station      102.000 to Point/Station      101.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 0.898
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.102
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 35.77
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.095(In/Hr)
Time of concentration =    24.24 min.
Rainfall intensity =      2.067(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.860
Subarea runoff =    130.562(CFS) for   84.300(Ac.)
Total runoff =    357.636(CFS)
Effective area this stream =      201.20(Ac.)
Total Study Area (Main Stream No. 1) =     1213.02(Ac.)
Area averaged Fm value =    0.092(In/Hr)


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Process from Point/Station      101.000 to Point/Station      100.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   644.900(Ft.)
Downstream point/station elevation =   643.630(Ft.)
Pipe length  =  1350.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   357.636(CFS)
Nearest computed pipe diameter  =    108.00(In.)
Calculated individual pipe flow  =   357.636(CFS)
Normal flow depth in pipe =   82.69(In.)
Flow top width inside pipe =   91.50(In.)
Critical Depth =   55.52(In.)
Pipe flow velocity =      6.84(Ft/s)
Travel time through pipe =    3.29 min.
Time of concentration (TC) =    27.53 min.


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Process from Point/Station      101.000 to Point/Station      100.000
**** SUBAREA FLOW ADDITION ****
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COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Time of concentration =    27.53 min.
Rainfall intensity =      1.915(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.856
Subarea runoff =     86.812(CFS) for   69.900(Ac.)
Total runoff =    444.448(CFS)
Effective area this stream =      271.10(Ac.)
Total Study Area (Main Stream No. 1) =     1282.92(Ac.)
Area averaged Fm value =    0.093(In/Hr)


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Process from Point/Station      101.000 to Point/Station      100.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =    271.100(Ac.)
Runoff from this stream =    444.448(CFS)
Time of concentration =   27.53 min.
Rainfall intensity =     1.915(In/Hr)
Area averaged loss rate (Fm) =    0.0934(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

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


1   1168.12   910.476     33.14    0.404      1.713
2    444.45   271.100     27.53    0.093      1.915
Qmax(1) =
         1.000 *    1.000 *  1168.120) +
         0.889 *    1.000 *   444.448) + =    1563.374
Qmax(2) =
         1.154 *    0.831 *  1168.120) +
         1.000 *    1.000 *   444.448) + =    1564.331

Total of 2 main streams to confluence:
Flow rates before confluence point:
    1169.120     445.448
Maximum flow rates at confluence using above data:
     1563.374     1564.331
Area of streams before confluence:
      910.476      271.100
Effective area values after confluence:
     1181.576     1027.480
```

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Results of confluence:
Total flow rate =   1564.331(CFS)
Time of concentration =    27.532 min.
Effective stream area after confluence  =   1027.480(Ac.)
Study area average Pervious fraction(Ap) =  0.366
Study area average soil loss rate(Fm) =    0.333(In/Hr)
Study area total =    1181.58(Ac.)


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Process from Point/Station     1722.100 to Point/Station     1722.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   643.400(Ft.)
Downstream point/station elevation =   642.200(Ft.)
Pipe length  =  1190.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =  1564.331(CFS)
Nearest computed pipe diameter  =    183.00(In.)
Calculated individual pipe flow  =  1564.331(CFS)
Normal flow depth in pipe =  144.75(In.)
Flow top width inside pipe =  148.82(In.)
Critical Depth =  102.22(In.)
Pipe flow velocity =     10.09(Ft/s)
Travel time through pipe =    1.97 min.
Time of concentration (TC) =    29.50 min.


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Process from Point/Station     1722.000 to Point/Station     1722.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =   1510.533(CFS)
therefore the upstream flow rate of Q =   1564.331(CFS) is being used
Time of concentration =    29.50 min.
Rainfall intensity =      1.837(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.745
Subarea runoff =      0.000(CFS) for   76.220(Ac.)
Total runoff =   1564.331(CFS)
Effective area this stream =     1103.70(Ac.)
Total Study Area (Main Stream No. 1) =     1359.14(Ac.)
Area averaged Fm value =    0.317(In/Hr)


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Process from Point/Station     1722.000 to Point/Station     1724.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
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Upstream point/station elevation =   649.400(Ft.)
Downstream point/station elevation =   643.000(Ft.)
Pipe length  =  1335.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =  1564.331(CFS)
Nearest computed pipe diameter  =    135.00(In.)
Calculated individual pipe flow  =  1564.331(CFS)
Normal flow depth in pipe =  110.44(In.)
Flow top width inside pipe =  104.17(In.)
Critical Depth =  110.43(In.)
Pipe flow velocity =     17.98(Ft/s)
Travel time through pipe =    1.24 min.
Time of concentration (TC) =    30.74 min.


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Process from Point/Station     1724.000 to Point/Station     1724.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 46.02
Pervious ratio(Ap) = 0.4300     Max loss rate(Fm)=     0.368(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =   1472.382(CFS)
therefore the upstream flow rate of Q =   1564.331(CFS) is being used
Time of concentration =    30.74 min.
Rainfall intensity =      1.793(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.741
Subarea runoff =      0.000(CFS) for    4.920(Ac.)
Total runoff =   1564.331(CFS)
Effective area this stream =     1108.62(Ac.)
Total Study Area (Main Stream No. 1) =     1364.06(Ac.)
Area averaged Fm value =    0.317(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1724.000 to Point/Station     1724.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =   1108.620(Ac.)
Runoff from this stream =   1564.331(CFS)
Time of concentration =   30.74 min.
Rainfall intensity =     1.793(In/Hr)
Area averaged loss rate (Fm) =    0.3169(In/Hr)
Area averaged Pervious ratio (Ap) = 0.3485


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1726.000 to Point/Station     1728.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 0.390
```

```
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.610
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 54.57
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.075(In/Hr)
Initial subarea data:
Initial area flow distance =   810.000(Ft.)
Top (of initial area) elevation =   685.000(Ft.)
Bottom (of initial area) elevation =   670.400(Ft.)
Difference in elevation =    14.600(Ft.)
Slope =    0.01802  s(%)=       1.80
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.888 min.
Rainfall intensity =      3.540(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.881
Subarea runoff =     23.450(CFS)
Total initial stream area =        7.520(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.075(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1728.000 to Point/Station     1730.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
________________________________________________________________________
Top of street segment elevation =   670.400(Ft.)
End of street segment elevation =   665.200(Ft.)
Length of street segment  =   541.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  30.000(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 [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     30.983(CFS)
Depth of flow =   0.546(Ft.), Average velocity =   3.431(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  20.949(Ft.)
Flow velocity =   3.43(Ft/s)
Travel time =    2.63 min.     TC =   12.52  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.330
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.670
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 56.79
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.072(In/Hr)
Rainfall intensity =      3.073(In/Hr) for a   100.0 year storm
```

```
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.878
Subarea runoff =     14.963(CFS) for    6.710(Ac.)
Total runoff =     38.413(CFS)
Effective area this stream =       14.23(Ac.)
Total Study Area (Main Stream No. 1) =     1378.29(Ac.)
Area averaged Fm value =    0.074(In/Hr)
Street flow at end of street =     38.413(CFS)
Half street flow at end of street =     19.206(CFS)
Depth of flow =   0.582(Ft.), Average velocity =   3.617(Ft/s)
Flow width (from curb towards crown)=  22.766(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1730.000 to Point/Station     1730.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 70.23
Pervious ratio(Ap) = 0.4700     Max loss rate(Fm)=     0.249(In/Hr)
Time of concentration =    12.52 min.
Rainfall intensity =      3.073(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.871
Subarea runoff =      5.644(CFS) for    2.220(Ac.)
Total runoff =     44.057(CFS)
Effective area this stream =       16.45(Ac.)
Total Study Area (Main Stream No. 1) =     1380.51(Ac.)
Area averaged Fm value =    0.097(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1730.000 to Point/Station     1730.000
**** 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 = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 69.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.055(In/Hr)
Time of concentration =    12.52 min.
Rainfall intensity =      3.073(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.876
Subarea runoff =     28.633(CFS) for   10.540(Ac.)
Total runoff =     72.690(CFS)
Effective area this stream =       26.99(Ac.)
Total Study Area (Main Stream No. 1) =     1391.05(Ac.)
Area averaged Fm value =    0.081(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1730.000 to Point/Station     1732.000
```

```
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   661.450(Ft.)
Downstream point/station elevation =   656.790(Ft.)
Pipe length  =   491.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    72.690(CFS)
Nearest computed pipe diameter  =     39.00(In.)
Calculated individual pipe flow  =    72.690(CFS)
Normal flow depth in pipe =   29.02(In.)
Flow top width inside pipe =   34.04(In.)
Critical Depth =   32.39(In.)
Pipe flow velocity =     10.98(Ft/s)
Travel time through pipe =    0.75 min.
Time of concentration (TC) =    13.26 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1732.000 to Point/Station     1732.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 0.320
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.680
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 57.16
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.072(In/Hr)
Time of concentration =    13.26 min.
Rainfall intensity =      2.968(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.876
Subarea runoff =     34.315(CFS) for   14.140(Ac.)
Total runoff =    107.005(CFS)
Effective area this stream =       41.13(Ac.)
Total Study Area (Main Stream No. 1) =     1405.19(Ac.)
Area averaged Fm value =    0.078(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1732.000 to Point/Station     1732.000
**** 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 = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 69.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.055(In/Hr)
Time of concentration =    13.26 min.
Rainfall intensity =      2.968(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.877
Subarea runoff =     19.169(CFS) for    7.310(Ac.)
Total runoff =    126.173(CFS)
Effective area this stream =       48.44(Ac.)
```

```
Total Study Area (Main Stream No. 1) =     1412.50(Ac.)
Area averaged Fm value =    0.074(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1732.000 to Point/Station     1734.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   656.790(Ft.)
Downstream point/station elevation =   652.050(Ft.)
Pipe length  =   511.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   126.173(CFS)
Nearest computed pipe diameter  =     48.00(In.)
Calculated individual pipe flow  =   126.173(CFS)
Normal flow depth in pipe =   36.00(In.)
Flow top width inside pipe =   41.57(In.)
Critical Depth =   40.43(In.)
Pipe flow velocity =     12.48(Ft/s)
Travel time through pipe =    0.68 min.
Time of concentration (TC) =    13.94 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1734.000 to Point/Station     1734.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.580
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.420
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 47.54
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.084(In/Hr)
Time of concentration =    13.94 min.
Rainfall intensity =      2.880(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.876
Subarea runoff =     32.530(CFS) for   14.450(Ac.)
Total runoff =    158.703(CFS)
Effective area this stream =       62.89(Ac.)
Total Study Area (Main Stream No. 1) =     1426.95(Ac.)
Area averaged Fm value =    0.076(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1734.000 to Point/Station     1734.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 70.22
Pervious ratio(Ap) = 0.4700     Max loss rate(Fm)=     0.249(In/Hr)
Time of concentration =    13.94 min.
Rainfall intensity =      2.880(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.873
```

```
Subarea runoff =      8.053(CFS) for    3.400(Ac.)
Total runoff =    166.757(CFS)
Effective area this stream =       66.29(Ac.)
Total Study Area (Main Stream No. 1) =     1430.35(Ac.)
Area averaged Fm value =    0.085(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1734.000 to Point/Station     1734.000
**** 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 = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 69.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.055(In/Hr)
Time of concentration =    13.94 min.
Rainfall intensity =      2.880(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.874
Subarea runoff =     19.123(CFS) for    7.520(Ac.)
Total runoff =    185.880(CFS)
Effective area this stream =       73.81(Ac.)
Total Study Area (Main Stream No. 1) =     1437.87(Ac.)
Area averaged Fm value =    0.082(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1734.000 to Point/Station     1736.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   652.050(Ft.)
Downstream point/station elevation =   648.150(Ft.)
Pipe length  =   412.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   185.880(CFS)
Nearest computed pipe diameter  =     54.00(In.)
Calculated individual pipe flow  =   185.880(CFS)
Normal flow depth in pipe =   42.94(In.)
Flow top width inside pipe =   43.59(In.)
Critical Depth =   47.21(In.)
Pipe flow velocity =     13.71(Ft/s)
Travel time through pipe =    0.50 min.
Time of concentration (TC) =    14.44 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1736.000 to Point/Station     1736.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.630
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.370
Decimal fraction soil group D = 0.000
```

```
SCS curve number for soil(AMC 2)  = 45.69
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.086(In/Hr)
Time of concentration =    14.44 min.
Rainfall intensity =      2.820(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.874
Subarea runoff =     24.682(CFS) for   11.660(Ac.)
Total runoff =    210.562(CFS)
Effective area this stream =       85.47(Ac.)
Total Study Area (Main Stream No. 1) =     1449.53(Ac.)
Area averaged Fm value =    0.083(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1736.000 to Point/Station     1736.000
**** 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 = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 69.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.055(In/Hr)
Time of concentration =    14.44 min.
Rainfall intensity =      2.820(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.874
Subarea runoff =     12.842(CFS) for    5.160(Ac.)
Total runoff =    223.404(CFS)
Effective area this stream =       90.63(Ac.)
Total Study Area (Main Stream No. 1) =     1454.69(Ac.)
Area averaged Fm value =    0.081(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1736.000 to Point/Station     1724.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   648.150(Ft.)
Downstream point/station elevation =   643.000(Ft.)
Pipe length  =   481.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   223.404(CFS)
Nearest computed pipe diameter  =     57.00(In.)
Calculated individual pipe flow  =   223.404(CFS)
Normal flow depth in pipe =   44.34(In.)
Flow top width inside pipe =   47.38(In.)
Critical Depth =   50.72(In.)
Pipe flow velocity =     15.09(Ft/s)
Travel time through pipe =    0.53 min.
Time of concentration (TC) =    14.98 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1724.000 to Point/Station     1724.000
**** SUBAREA FLOW ADDITION ****
```

```
COMMERCIAL subarea type
Decimal fraction soil group A = 0.600
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.400
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 46.80
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.085(In/Hr)
Time of concentration =    14.98 min.
Rainfall intensity =      2.760(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.873
Subarea runoff =     19.409(CFS) for   10.110(Ac.)
Total runoff =    242.813(CFS)
Effective area this stream =      100.74(Ac.)
Total Study Area (Main Stream No. 1) =     1464.80(Ac.)
Area averaged Fm value =    0.081(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1724.000 to Point/Station     1724.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 70.21
Pervious ratio(Ap) = 0.4600     Max loss rate(Fm)=     0.243(In/Hr)
Time of concentration =    14.98 min.
Rainfall intensity =      2.760(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.872
Subarea runoff =      6.250(CFS) for    2.760(Ac.)
Total runoff =    249.063(CFS)
Effective area this stream =      103.50(Ac.)
Total Study Area (Main Stream No. 1) =     1467.56(Ac.)
Area averaged Fm value =    0.086(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1724.000 to Point/Station     1724.000
**** 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 = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 69.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.055(In/Hr)
Time of concentration =    14.98 min.
Rainfall intensity =      2.760(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.873
Subarea runoff =     14.289(CFS) for    5.870(Ac.)
Total runoff =    263.352(CFS)
Effective area this stream =      109.37(Ac.)
```

```
Total Study Area (Main Stream No. 1) =     1473.43(Ac.)
Area averaged Fm value =    0.084(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1724.000 to Point/Station     1724.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =    109.370(Ac.)
Runoff from this stream =    263.352(CFS)
Time of concentration =   14.98 min.
Rainfall intensity =     2.760(In/Hr)
Area averaged loss rate (Fm) =    0.0841(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1281
Summary of stream data:

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


1   1564.33  1108.620     30.74    0.317      1.793
2    263.35   109.370     14.98    0.084      2.760
Qmax(1) =
         1.000 *    1.000 *  1564.331) +
         0.639 *    1.000 *   263.352) + =    1732.505
Qmax(2) =
         1.655 *    0.487 *  1564.331) +
         1.000 *    1.000 *   263.352) + =    1525.003

Total of 2 streams to confluence:
Flow rates before confluence point:
    1564.331     263.352
Maximum flow rates at confluence using above data:
     1732.505     1525.003
Area of streams before confluence:
     1108.620      109.370
Effective area values after confluence:
     1217.990      649.541
Results of confluence:
Total flow rate =   1732.505(CFS)
Time of concentration =    30.735 min.
Effective stream area after confluence =   1217.990(Ac.)
Study area average Pervious fraction(Ap) =  0.329
Study area average soil loss rate(Fm) =    0.296(In/Hr)
Study area total (this main stream) =    1217.99(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1724.000 to Point/Station     1738.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   643.000(Ft.)
Downstream point/station elevation =   641.900(Ft.)
Pipe length  =   784.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =  1732.505(CFS)
```

```
Nearest computed pipe diameter  =    177.00(In.)
Calculated individual pipe flow  =  1732.505(CFS)
Normal flow depth in pipe =  143.81(In.)
Flow top width inside pipe =  138.17(In.)
Critical Depth =  108.83(In.)
Pipe flow velocity =     11.65(Ft/s)
Travel time through pipe =    1.12 min.
Time of concentration (TC) =    31.86 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1738.000 to Point/Station     1738.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 70.02
Pervious ratio(Ap) = 0.4100     Max loss rate(Fm)=     0.218(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =   1602.926(CFS)
therefore the upstream flow rate of Q =   1732.505(CFS) is being used
Time of concentration =    31.86 min.
Rainfall intensity =      1.754(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.748
Subarea runoff =      0.000(CFS) for    3.020(Ac.)
Total runoff =   1732.505(CFS)
Effective area this stream =     1221.01(Ac.)
Total Study Area (Main Stream No. 1) =     1476.45(Ac.)
Area averaged Fm value =    0.296(In/Hr)
End of computations, Total Study Area =         1476.45 (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) = 0.345
Area averaged SCS curve number =  39.9
```

APPENDIX B – 100 YEAR HYDROLOGY CALCULATIONS FOR AREA XIII

```
**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
         (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
        (c) Copyright 1983-2011 Advanced Engineering Software (aes)
            Ver. 18.0  Release Date: 07/01/2011  License ID 1239

                          Analysis prepared by:

                          HUNSAKER & ASSOCIATES
                                Irvine,Inc
                      Planning * Engineering * Surveying
           Three Hughes * Irvine, California 92618 * (949)583-1010

 ************************* DESCRIPTION OF STUDY *************************
* W.O. #915-1, ONTARIO MPD                                              *
* 100-YR STUDY                                                          *
* GROVE AVE. AREA 'B'                                                   *
 ************************************************************************

  FILE NAME: GROVE_M.DAT
  TIME/DATE OF STUDY: 13:01 08/09/2011
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2000

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

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-   / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  ========  ================  ======  ===== ====== ===== =======
  1   65.0     60.0    0.020/0.020/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   54.0     49.0    0.020/0.020/0.020   0.67    2.00 0.0312 0.167 0.0150
  3   47.0     42.0    0.020/0.020/0.020   0.67    2.00 0.0312 0.167 0.0150
  4   42.0     37.0    0.020/0.020/0.020   0.67    2.00 0.0312 0.167 0.0150
  5   38.0     33.0    0.020/0.020/0.020   0.67    2.00 0.0312 0.167 0.0150
  6   32.0     27.0    0.020/0.020/0.020   0.67    2.00 0.0312 0.167 0.0150
  7   24.0     19.0    0.020/0.020/0.020   0.67    2.00 0.0312 0.167 0.0150
  8   20.0     15.0    0.020/0.020/0.020   0.67    2.00 0.0312 0.167 0.0150
  9   18.0     13.0    0.020/0.020/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

  UNIT-HYDROGRAPH MODEL SELECTIONS/PARAMETERS:
    WATERSHED LAG = 0.80 * Tc
    USED "VALLEY UNDEVELOPED" S-GRAPH FOR DEVELOPMENTS OF
    2 UNITS/ACRE AND LESS; AND "VALLEY DEVELOPED" S-GRAPH
    FOR DEVELOPMENTS OF 3-4 UNITS/ACRE AND MORE.
    SIERRA MADRE DEPTH-AREA FACTORS USED.
                      AREA-AVERAGED
         DURATION    RAINFALL(INCH)
         5-MINUTES         0.44
        30-MINUTES         0.91
         1-HOUR            1.20
         3-HOUR            2.10
         6-HOUR            3.00
        24-HOUR            6.00
 *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR UNIT HYDROGRAPH METHOD*


**************************************************************************
  FLOW PROCESS FROM NODE     60.00 TO NODE     61.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   912.00
  ELEVATION DATA: UPSTREAM(FEET) =    780.00  DOWNSTREAM(FEET) =    770.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   14.654
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.796
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       C       10.00      0.57     0.500    69   14.65
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.57
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.500
  SUBAREA RUNOFF(CFS) =     22.62
  TOTAL AREA(ACRES) =     10.00   PEAK FLOW RATE(CFS) =     22.62

**************************************************************************
  FLOW PROCESS FROM NODE     61.00 TO NODE     62.00 IS CODE =  62
--------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  9 USED)<<<<<
==========================================================================
  UPSTREAM ELEVATION(FEET) =  770.00  DOWNSTREAM ELEVATION(FEET) =  750.00
  STREET LENGTH(FEET) =  1838.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 18.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  13.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020
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 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      40.94
   ***STREET FLOWING FULL***
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.60
   HALFSTREET FLOOD WIDTH(FEET) =   18.00
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.22
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.52
 STREET FLOW TRAVEL TIME(MIN.) =   7.25   Tc(MIN.) =   21.91
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.196
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "5-7 DWELLINGS/ACRE"       A       19.20      0.98     0.500    32
 RESIDENTIAL
 "5-7 DWELLINGS/ACRE"       C        3.80      0.57     0.500    69
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.91
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.500
 SUBAREA AREA(ACRES) =   23.00      SUBAREA RUNOFF(CFS) =   36.07
 EFFECTIVE AREA(ACRES) =     33.00    AREA-AVERAGED Fm(INCH/HR) =  0.40
 AREA-AVERAGED Fp(INCH/HR) =  0.80  AREA-AVERAGED Ap =  0.50
 TOTAL AREA(ACRES) =       33.0        PEAK FLOW RATE(CFS) =      53.30

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.64   HALFSTREET FLOOD WIDTH(FEET) =  18.00
 FLOW VELOCITY(FEET/SEC.) =  4.67   DEPTH*VELOCITY(FT*FT/SEC.) =   3.01
 LONGEST FLOWPATH FROM NODE     60.00 TO NODE     62.00 =    2750.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     62.00 TO NODE     63.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   750.00  DOWNSTREAM(FEET) =   748.00
 FLOW LENGTH(FEET) =  1318.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  51.0 INCH PIPE IS  36.3 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   4.94
 ESTIMATED PIPE DIAMETER(INCH) =  51.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      53.30
 PIPE TRAVEL TIME(MIN.) =   4.45    Tc(MIN.) =   26.35
 LONGEST FLOWPATH FROM NODE     60.00 TO NODE     63.00 =    4068.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     63.00 TO NODE     63.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =   26.35
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.966
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"       A       18.90      0.98     0.200    32
 RESIDENTIAL
 "5-7 DWELLINGS/ACRE"       A       13.40      0.98     0.500    32
 RESIDENTIAL
 "5-7 DWELLINGS/ACRE"       C        5.50      0.57     0.500    69
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.89
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
 SUBAREA AREA(ACRES) =   37.80      SUBAREA RUNOFF(CFS) =   56.29
 EFFECTIVE AREA(ACRES) =     70.80   AREA-AVERAGED Fm(INCH/HR) =  0.35
 AREA-AVERAGED Fp(INCH/HR) =  0.84  AREA-AVERAGED Ap =  0.42
 TOTAL AREA(ACRES) =       70.8       PEAK FLOW RATE(CFS) =     102.74

****************************************************************************
 FLOW PROCESS FROM NODE     63.00 TO NODE     63.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =   26.35
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.966
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 A        9.00      0.98     0.100    32
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"       A       42.10      0.98     0.200    32
 RESIDENTIAL
 "5-7 DWELLINGS/ACRE"       A       26.30      0.98     0.500    32
 COMMERCIAL                 C        0.90      0.57     0.100    69
 RESIDENTIAL
 "5-7 DWELLINGS/ACRE"       C        3.80      0.57     0.500    69
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.94
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.298
 SUBAREA AREA(ACRES) =   82.10      SUBAREA RUNOFF(CFS) =  124.54
 EFFECTIVE AREA(ACRES) =    152.90   AREA-AVERAGED Fm(INCH/HR) =  0.31
 AREA-AVERAGED Fp(INCH/HR) =  0.89  AREA-AVERAGED Ap =  0.35
 TOTAL AREA(ACRES) =      152.9       PEAK FLOW RATE(CFS) =     227.27

****************************************************************************
 FLOW PROCESS FROM NODE     63.00 TO NODE     63.00 IS CODE =  16
----------------------------------------------------------------------------
 >>>>>USER SPECIFIED CONSTANT SOURCE FLOW AT NODE<<<<<
============================================================================
 USER-SPECIFIED CONSTANT SOURCE FLOW =   300.00(CFS)
 USER-SPECIFIED AREA ASSOCIATED TO SOURCE FLOW =   248.90(ACRES)
 * CUMULATIVE SOURCE FLOW DATA: FLOW(CFS) =   300.00  AREA(AC.) =   248.90
 * SUMMED DATA: FLOW(CFS) =   527.27    TOTAL AREA(ACRES) =   401.80

****************************************************************************
 FLOW PROCESS FROM NODE     63.00 TO NODE     65.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
```

```
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   748.00  DOWNSTREAM(FEET) =   720.00
  FLOW LENGTH(FEET) =  2635.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  81.0 INCH PIPE IS  61.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  18.00
  ESTIMATED PIPE DIAMETER(INCH) =  81.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     527.27
  PIPE TRAVEL TIME(MIN.) =   2.44    Tc(MIN.) =   28.79
  * TOTAL SOURCE FLOW(CFS) =     300.00
  LONGEST FLOWPATH FROM NODE     60.00 TO NODE     65.00 =    6703.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     65.00 TO NODE     65.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==========================================================================
  MAINLINE Tc(MIN.) =   28.79
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.864
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        9.80      0.98     0.100    32
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"       A       26.50      0.98     0.200    32
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       A       15.30      0.98     0.500    32
  PUBLIC PARK                A        4.80      0.98     0.850    32
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"       C        0.50      0.57     0.200    69
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       C        8.40      0.57     0.500    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.90
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.342
  SUBAREA AREA(ACRES) =   65.30      SUBAREA RUNOFF(CFS) =   91.57
  EFFECTIVE AREA(ACRES) =    218.20   AREA-AVERAGED Fm(INCH/HR) =  0.31
  AREA-AVERAGED Fp(INCH/HR) =  0.89  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =      218.2       PEAK FLOW RATE(CFS) =     304.84

  * SOURCE FLOW DATA: FLOW(CFS) =     300.00     AREA(ACRES) =      248.9
  * SUMMED DATA: FLOW(CFS) =     604.84    TOTAL AREA(ACRES) =      467.1

****************************************************************************
  FLOW PROCESS FROM NODE     65.00 TO NODE     65.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==========================================================================
  MAINLINE Tc(MIN.) =   28.79
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.864
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"       A       36.90      0.98     0.200    32
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       A       17.00      0.98     0.500    32
  PUBLIC PARK                A        5.10      0.98     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.97
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.343
  SUBAREA AREA(ACRES) =   59.00      SUBAREA RUNOFF(CFS) =   81.25
  EFFECTIVE AREA(ACRES) =    277.20   AREA-AVERAGED Fm(INCH/HR) =  0.32
  AREA-AVERAGED Fp(INCH/HR) =  0.91  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =      277.2       PEAK FLOW RATE(CFS) =     386.09

  * SOURCE FLOW DATA: FLOW(CFS) =     300.00     AREA(ACRES) =      248.9
  * SUMMED DATA: FLOW(CFS) =     686.09    TOTAL AREA(ACRES) =      526.1

****************************************************************************
  FLOW PROCESS FROM NODE     65.00 TO NODE     66.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   720.00  DOWNSTREAM(FEET) =   695.00
  FLOW LENGTH(FEET) =  2650.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  90.0 INCH PIPE IS  71.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  18.25
  ESTIMATED PIPE DIAMETER(INCH) =  90.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     686.09
  PIPE TRAVEL TIME(MIN.) =   2.42    Tc(MIN.) =   31.21
  * TOTAL SOURCE FLOW(CFS) =     300.00
  LONGEST FLOWPATH FROM NODE     60.00 TO NODE     66.00 =    9353.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     66.00 TO NODE     66.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==========================================================================
  MAINLINE Tc(MIN.) =   31.21
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.776
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        8.50      0.98     0.100    32
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"       A       14.90      0.98     0.200    32
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       A       19.50      0.98     0.500    32
  PUBLIC PARK                A        4.60      0.98     0.850    32
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"       C       22.20      0.57     0.200    69
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       C        9.30      0.57     0.500    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.84
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.336
  SUBAREA AREA(ACRES) =   79.00      SUBAREA RUNOFF(CFS) =  106.30
  EFFECTIVE AREA(ACRES) =    356.20   AREA-AVERAGED Fm(INCH/HR) =  0.31
  AREA-AVERAGED Fp(INCH/HR) =  0.89  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =      356.2       PEAK FLOW RATE(CFS) =     470.41

  * SOURCE FLOW DATA: FLOW(CFS) =     300.00     AREA(ACRES) =      248.9
  * SUMMED DATA: FLOW(CFS) =     770.41    TOTAL AREA(ACRES) =      605.1
```

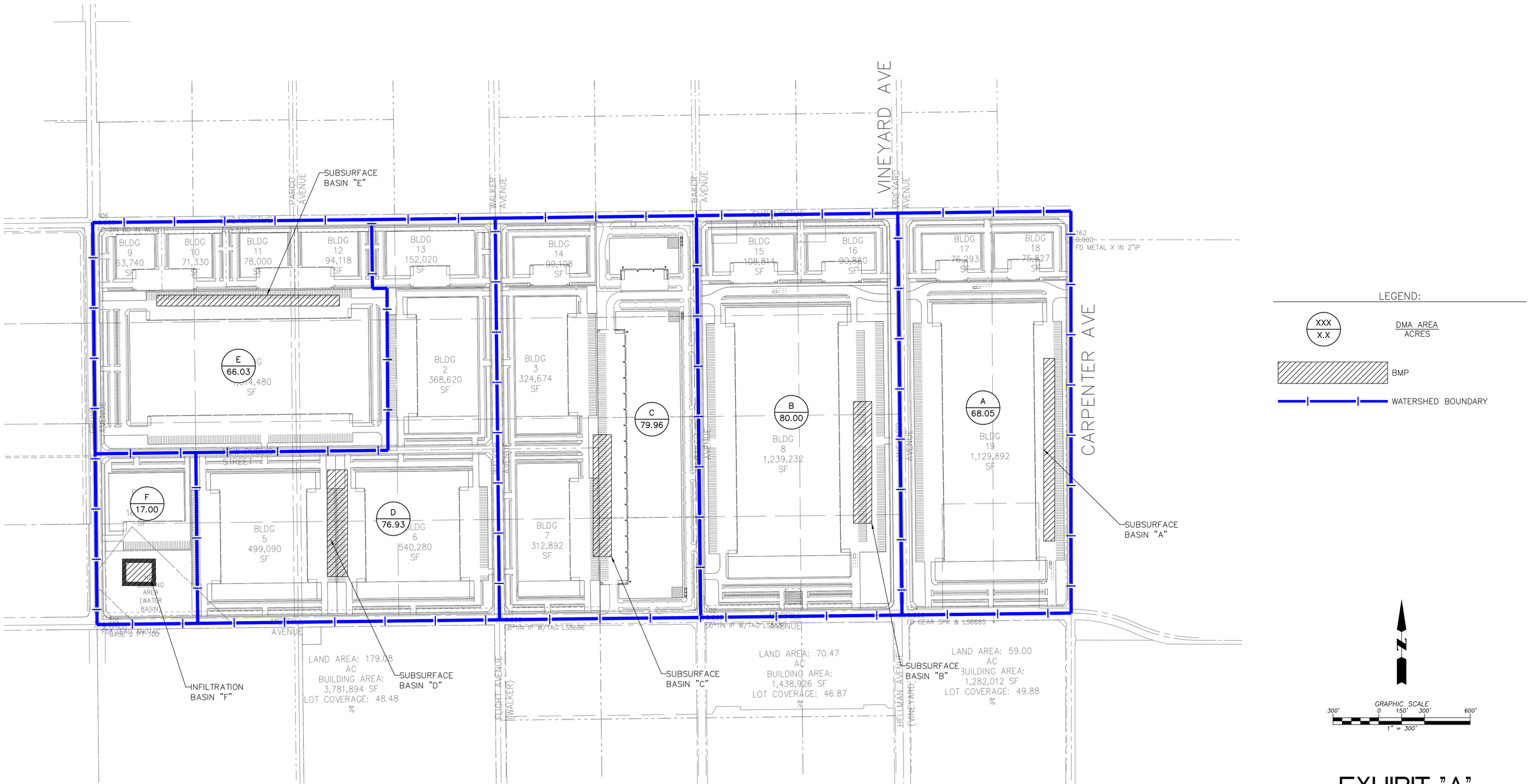
```
****************************************************************************
  FLOW PROCESS FROM NODE     66.00 TO NODE     66.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   31.21
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.776
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE           GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                A        8.40      0.98     0.100    32
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"      A       19.30      0.98     0.200    32
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"      A       26.00      0.98     0.500    32
  PUBLIC PARK               A        3.20      0.98     0.850    32
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"      C       19.00      0.57     0.200    69
  PUBLIC PARK               C        2.10      0.57     0.850    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.89
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.333
  SUBAREA AREA(ACRES) =   78.00      SUBAREA RUNOFF(CFS) =  103.92
  EFFECTIVE AREA(ACRES) =    434.20   AREA-AVERAGED Fm(INCH/HR) =  0.31
  AREA-AVERAGED Fp(INCH/HR) =  0.89  AREA-AVERAGED Ap =  0.34
  TOTAL AREA(ACRES) =      434.2       PEAK FLOW RATE(CFS) =     574.33

  * SOURCE FLOW DATA: FLOW(CFS) =     300.00     AREA(ACRES) =      248.9
  * SUMMED DATA: FLOW(CFS) =     874.33    TOTAL AREA(ACRES) =      683.1

****************************************************************************
  FLOW PROCESS FROM NODE     66.00 TO NODE     67.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   695.00  DOWNSTREAM(FEET) =   673.50
  FLOW LENGTH(FEET) =  2642.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN 102.0 INCH PIPE IS  79.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  18.40
  ESTIMATED PIPE DIAMETER(INCH) = 102.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     874.33
  PIPE TRAVEL TIME(MIN.) =   2.39    Tc(MIN.) =   33.61
  * TOTAL SOURCE FLOW(CFS) =     300.00
  LONGEST FLOWPATH FROM NODE     60.00 TO NODE     67.00 =   11995.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     67.00 TO NODE     67.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   33.61
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.699
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE           GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                A       15.70      0.98     0.100    32
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"      A       32.60      0.98     0.200    32
  PUBLIC PARK               A       10.70      0.98     0.850    32
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"      C       10.40      0.57     0.200    69
  PUBLIC PARK               C       11.40      0.57     0.850    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.81
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.358
  SUBAREA AREA(ACRES) =   80.80      SUBAREA RUNOFF(CFS) =  102.48
  EFFECTIVE AREA(ACRES) =    515.00   AREA-AVERAGED Fm(INCH/HR) =  0.30
  AREA-AVERAGED Fp(INCH/HR) =  0.88  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =      515.0       PEAK FLOW RATE(CFS) =     646.72

  * SOURCE FLOW DATA: FLOW(CFS) =     300.00     AREA(ACRES) =      248.9
  * SUMMED DATA: FLOW(CFS) =     946.72    TOTAL AREA(ACRES) =      763.9

****************************************************************************
  FLOW PROCESS FROM NODE     67.00 TO NODE     67.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   33.61
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.699
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE           GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                A       16.90      0.98     0.100    32
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"      A       50.60      0.98     0.200    32
  PUBLIC PARK               A       12.90      0.98     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.283
  SUBAREA AREA(ACRES) =   80.40      SUBAREA RUNOFF(CFS) =  102.96
  EFFECTIVE AREA(ACRES) =    595.40   AREA-AVERAGED Fm(INCH/HR) =  0.30
  AREA-AVERAGED Fp(INCH/HR) =  0.89  AREA-AVERAGED Ap =  0.34
  TOTAL AREA(ACRES) =      595.4       PEAK FLOW RATE(CFS) =     749.69

  * SOURCE FLOW DATA: FLOW(CFS) =     300.00     AREA(ACRES) =      248.9
  * SUMMED DATA: FLOW(CFS) =    1049.69    TOTAL AREA(ACRES) =      844.3

****************************************************************************
  FLOW PROCESS FROM NODE     67.00 TO NODE     68.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   673.50  DOWNSTREAM(FEET) =   655.90
  FLOW LENGTH(FEET) =  2641.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN 114.0 INCH PIPE IS  87.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  17.92
  ESTIMATED PIPE DIAMETER(INCH) = 114.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =    1049.69
  PIPE TRAVEL TIME(MIN.) =   2.46    Tc(MIN.) =   36.06
  * TOTAL SOURCE FLOW(CFS) =     300.00
  LONGEST FLOWPATH FROM NODE     60.00 TO NODE     68.00 =   14636.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE     68.00 TO NODE     68.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   36.06
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.629
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"       A       16.00      0.98     0.200    32
  COMMERCIAL                 B        5.00      0.75     0.100    56
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"       C       16.90      0.57     0.200    69
  COMMERCIAL                 C       19.60      0.57     0.100    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.72
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.157
  SUBAREA AREA(ACRES) =   57.50      SUBAREA RUNOFF(CFS) =   78.42
  EFFECTIVE AREA(ACRES) =    652.90   AREA-AVERAGED Fm(INCH/HR) =  0.28
  AREA-AVERAGED Fp(INCH/HR) =  0.88  AREA-AVERAGED Ap =  0.32
  TOTAL AREA(ACRES) =      652.9       PEAK FLOW RATE(CFS) =     790.37

  * SOURCE FLOW DATA: FLOW(CFS) =     300.00     AREA(ACRES) =      248.9
  * SUMMED DATA: FLOW(CFS) =    1090.37    TOTAL AREA(ACRES) =      901.8

****************************************************************************
  FLOW PROCESS FROM NODE     68.00 TO NODE     68.00 IS CODE =  71
----------------------------------------------------------------------------
  >>>>>PEAK FLOW RATE ESTIMATOR CHANGED TO UNIT-HYDROGRAPH METHOD<<<<<
  >>>>>USING TIME-OF-CONCENTRATION OF LONGEST FLOWPATH<<<<<
============================================================================
  UNIT-HYDROGRAPH DATA:
  RAINFALL(INCH): 5M= 0.44;30M= 0.91;1H= 1.20;3H= 2.10;6H= 3.00;24H= 6.00
  S-GRAPH: VALLEY(DEV.)=100.0%;VALLEY(UNDEV.)/DESERT=  0.0%
           MOUNTAIN=  0.0%;FOOTHILL=  0.0%;DESERT(UNDEV.)=  0.0%
  Tc(HR) = 0.60; LAG(HR) = 0.48; Fm(INCH/HR) = 0.28; Ybar = 0.31
  USED SIERRA MADRE DEPTH-AREA CURVES WITH AMC  II CONDITION.
  DEPTH-AREA FACTORS: 5M = 0.97; 30M = 0.97; 1HR = 0.97;
  3HR = 1.00; 6HR = 1.00; 24HR= 1.00
  UNIT-INTERVAL(MIN) =  5.00   TOTAL AREA(ACRES) =      652.9
  LONGEST FLOWPATH FROM NODE     60.00 TO NODE     68.00 =   14636.00 FEET.
   EQUIVALENT BASIN FACTOR APPROXIMATIONS:
   Lca/L=0.3,n=.0300; Lca/L=0.4,n=.0269; Lca/L=0.5,n=.0247;Lca/L=0.6,n=.0231
  TIME OF PEAK FLOW(HR) = 16.50  RUNOFF VOLUME(AF) =     232.33
  UNIT-HYDROGRAPH METHOD PEAK FLOW RATE(CFS) =    854.97
  TOTAL PEAK FLOW RATE(CFS) =   1154.97 (SOURCE FLOW INCLUDED)
  RATIONAL METHOD PEAK FLOW RATE(CFS) =   1090.37
   (UPSTREAM NODE PEAK FLOW RATE(CFS) =   1090.37)
  PEAK FLOW RATE(CFS) USED =   1154.97
  TOTAL SOURCE FLOW(CFS) =     300.00
  TOTAL AREA ASSOCIATED TO SOURCE FLOW(ACRES) =      248.9

****************************************************************************
  FLOW PROCESS FROM NODE     68.00 TO NODE     68.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   36.06
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.629
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A       17.60      0.98     0.100    32
  COMMERCIAL                 B        8.50      0.75     0.100    56
  COMMERCIAL                 C       14.80      0.57     0.100    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.78
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =   40.90
  UNIT-HYDROGRAPH DATA:
  RAINFALL(INCH): 5M= 0.44;30M= 0.91;1H= 1.20;3H= 2.10;6H= 3.00;24H= 6.00
  S-GRAPH: VALLEY(DEV.)=100.0%;VALLEY(UNDEV.)/DESERT=  0.0%
           MOUNTAIN=  0.0%;FOOTHILL=  0.0%;DESERT(UNDEV.)=  0.0%
  Tc(HR) = 0.60; LAG(HR) = 0.48; Fm(INCH/HR) = 0.27; Ybar = 0.30
  USED SIERRA MADRE DEPTH-AREA CURVES WITH AMC  II CONDITION.
  DEPTH-AREA FACTORS: 5M = 0.97; 30M = 0.97; 1HR = 0.97;
  3HR = 1.00; 6HR = 1.00; 24HR= 1.00
  UNIT-INTERVAL(MIN) =  5.00   TOTAL AREA(ACRES) =      693.8
  LONGEST FLOWPATH FROM NODE     60.00 TO NODE     68.00 =   14636.00 FEET.
   EQUIVALENT BASIN FACTOR APPROXIMATIONS:
   Lca/L=0.3,n=.0300; Lca/L=0.4,n=.0269; Lca/L=0.5,n=.0247;Lca/L=0.6,n=.0231
  TIME OF PEAK FLOW(HR) = 16.50  RUNOFF VOLUME(AF) =     250.59
  UNIT-HYDROGRAPH PEAK FLOW RATE(CFS) =     913.69
  TOTAL AREA(ACRES) =      693.8       PEAK FLOW RATE(CFS) =     913.69

  * SOURCE FLOW DATA: FLOW(CFS) =     300.00     AREA(ACRES) =      248.9
  * SUMMED DATA: FLOW(CFS) =    1213.69    TOTAL AREA(ACRES) =      942.7
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =      693.8  TC(MIN.) =     36.06
  AREA-AVERAGED Fm(INCH/HR)=  0.27   Ybar =  0.30
  PEAK FLOW RATE(CFS)   =    913.69
  * CUMULATIVE SOURCE FLOW DATA: FLOW(CFS) =     300.00  AREA(AC.) =
248.9
  * SUMMED DATA: FLOW(CFS) =    1213.69    TOTAL AREA(ACRES) =      942.7
============================================================================
============================================================================
  END OF INTEGRATED RATIONAL/UNIT-HYDROGRAPH METHOD ANALYSIS
```

BORBA II

IN THE CITY OF ONTARIO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA

WQMP SITE PLAN



Building sizes, locations, and orientations are illustrative only. No building footprints would be entitled under the EIR Project or as part of the Specific Plan approval.

EXHIBIT "A"

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

BORBA II

WQMP SITE PLAN

Drawing Name: G:\265.08.19\Engineering\WQMP\Appendix 1 - Maps & Site Plan\Prelim WQMP Exhibit.dwg
Last Opened: Sep 16, 2019 - 3:19pm by jsarver