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Appendix 5.15A
Grading and Drainage Study

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PROJECT
Calpine Mission Rock

TITLE
PRELIMINARY STORMWATER MANAGEMENT DESIGN
PROJECT DOCUMENT Nº
CALPN-GNL-LI-0005

REV	**0**	ISSUED FOR	**Approval**
DATE	**11/4/2015**		

J. Dahlgren	R. Saylo	K. Stucki
PREPARED BY	CHECKED BY	APPROVED BY

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND CAN NOT BE DUPLICATED, MODIFIED OR DISCLOSED TO THIRD PARTIES FOR ANY USE OTHER THAN THIS PROJECT AND THE PURPOSE FOR WHICH IT IS INTENDED FOR, WITHOUT THE WRITTEN CONSENT OF CALPINE.

REVISION SUMMARY

Revision	Date	Description of the changes
0	11/4/2015	For Approval

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1. PROJECT LOCATION

Calpine proposes to construct and operate Mission Rock Peaker Power Plant on a 9.8 acres parcel of land located in Ventura County, California near the city of Santa Paula. The site is situated south-east of California State Route 126, east of Todd Road and north-west of the Santa Clara River. The plant will occupy the entire 9.8 acres of the site.

The property is located at an approximate elevation of 184 feet above mean sea level and has a gently sloping southerly existing grade. Stormwater runoff occurs primarily during thunder storms and seasonal winter storms. The site is isolated from run-on flows from adjoining properties due to roadway curbs and fencing surrounding the entire property. The existing drainage flow exits the site in the southern corner and drains through an existing drainage ditch to the Santa Clara River.

The current use of the property consists of a self-storage yard for recreational vehicles, boats and passenger vehicles. It is covered with asphalt paving and storage buildings.

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2. PROJECT DESCRIPTION

Calpine is developing a peaking power plant site near Santa Paula, CA. As currently envisioned the plant will consist of five GE LM6000 simple cycle gas turbine generating units (with space reserved for a sixth unit), and turbine inlet air chillers to minimize capacity fade during hot weather conditions. Additionally, space has been reserved for grid scale energy storage devices (batteries). To ensure the equipment will be available to perform its important societal support function even during 100 year flood events, the entire site will be elevated somewhat with imported fill. The following report summarizes the findings of an analysis of the existing conditions and the post construction conditions from a drainage impact and potential flooding perspective, undertaken in an effort to comply with all pertinent local development regulations and to comply with California Energy Commission permitting requirements.

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3. OBJECTIVE

The hydrologic and hydraulic assessment associated with the development of approximately 9.8 acres for the Project is addressed in this Drainage Study.

This Drainage Study addresses existing drainage patterns associated with pre-developed conditions and the future post development drainage flows through the Site. The objective of the study is to model the existing proposed drainage conditions and quantities for the site. This objective was achieved by undertaking the following activities:

- Determine the drainage watershed boundary for the project site for pre-developed and post-developed conditions.
- Determine the quantity of stormwater runoff within the project site under pre-developed and post-developed conditions.
- Hydrology calculations are performed per the Ventura County Watershed Protection District Hydrology Manual (**see Appendix D**) using the Modified Rational Method using the VCRat 2.6 and the Tc calculator computer programs provided by Ventura County. The required data for the program input to calculate pre and post storm water flows for each sub-basin are: pervious and impervious areas, time of concentration, soil type and design storm.

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4. HYDROLOGY

The hydrology analysis was performed and analyzed as set forth in the Ventura County Watershed Protection District Hydrology Manual.

The site is isolated from run-on drainage flows due to curbs and fencing surrounding the site. All storm water flows originate from on-site.

4.1 RAINFALL

In the 100 year, 24 hour storm event, 7.82 inches of rainfall shall fall (refer to **Appendix B**). The NOAA Atlas 14 data was provided for reference. The VCrat and TC calculation programs have the rainfall data included in the programs. Per the VCWPD Hydrology Manual this site lies in VCWPD Zone 2 and Rainfall Zone K (**see Appendix D**), which receives 10.6 inches of rainfall in the 100 year 24 hour storm event as shown on Section 4.4.1, **Appendix D**.

The FEMA Flood Insurance Rate Map has been provided in **Appendix A** for reference to the flood boundaries overlapping the site. Major flooding in the 100 year storm comes from the Santa Clara River channel directly south of the site.

4.2 SOILS

Soil classification was made using the 100-Year 1-Day Rainfall Contours map for Ventura County provided in the VCWPD Hydrology Manual (refer to **Appendix C**). The soil type number within the pre-developed watershed and post-developed watershed is listed as Type 7.

The soil on site is classified as Metz loamy sand and Pico sandy loam. A soil list for the watershed is included in **Appendix C**.

4.3 PRE-DEVELOPED CONDITIONS

The pre-developed drainage watershed area plan and runoff calculations are shown in **Appendix E**. The total watershed area is 9.8 acres. The existing site is covered with asphalt surfacing and storage unit buildings that make the site approximately 90% or greater impervious. The existing site was broken down in to four subareas with contributing overland sheet flows to the outlet point in the south-west corner of the site that releases the storm water flows to a ditch that drains to the Santa Clara River. There are two valley gutter drains that collect on-site overland sheet flow routing it to the collection point in the south-west corner (see **Appendix E** Pre-Drainage Plan Exhibit). The pre-developed conditions storm water totals are Q=42 cfs and the total storm water Volume=7.21 acre-feet. See **Appendix E** for related drainage calculation input data and drainage calculations.

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4.4 POST-DEVELOPED CONDITIONS

The post-developed drainage watershed area plan and runoff calculations are shown in **Appendix E**. The total watershed is 9.8 acres. The site will be raised to elevation 191.30 above mean sea level to be above the 100 year flood elevation per the FEMA flood map studies (see **Appendix A and Appendix F).** Power plant equipment foundations will be set at the elevation 192.30 above mean sea level to be one foot above the 100 year flood elevation to protect the power plant equipment from being destroyed during a flood. The proposed site will be covered in power plant equipment, asphalt paving, crushed rock high resistivity surfacing and related buildings resulting in the site being 37% impervious. The proposed site was broken down into two subareas, consisting of the main power generation areas as subarea 1 and the switchyard / battery bank areas as subarea 2. It is assumed that the proposed power plant will have an underground storm drain system that will collect the storm water flows on-site and route them to the local jurisdictions storm water collection system or the ditch at the south-west corner of the site that releases to the Santa Clara River. A portion of the storm water flows that are in areas of the plant that can pick up industrial contaminants will be routed through an oil/water separator before being released to the storm drain collection system. The post-developed conditions storm water totals are Q=15 cfs and the total storm water Volume=3.06 acre-feet. Further analysis of the proposed design for the power plant storm water drainage system will need to be undertaken at a later date during final design. See **Appendix E** for related drainage calculation input data and drainage calculations.

4.5 SUMMARY

In summary post-developed conditions of the site related to storm water volumes will be significantly less than the pre-developed storm water volumes for the site. This is due to the site having less impervious area as a result of crushed rock surfacing around foundations and areas where asphalt paving is not required in the post-developed conditions. More of the storm water will percolate into the ground on-site. The difference in total volumes between pre and post is 27 cfs and 4.15 acre-feet. The main differences between pre and post conditions is the routing flow paths of the storm water being longer due to the power plant equipment that creates a greater time of concentration, (17 minutes in post-developed versus 6 minutes in pre-developed conditions) and the impervious area being less in post conditions.

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FIGURE 1: PROJECT LOCATION

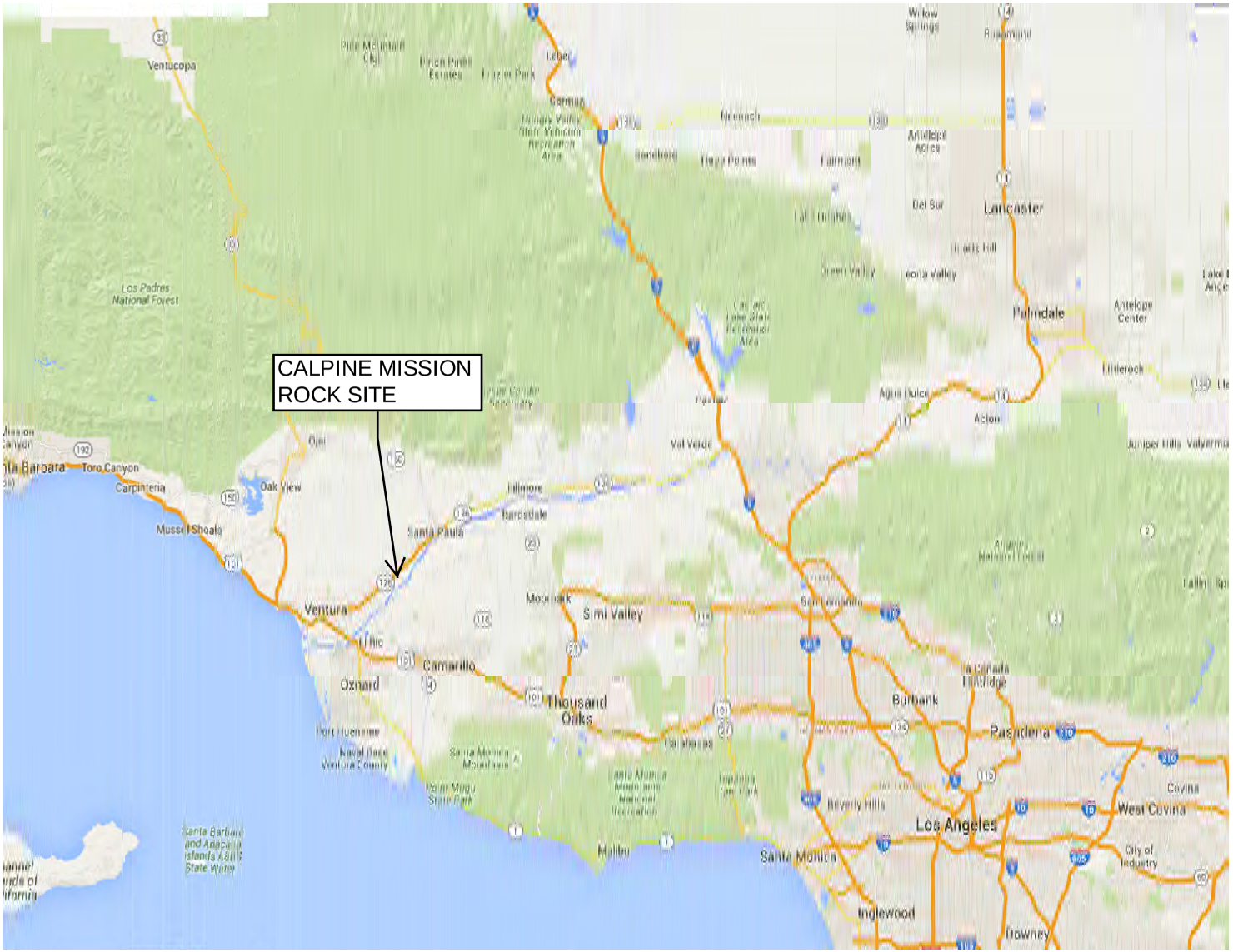

FIGURE 1: PROJECT LOCATION

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APPENDICES

APPENDIX A – FLOOD MAP

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations tables should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 11. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

Spatial Reference System Division
National Geodetic Survey, NOAA
Silver Spring Metro Center
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from U.S. Geological Survey Digital Orthophoto Quadrangles produced at a scale of 1:12,000 from photography dated 1994 or later.

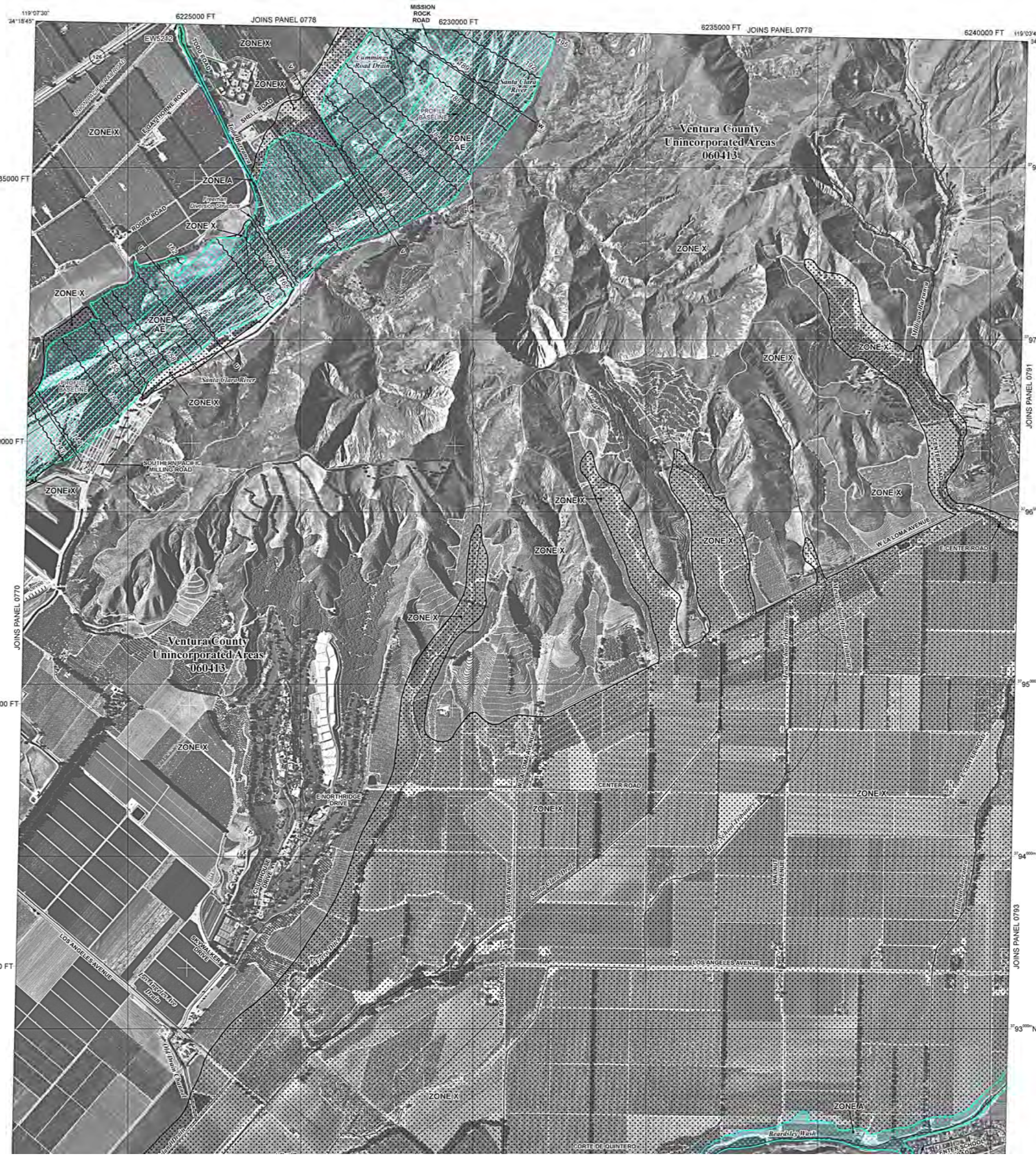
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to confirm to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.mcs.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.



SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

(A)———(A)	Cross section line
(23)- - - - - -(23)	Transect line
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
3776000mN	1000-meter Universal Transverse Mercator grid values, zone 11
600000 FT	5000-foot grid ticks: California State Plane coordinate system, zone V (FIPSZONE 0405), Lambert Conformal Conic projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
●M1.5	River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
January 20, 2010

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

FLOOD INSURANCE PROGRAM

PANEL 0790E

FIRM

FLOOD INSURANCE RATE MAP

VENTURA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 790 OF 1275
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CAMARILLO, CITY OF	060230	0790	E
VENTURA COUNTY	060413	0790	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number**

APPENDIX B – RAINFALL PRECIPITATION

NOAA Atlas 14, Volume 6, Version 2
Location name: Santa Paula, California, US*
Latitude: 34.3088°, Longitude: -119.1070°
Elevation: 185 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.144 (0.121–0.174)	0.185 (0.154–0.223)	0.236 (0.197–0.287)	0.278 (0.230–0.340)	0.333 (0.266–0.423)	0.375 (0.292–0.487)	0.418 (0.317–0.556)	0.461 (0.339–0.633)	0.519 (0.365–0.745)	0.564 (0.382–0.840)
10-min	0.207 (0.173–0.250)	0.265 (0.221–0.320)	0.339 (0.282–0.411)	0.398 (0.329–0.487)	0.478 (0.381–0.606)	0.538 (0.419–0.698)	0.599 (0.454–0.797)	0.661 (0.486–0.907)	0.744 (0.524–1.07)	0.808 (0.548–1.20)
15-min	0.250 (0.210–0.302)	0.320 (0.268–0.387)	0.410 (0.342–0.497)	0.482 (0.398–0.589)	0.578 (0.460–0.733)	0.651 (0.507–0.844)	0.724 (0.549–0.964)	0.799 (0.588–1.10)	0.900 (0.633–1.29)	0.977 (0.663–1.46)
30-min	0.372 (0.311–0.449)	0.475 (0.397–0.574)	0.608 (0.507–0.737)	0.715 (0.591–0.874)	0.858 (0.684–1.09)	0.966 (0.753–1.25)	1.08 (0.816–1.43)	1.19 (0.873–1.63)	1.34 (0.940–1.92)	1.45 (0.984–2.16)
60-min	0.606 (0.507–0.732)	0.775 (0.648–0.937)	0.992 (0.827–1.20)	1.17 (0.963–1.43)	1.40 (1.12–1.77)	1.58 (1.23–2.04)	1.75 (1.33–2.34)	1.94 (1.42–2.66)	2.18 (1.53–3.13)	2.37 (1.61–3.52)
2-hr	0.896 (0.750–1.08)	1.14 (0.951–1.38)	1.45 (1.21–1.76)	1.70 (1.40–2.08)	2.03 (1.62–2.57)	2.28 (1.78–2.96)	2.54 (1.92–3.38)	2.80 (2.06–3.84)	3.14 (2.21–4.51)	3.41 (2.32–5.08)
3-hr	1.12 (0.935–1.35)	1.42 (1.19–1.71)	1.80 (1.50–2.19)	2.11 (1.75–2.58)	2.53 (2.01–3.20)	2.84 (2.21–3.68)	3.15 (2.39–4.20)	3.48 (2.56–4.77)	3.91 (2.75–5.61)	4.24 (2.88–6.32)
6-hr	1.58 (1.32–1.91)	2.02 (1.68–2.44)	2.57 (2.14–3.12)	3.01 (2.49–3.69)	3.61 (2.87–4.57)	4.06 (3.16–5.26)	4.51 (3.42–6.00)	4.96 (3.65–6.81)	5.58 (3.93–8.01)	6.06 (4.11–9.02)
12-hr	2.03 (1.70–2.45)	2.61 (2.19–3.16)	3.36 (2.80–4.08)	3.96 (3.27–4.84)	4.75 (3.79–6.03)	5.35 (4.17–6.94)	5.95 (4.51–7.92)	6.55 (4.82–9.00)	7.36 (5.18–10.6)	7.98 (5.41–11.9)
24-hr	2.54 (2.25–2.93)	3.34 (2.95–3.85)	4.35 (3.84–5.03)	5.16 (4.51–6.01)	6.22 (5.27–7.50)	7.02 (5.82–8.65)	7.82 (6.33–9.87)	8.63 (6.79–11.2)	9.71 (7.32–13.1)	10.5 (7.67–14.7)
2-day	3.12 (2.77–3.60)	4.18 (3.69–4.82)	5.53 (4.88–6.39)	6.61 (5.78–7.71)	8.05 (6.81–9.71)	9.14 (7.57–11.3)	10.2 (8.27–12.9)	11.3 (8.92–14.7)	12.8 (9.68–17.3)	14.0 (10.2–19.6)
3-day	3.46 (3.06–3.99)	4.68 (4.14–5.40)	6.25 (5.52–7.23)	7.52 (6.58–8.77)	9.22 (7.81–11.1)	10.5 (8.72–13.0)	11.8 (9.56–14.9)	13.2 (10.3–17.1)	14.9 (11.3–20.2)	16.3 (11.9–22.9)
4-day	3.76 (3.33–4.33)	5.12 (4.53–5.90)	6.88 (6.07–7.96)	8.31 (7.27–9.69)	10.2 (8.66–12.3)	11.7 (9.70–14.4)	13.2 (10.7–16.6)	14.7 (11.6–19.1)	16.8 (12.7–22.7)	18.4 (13.4–25.7)
7-day	4.34 (3.84–5.00)	5.93 (5.24–6.84)	8.01 (7.07–9.27)	9.72 (8.51–11.3)	12.1 (10.2–14.5)	13.9 (11.5–17.1)	15.7 (12.7–19.8)	17.6 (13.8–22.8)	20.2 (15.2–27.3)	22.2 (16.2–31.1)
10-day	4.66 (4.13–5.37)	6.38 (5.64–7.36)	8.66 (7.64–10.0)	10.5 (9.22–12.3)	13.1 (11.1–15.8)	15.1 (12.5–18.6)	17.2 (13.9–21.7)	19.4 (15.2–25.1)	22.3 (16.8–30.2)	24.7 (18.0–34.5)
20-day	5.44 (4.82–6.27)	7.50 (6.64–8.66)	10.3 (9.06–11.9)	12.6 (11.0–14.7)	15.8 (13.4–19.1)	18.4 (15.2–22.6)	21.0 (17.0–26.5)	23.8 (18.7–30.9)	27.7 (20.9–37.4)	30.8 (22.4–43.1)
30-day	6.45 (5.71–7.43)	8.91 (7.88–10.3)	12.2 (10.8–14.2)	15.0 (13.2–17.5)	19.0 (16.0–22.9)	22.1 (18.3–27.2)	25.3 (20.5–32.0)	28.8 (22.6–37.4)	33.7 (25.4–45.5)	37.6 (27.4–52.6)
45-day	7.64 (6.77–8.80)	10.5 (9.30–12.1)	14.4 (12.7–16.7)	17.7 (15.5–20.7)	22.4 (19.0–27.1)	26.2 (21.7–32.3)	30.1 (24.4–38.0)	34.4 (27.0–44.6)	40.3 (30.4–54.5)	45.2 (32.9–63.2)
60-day	8.72 (7.72–10.0)	11.9 (10.5–13.7)	16.3 (14.4–18.8)	20.0 (17.5–23.3)	25.3 (21.4–30.5)	29.6 (24.5–36.4)	34.1 (27.6–43.0)	38.9 (30.6–50.5)	45.8 (34.6–62.0)	51.4 (37.5–72.0)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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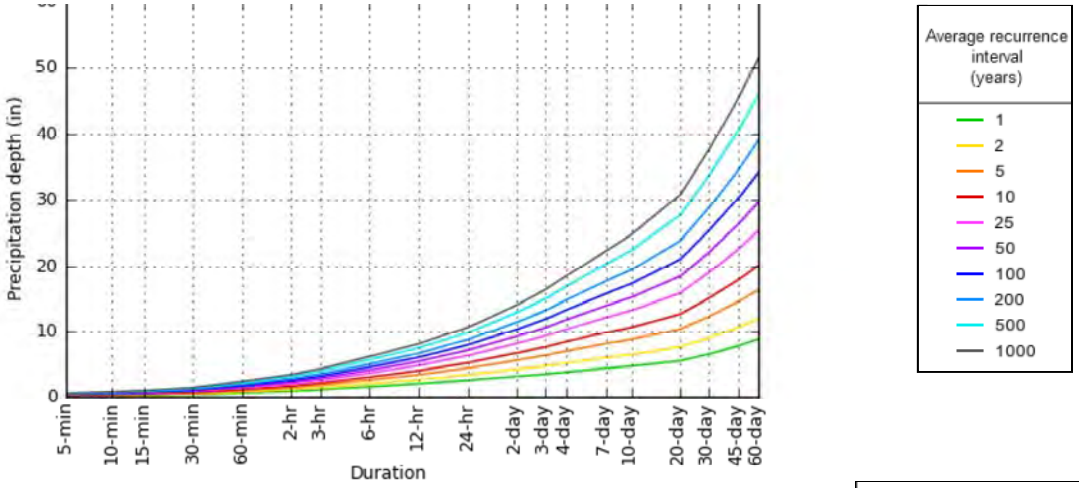
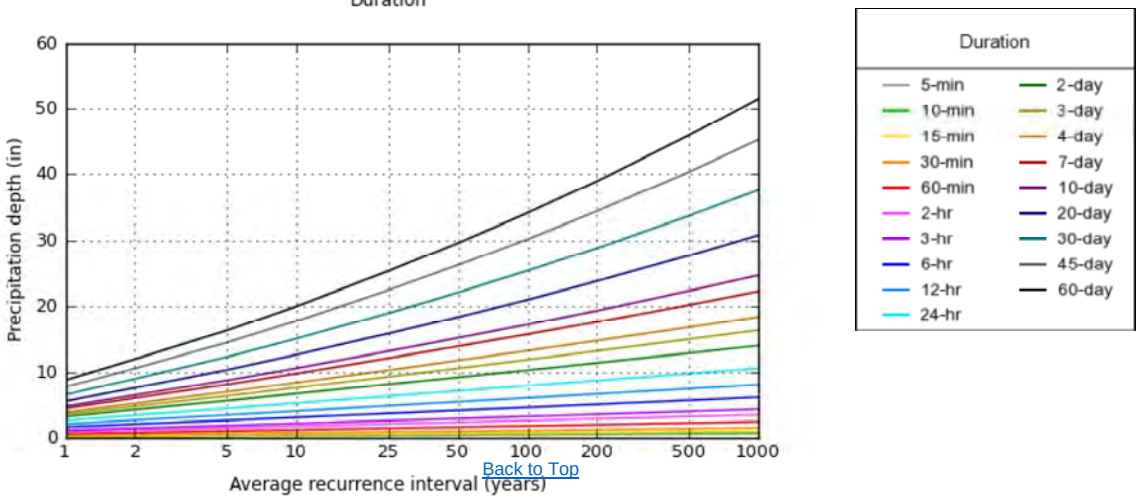
PF graphical





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NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Mon Oct 26 17:39:31 2015

Maps & aerials

Small scale terrain

Large scale terrain

Large scale aerial

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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
Office of Hydrologic Development
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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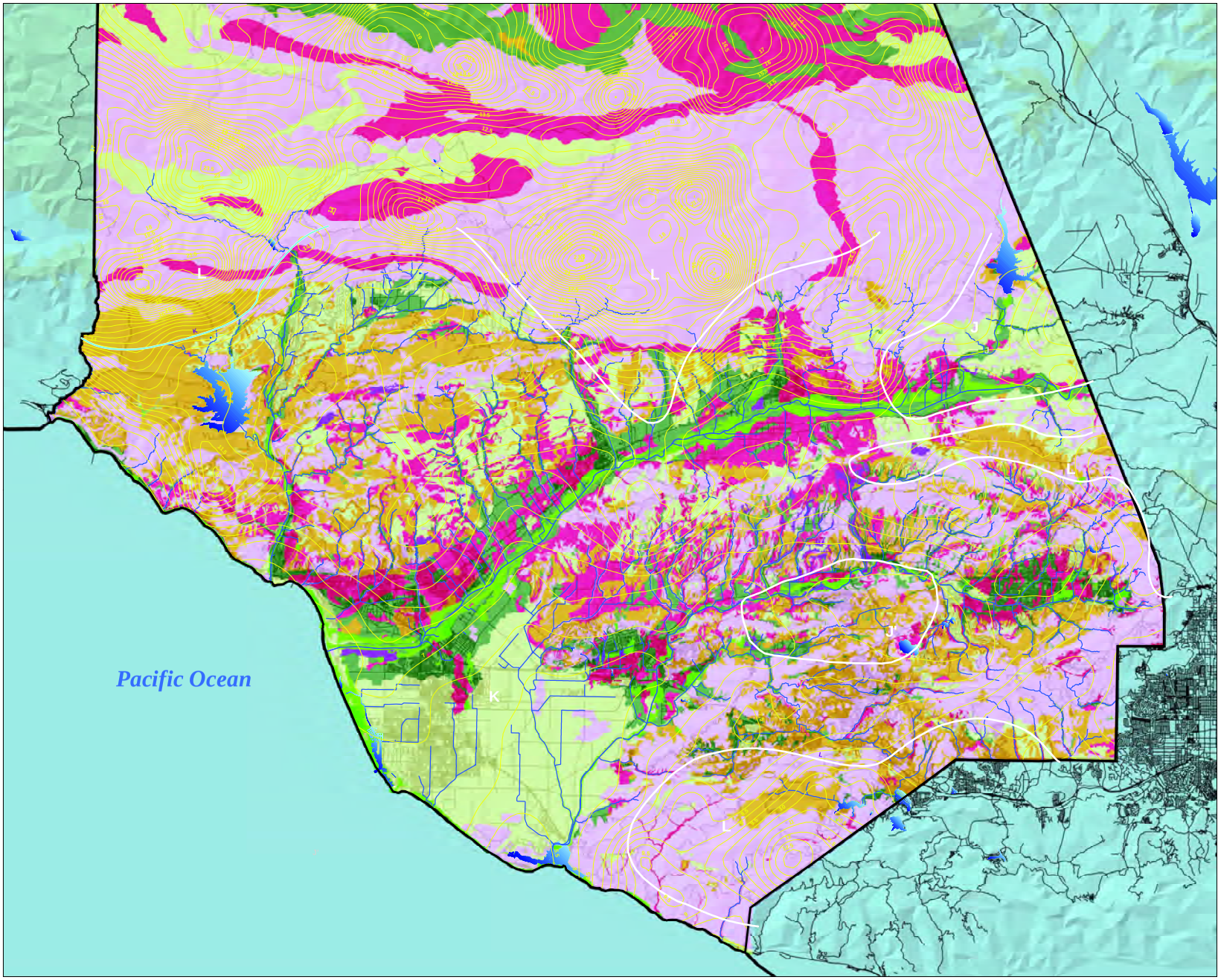
APPENDIX C – SOIL CLASSIFICATION

100-Year, 1-Day Rainfall Contours for Ventura County



0 0.5 1 2 3 4 5 6 Miles

N
W E
S

Rainfall Zones

Ventura County Boundary

Rainfall Contours (Inches)-100yr

VCWPD Channels

Lakes

Ventura County Soil Numbers

1

2

3

4

5

6

7

Major Streets and Highways

Topography of Ventura County

Elevation (ft.)

7,848 - 8,832

6,864 - 7,848

5,881 - 6,864

4,897 - 5,881

3,914 - 4,897

2,930 - 3,914

1,947 - 2,930

963 - 1,947

0 - 963

United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Ventura Area, California

October 26, 2015

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

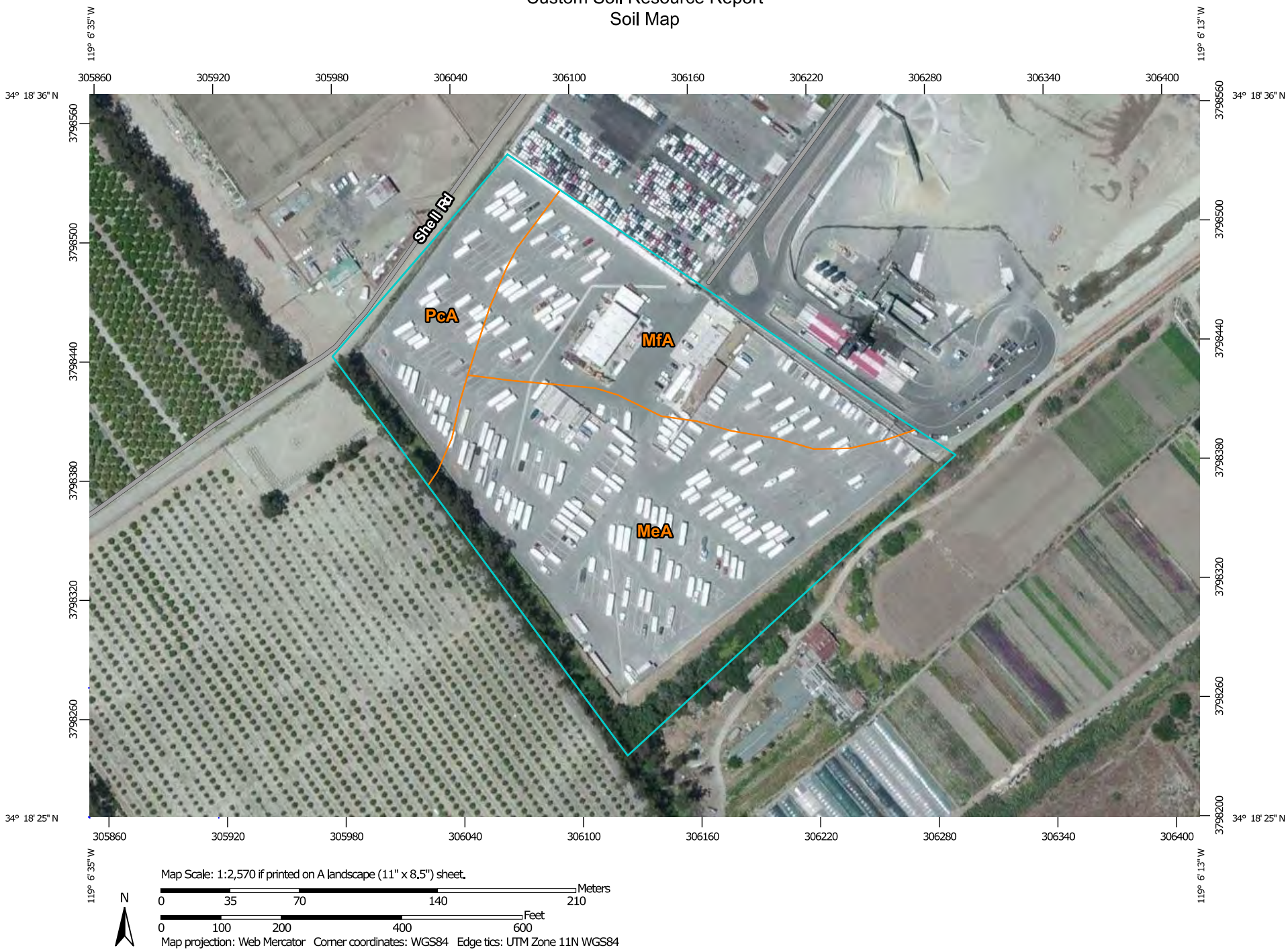
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Ventura Area, California
Survey Area Data: Version 9, Sep 22, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 5, 2010—Aug 31, 2010

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Ventura Area, California (CA674)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
MeA	Metz loamy sand, 0 to 2 percent slopes	6.4	55.9%
MfA	Metz loamy sand, loamy substratum, 0 to 2 percent slope s	3.2	28.4%
PcA	Pico sandy loam, 0 to 2 percent slopes	1.8	15.7%
Totals for Area of Interest		**11.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that

have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Ventura Area, California

MeA—Metz loamy sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hc9j
Elevation: 30 to 2,500 feet
Mean annual precipitation: 20 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 200 to 340 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Metz and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Metz

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified alluvium derived from sedimentary rock

Typical profile

H1 - 0 to 7 inches: loamy sand
H2 - 7 to 60 inches: stratified sand to sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 5.3 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A

Minor Components

Anacapa

Percent of map unit: 4 percent

Corralitos

Percent of map unit: 4 percent

Pico
Percent of map unit: 3 percent

Hueneme
Percent of map unit: 2 percent

Metz, loamy substratum
Percent of map unit: 2 percent

MfA—Metz loamy sand, loamy substratum, 0 to 2 percent slope s

Map Unit Setting

National map unit symbol: hc9l
Elevation: 30 to 2,500 feet
Mean annual precipitation: 20 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 200 to 340 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Metz and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Metz

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified alluvium derived from sedimentary rock

Typical profile

H1 - 0 to 7 inches: loamy sand
H2 - 7 to 24 inches: stratified sand to sandy loam
H3 - 24 to 60 inches: stratified loamy very fine sand to silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A

Minor Components

Anacapa

Percent of map unit: 4 percent

Corralitos

Percent of map unit: 4 percent

Hueneme

Percent of map unit: 3 percent

Metz, loamy sand

Percent of map unit: 2 percent

Pico

Percent of map unit: 2 percent

PcA—Pico sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hcb6
Elevation: 10 to 1,500 feet
Mean annual precipitation: 10 to 20 inches
Mean annual air temperature: 57 to 63 degrees F
Frost-free period: 200 to 300 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Pico and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pico

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

H1 - 0 to 14 inches: sandy loam
H2 - 14 to 54 inches: stratified sandy loam to loam
H3 - 54 to 60 inches: stratified gravelly sand to gravelly loamy coarse sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A

Minor Components

Anacapa

Percent of map unit: 3 percent

Corralitos

Percent of map unit: 3 percent

Cortina

Percent of map unit: 3 percent

Metz

Percent of map unit: 2 percent

Mocho

Percent of map unit: 2 percent

Pico, sandy substratum

Percent of map unit: 2 percent

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

WorleyParsons
resources & energy

APPENDIX D – VENTURA COUNTY WATERSHED PROTECTION DISTRICT HYDROLOGY MANUAL

HYDROLOGY MANUAL

VENTURA COUNTY WATERSHED PROTECTION DISTRICT

VENTURA COUNTY, CALIFORNIA

UPDATED DECEMBER, 2006

REPRINTED 1991

REPRINTED 1985

REVISED 1978

FIRST PRINTING 1975

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Ac.	Acres
ASCE	American Society of Civil Engineers
CFS	Cubic feet per second
Corps	US Army Corps of Engineers
District	Ventura County Watershed Protection District
FEMA	Federal Emergency Management Agency
Fps	Feet per second
Ft	Feet
In.	Inches
Mi.	Miles
NRCS	Natural Resources Conservation Service
SCS	Soil Conservation Service
Sq. Mi.	Square miles
Tc	Time of Concentration
VCWPD	Ventura County Watershed Protection District

SECTION 1 INTRODUCTION

1.1 PURPOSE AND SCOPE

The intent of this manual is to present guidelines and sufficient input data for the establishment of a uniform method for computing design hydrology in Ventura County (see Figure 1). The method should be used for projects subject to Ventura County Watershed Protection District (District) requirements. Input data and design procedures are sufficiently flexible that the method can be adopted for use by all agencies and engineering consultants engaged in the design of flood control works throughout the county. The method can be used on all small to intermediate size watersheds under various conditions of development. The method is especially designed for use in computer applications such as the District's VCRat program (see Section Four).

In developing this manual, the most commonly used methods for hydrologic design were evaluated. A summary of those considered includes:

1. Rational equation.
2. Modified rational method.
3. Flood-frequency analyses.
4. Unit-hydrograph methods.
5. Runoff simulation.

Flood-frequency and unit-hydrograph methods require long periods of runoff measurements from watersheds typical of those in which flood control works are being designed. The District is active in the measurement and collection of runoff data throughout the county; however, records of sufficient length from small, highly urbanized areas are generally not yet considered adequate to characterize storms flows with long recurrence intervals. The flood-frequency method has the added disadvantage that it cannot generate a hydrograph for flood routing through stream channels and detention basins.

The majority of watersheds considered in the flood protection program of cities, subdivision engineering and the Watershed Protection District generally range in size from a few acres up to about five to ten square miles. Projected development in those watersheds ranges from complete urbanization to urbanization interspersed with parks and open space land. Runoff conveyances consist of streets, pipes, concrete channels, and channels in their natural condition. For the analysis of design hydrology under these watershed and runoff conditions that do not contain regional detention facilities, the flexibility of the modified rational method is considered superior and it is described in this manual.

When appropriate, the District will continue to use unit-hydrograph techniques and flood-frequency analyses in the formulation of project hydrology. The large river systems of the county will be improved in conjunction with Federal agencies and hydrologic formulation will conform to methods recommended by those agencies. The modified rational method is considered appropriate for watersheds less than about 5,000 acres. For hydrologic design of watersheds greater than 5,000 acres and for projects with regional detention, the Ventura County Watershed Protection District should be consulted for appropriate procedures and criteria. Hydrologic techniques used in large watersheds will include flood-frequency analyses, and unit-hydrograph techniques developed by the U.S. Army Corps of Engineers, and the

Natural Resources Conservation Service (NRCS; formerly known as the Soil Conservation Service [SCS]). The recommended approach in each case will be determined by the availability and expected reliability of necessary input data. Considerable engineering judgment will be necessary in formulating project hydrology for watersheds of approximately 5,000 acres to ensure that peak flows computed by the various appropriate methods are consistent and compatible.

Project design in the vicinity of watersheds with a high wildfire and erosion potential may need to consider the effect of debris bulking on peak flows. Techniques for bulking peak flows in Ventura County have been developed and they are available in the offices of the Watershed Protection District. They will determine the need for debris bulking and specify appropriate procedures in all cases.

Although it is anticipated that the overall approach described in this manual will not significantly change, any hydrologic process should be considered a dynamic process and subject to periodic refinement as additional input data become available. Techniques described in this manual will be continuously reviewed and updated, as necessary, to provide a thorough and complete package for hydrologic design.

1.2 ACKNOWLEDGMENT

The method presented in this manual for computing runoff hydrographs was developed by the Los Angeles Department of Public Works (formerly known as the Los Angeles County Flood Control District) over the past 50 years and recommended by them for use in Los Angeles County. It has been adapted for use in Ventura County by the Hydrology Section of the Ventura County Watershed Protection District.

We gratefully acknowledge the very generous cooperation of the then-named Los Angeles County Flood Control District in assisting our staff with the development of necessary input data for adapting their method for use in Ventura County. Velocity-discharge relationships for natural channels, slope correction factors, and wave velocity relationships used in this manual were supplied to us by their staff. The computer program presented in this manual was supplied by them and originally adapted for use on the IBM 370 and Control Data Corporation 6600 computers, and currently for use on PCs.

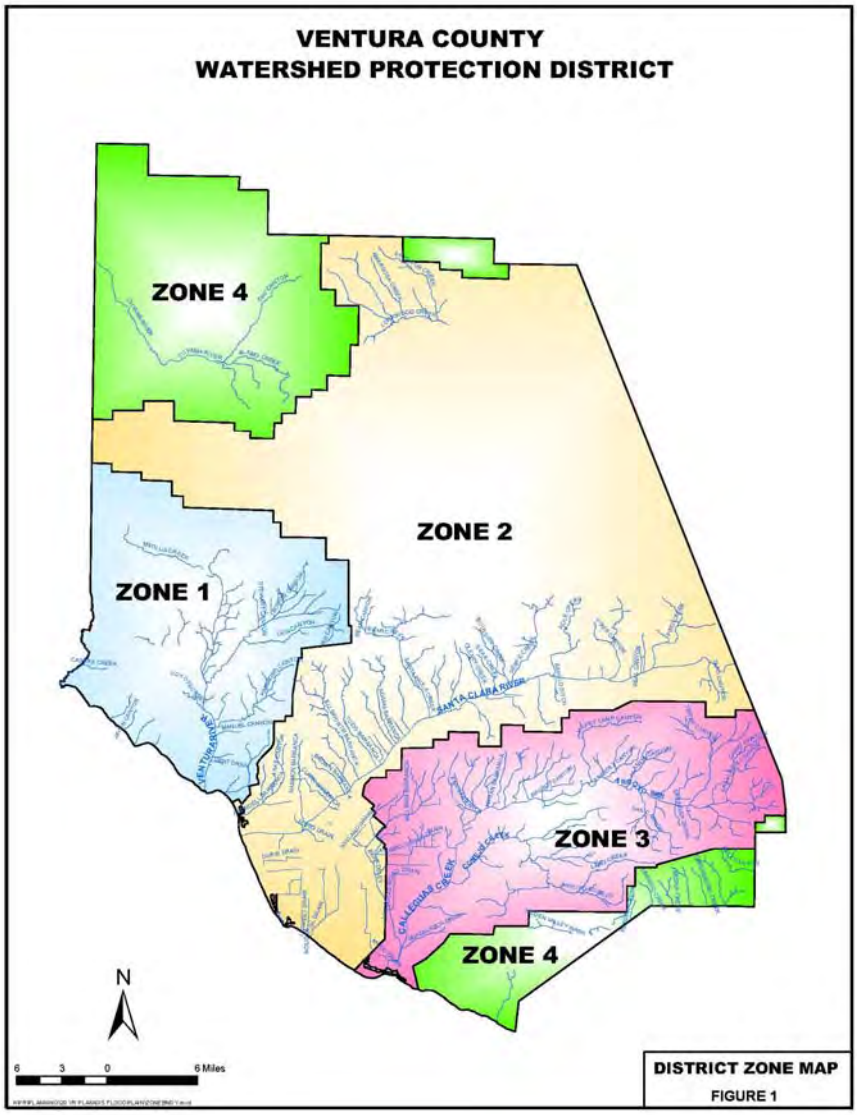
1.3 REPRINTS AND REVISIONS

In August 1978, the first reprinting of the Hydrology Manual was done. Because of recent interest in 100-year peak flow rates, and the need for more guidelines in estimating overland flow velocities for computing times of concentration, certain additions were incorporated in the manual at that time. A plate was added to include intensity-duration curves for the 100-year storm event. A new plate, Exhibit 8, was added which shows suggested minimum overland flow velocities for use in consistently estimating time of concentration throughout a study area and from watershed to watershed. Appropriate revisions were made to each section in the text to support the added information.

In this current Manual update (2006), the following procedures have been updated:

1. The District's VCRat 2.2 computer program has been modified to create a more user-friendly Windows version (VCRat 2.5). The program still includes all of the specialized operations available in VCRat 2.2 so that previous VCRat input files can be imported and yield the same results.

2. A Tc Calculator program has been developed to facilitate Tc calculations for the modified rational method program. Because the programs requires less time to calculate Tc's the number of required subareas with calculated Tc's has been increased to 75 percent of developed areas and 25 percent of undeveloped areas as described in Section Five.
3. Information and procedures for adjusting the hydrograph volumes to match the yield predicted by the SCS Unit Hydrograph method for the watershed have been added. This information is intended for use in designing detention facilities for developments receiving runoff from tributary areas less than one sq. mi. in size. The data required for use in the yield adjustment are provided in Appendix A.
4. The program requirements for performing areal reduction simulations are discussed.
5. The recommended effective imperviousness percents for use in hydrology analyses have been expanded to cover more land uses and reflect current construction techniques that lead to less pervious area in the watershed.



SECTION 2 RATIONAL EQUATION

The rational equation has been widely accepted for use in the design of flood protection measures. It is simple, and when used with adequate input parameters on small drainage areas, it provides reasonable results for use in project design.

The basic equation is:

$Q = CIA$

where:

Q	=	Peak discharge in cubic feet per second (cfs).
C	=	Coefficient of runoff (dimensionless).
I	=	Average rainfall intensity for a duration equal to the time of concentration of the watershed (inches/hour).
A	=	Drainage area of the watershed (acres).

The rational equation represents a ratio in which the total quantity of precipitation falling at a uniform rate on an area is related by simple proportion to the quantity that appears as runoff. Dimensionally the equation is approximately homogeneous. Units of discharge are acre-inches per hour which converts to cubic feet per second with a conversion factor of 1.008. In view of the uncertainties associated with measurement of necessary input parameters, the conversion factor is usually ignored and flow rates are considered to be in units of cfs.

The rational equation is dependent upon the following basic assumptions:

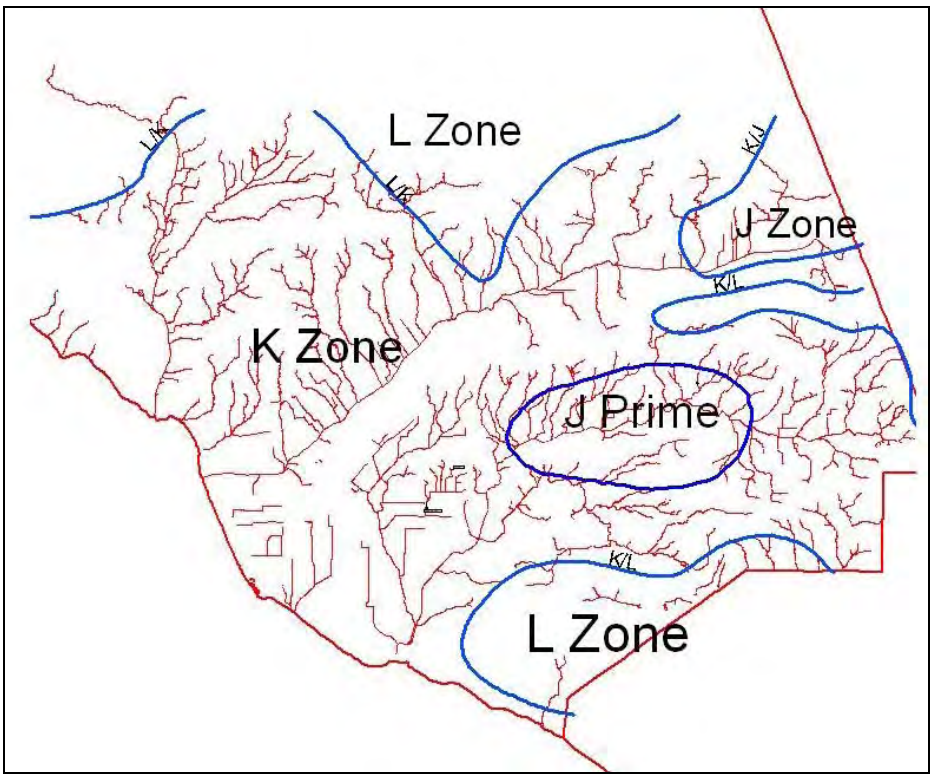
1. The peak rate of runoff at any point in a subarea is a direct function of the average rainfall intensity during the time of concentration to that point.
2. The time of concentration is the time required for runoff to become established and flow from the hydraulically-most-remote part of the drainage area to the point under design.

The method presented in this manual is based on input parameters developed specifically for soil types and rainfall characteristics in Ventura County. In addition to the watershed drainage area, input parameters for the rational equation include rainfall intensity-duration curves, runoff coefficient curves, and time of concentration.

2.1 Rainfall Intensity-Duration

Most precipitation in the Ventura County area results from general winter storms associated with extra tropical cyclones that develop in the North Pacific during the months of November through April. Precipitation during these storms may occur over large areas and a major storm causing high flows and flooding can last four days or more. The first several days of the storm normally contain light, persistent rainfall of moderate intensities. Rainfall during this period satisfies the soil moisture deficiency. The latter portion of the storm is characterized by short periods of extremely high intensities falling on saturated soils.

Using theoretical techniques proposed by the California Department of Water Resources, intensity-duration-frequency relationships were computed for all long-term recording rain gage data in Ventura County. Frequency analyses used storm intensities for durations of 5, 10, 15, and 30 minutes, and for 1, 2, 3, 4, 5, 12, and 24 hours. From this analysis, intensity-duration curves were plotted for each gage for selected frequencies and similar curves from gages in similar rainfall regimes were averaged, resulting in a family of intensity-duration curves that were labeled J', J, K, and L. Using the 50-year, 24-hour isohyetal map of the county, and considering orographic influences, each curve was assigned to a specific area in the county. The curves are presented in this manual for the 100-, 50-, 25-, and 10-year events. The appropriate areas in the county for each curve are shown in the hydrology maps, Exhibit 1a through d and Appendix E maps. The tabulation of intensities for selected duration and storm times are listed in Exhibits 2a through 5d.

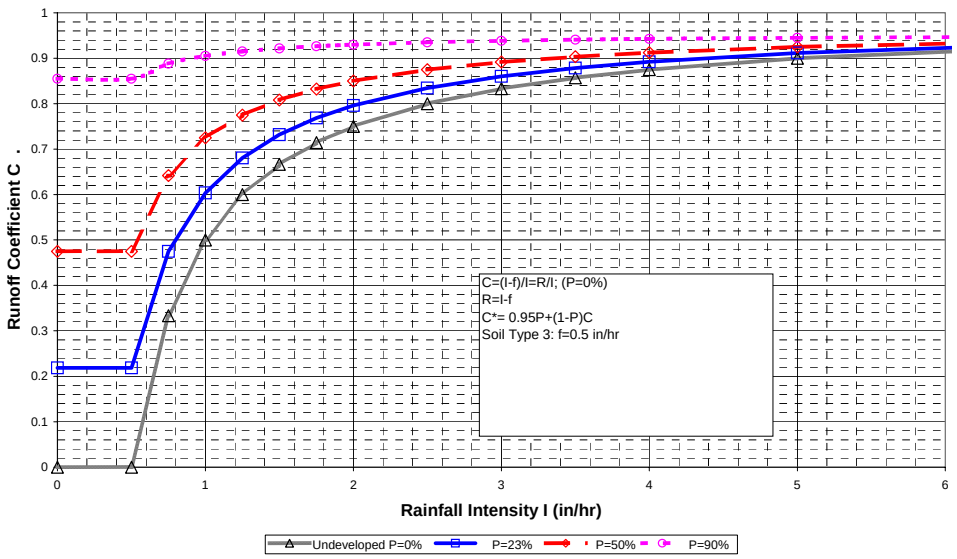


Rainfall Zone Map with VCWPD Jurisdictional (Redline) Channels

2.2 RUNOFF COEFFICIENT CURVES

For each acre of drainage area, a runoff coefficient used in the rational equation represents the ratio of runoff to rainfall. It is considered the percentage of rainfall on a watershed that runs off and its value ranges from zero on very porous soils to 0.95 on impervious surfaces (runoff is limited due to depression storage). It includes the composite effect of such watershed variables as infiltration, ground slope, ground cover, surface and depression storage, antecedent precipitation and soil moisture, and shape of the drainage basin. Runoff is not a constant percentage of rainfall, but is the residual of rainfall remaining after losses. Losses increase as precipitation increases in minor storms, but the increase in losses is not proportional to the increase in rain. Therefore, the ratio of runoff to rainfall increases as storm intensity increases and in the method presented in this manual the runoff coefficient is a function of intensity.

Using the Soil Survey completed by the SCS (now NRCS) of the U. S. Department of Agriculture in April 1970, soils in Ventura County were grouped into seven hydrologically homogeneous families. Two families were assigned to each of the SCS Hydrologic Soil Groups A, B, and C; while only one family was considered appropriate for SCS Hydrologic Soil Group D. The upper and lower limits of the group of runoff coefficient curves for Ventura County were defined by considering a composite plot of all those developed by Los Angeles County Flood Control District using ring infiltrometer tests. Individual curves for undeveloped soils were determined theoretically by considering representative infiltration rates for various soil textures recommended by the SCS and the ASCE in their Hydrology Handbook. Some adjustment was necessary at high rainfall intensities to ensure a family of approximately parallel runoff coefficient curves.



Runoff Coefficient Plot, Soil Type 3 (Exhibit 6a-e in Appendix A)

2.3 TIME OF CONCENTRATION

Time of concentration (Tc) is defined as the time required for runoff to travel from the hydraulically most distant point of a watershed to its outlet. It is a summation of the travel times associated with overland flow and concentrated flow in streets, pipes, and stream channels. Because of the complex flow path associated with most watersheds, generalized charts and nomograms such as Kirpich are not considered adequate for computing travel times.

To determine time of concentration, the watershed is divided into contributing subareas using topographic barriers as well as streets, known improvement plans, and projected ultimate development. Ideally, the subarea size should range between 40 and 80 acres; however, the method can be used on smaller subareas providing the time of concentration is greater than five minutes. If the subarea of interest is too small to provide a Tc calculation greater than 5-minutes, a larger subarea should be evaluated and the discharge pro-rated based on the peak flow per unit area as described in Section Five. The upper limit on Tc is 30 minutes.

For any given subarea, the time of concentration must be computed by the method of successive approximations. For a given flow path and drainage area, the travel time is a function of the peak flow, which is itself a function of the rainfall intensity. Intensity is a function of the time of concentration. The proper approach for computing an appropriate time of concentration is discussed in more detail in Section 4.2 and demonstrated in Appendix B.

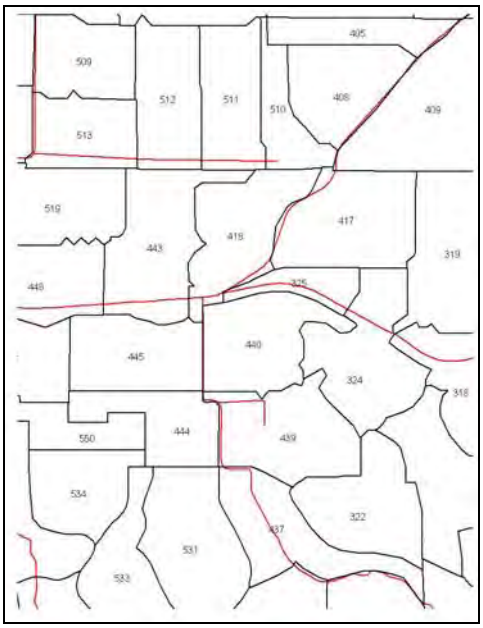
SECTION 3 MODIFIED RATIONAL EQUATION FOR HYDROGRAPH SYNTHESIS

The rational equation computes an instantaneous flow rate based upon average rainfall intensity over a period equal to the time of concentration of a watershed. When the intensity is the maximum for a given storm, the associated flow rate represents the peak for that storm. When storm intensities that are less than the peak period intensity are used in the rational equation, the resulting flow rates represent some point on a theoretical storm hydrograph.

Every design storm is made up of a series of intensities that change more or less uniformly throughout. A mass curve of rainfall represents an accumulation of storm totals at any point in a storm and its slope at any point represents the rainfall intensity at that point. By determining intensities at representative times throughout a design storm, a runoff hydrograph can be generated using the rational equation.

Each of the intensity-duration curves used by VCWPD has an associated mass curve. The mass curves are included in the computer program and they are used to define intensities for all hydrographs developed by the VCRat programs. Intensity tables shown on Exhibits 2a through 5d may be used for hand computations of runoff hydrographs. A typical calculation is shown in Appendix B.

Once the runoff hydrograph is generated, additional subareas can be evaluated and confluenced using the timing information contained in the hydrographs. In this way the rational method can be extended for use in watersheds with numerous distinct subareas such is shown below. The use of the method to confluence the hydrographs from different subareas is known as the modified rational method.



Subareas with Node I.D.s and Channels in Calleguas VCRat 2.2 Model

SECTION 4 VCRAT AND TC CALCULATOR PROGRAMS

4.1 VCRAT GENERAL DESCRIPTION

The VCRat computer programs perform a number of functions in implementing the modified rational method. First, the consistency of input data that may include runoff coefficient curves, rainfall mass curves, and subarea and hydrograph data input are verified. When errors are encountered, processing is terminated and error messages are printed. After the input data have been verified, the program proceeds with specified hydrologic calculations.

4.1.1 Computations Performed

For a specified design storm, VCRat calculates a hydrograph of runoff at all subarea collection points within the watershed, combines hydrographs from each subarea, and routes the combined hydrograph through the channel system. The program accounts for channel storage and it reports peak flow rates in each reach of each drain, coincident flow rates of tributaries at confluence structures, and hydrographs at subarea collection points as specified in the program input data.

Options are available for the computation of hydrographs for a multiple day design storm to obtain the runoff volume data necessary for retention basin and pump plant design. Separation of flow at the junction of two drains may be made by either specifying a percentage split of the inflow hydrograph, or a split with all flow up to a specified discharge placed in one drain and the remaining flow placed in the other.

If the type and size of a drain are not specified, the system will automatically begin routing flow in a street section in the upper limits of a watershed; change from street to pipe section when flow depth reaches the property line (located at the development boundary of an assumed 10-ft wide sidewalk adjacent to the street); from pipe to rectangular channel when a pipe diameter of 8 feet is exceeded; and from the hydraulically most efficient rectangular section to a rectangular section with a maximum depth of 13 feet deep when the depth reaches 13 feet. Consistency of drain type and size are automatically maintained such that a drain does not decrease in size in a downstream direction and drain type will progress continuously from street to pipe to rectangular channel as necessary.

The required input data for a subarea consists of the area, Tc, soil type, and design storm type. Channnel channel routing information can be added if necessary. If a subarea is provided with channel routing information, the program routes the accumulated flow from that subarea and any tributary subareas down to the collection point for the next subarea (downstream end of the channel) before it is confluenced with the hydrograph from the next downstream subarea.

4.1.2 Program Requirements

The VCRat program is written in FORTRAN and compiled to run on PCs with minimal memory and storage requirements. Program VCRat 2.2 was generated by revising and linking together a number of historic FORTRAN modules with a Visual Basic interface to run a composite input data file combining subarea information with rainfall and infiltration data. Historic operations such as hydrograph “fattening”

and routing that were performed with separate codes were combined in VCRat 2.2 so that all of the operations could be done in one simulation. These options continue to be incorporated in the most current version of the program, VCRat 2.5.

VCRat 2.5 is a Windows-compliant program developed using Visual Basic.Net. Minimum requirements are Windows 2000 or Windows XP operating system with 256 MB of RAM and minimum 10MB hard drive capacity for storing the resultant output files. Microsoft .Net Framework 2.0 is required for VCRat 2.5 to run. Microsoft .Net Framework 2.0 can be obtained through Windows Updates, from http://www.microsoft.com or by following the instructions provided in the help file provided with VCRat 2.5.

4.1.3 Computer Output

Typical computer input and output data shown in Appendix D and includes appropriate subarea input data, subarea Q's, and confluence Q's. At specified confluence structures, storm times and coincident Q's at the peak in each tributary are listed, and the time of peak and combined Q leaving the confluence are shown. Typical printed outputs of hydrograph data are also shown in Appendix D. Hydrograph data output in an output file may be generated to be used as input for future runs.

4.1.4 Limitations of Program

The following computations should be specified separately and cannot be combined with any other computation.

1. Compute a subarea hydrograph and add it to other flow in drain.
2. Add two hydrographs at a confluence.
3. Read hydrograph data input.
4. Modify a hydrograph at a relief drain junction and transfer a portion of the flow to the other drain.

A maximum of 200 points during the standard 1,500-minute-long storm period may be used to define rainfall mass curves and these same points must be used to define a storm runoff hydrograph. Selected times in the following table for storm patterns J through L apply to hydrograph data points.

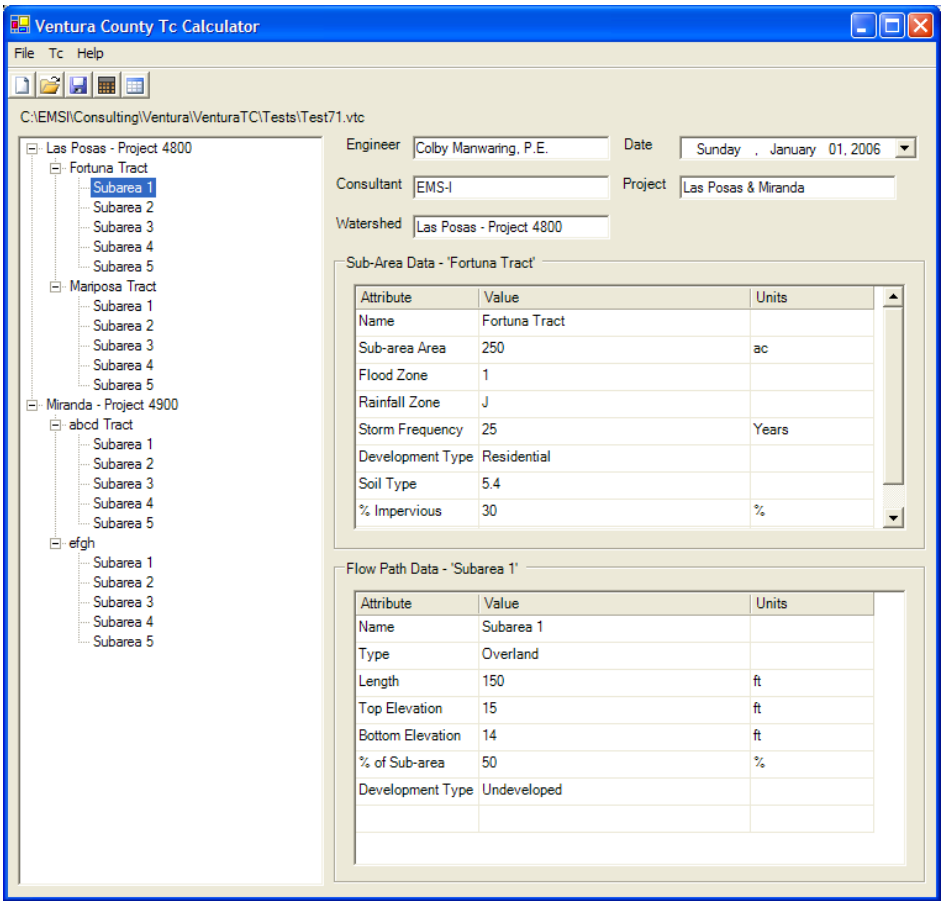
100-Yr Hydrograph Discretization

Time Period Minutes	Point Spacing Minutes	Number of Points
0 - 1000	100	11
1000 - 1100	50	2
1100 - 1130	10	3
1130 - 1300	1	170
1300 - 1400	10	10
1400 - 1460	20	3
1460 - 1500	40	1
		Total 200

4.1.5 Areal Reduction Simulations

Program VCRat 1.0 had the capability of doing simulations that would automatically perform areal reduction on the rainfall data to provide areally-reduced flow at a specific model location. However, VCRat 1.0 did not incorporate hydrograph fattening and detention basin routing capabilities that are part of VCRat 2.2. In order to use VCRat 2.2 for areal reduction simulations, the modeler must remove any areal reduction, fattening, and basin routing operations from the VCRat 2.2 input file. Additionally, the rainfall mass curves can be the A97, B98, and C99 100-yr storms or the T01 50-yr storm (similar to K zone 50-yr rainfall) for the areal reduction simulation and areal reduction can only be performed on the "A" line in the model. VCRat 2.5 does not currently have the capability of doing areal reduction simulations.

4.2 TIME OF CONCENTRATION (TC) CALCULATIONS



Sample Tc Calculation Window from Tc Calculator

The Tc calculator program provided for use in Tc calculations by the District was developed using Microsoft Visual Studio.NET 2003 and was written in Visual Basic programming language. The

program consists of several parts. The variable collection loop goes through the input and creates an input file to be read by the computation loop. Several parameters are collected from data files that contain necessary information and are also read in as variables. The next part is a computation loop that iterates through the Time of Concentration process until a specified tolerance is reached. This loop goes through each flow-path and utilizes the appropriate equations and parameters to complete the computations. The information is then passed to the output loop that writes an output file consisting of the travel times for each flow-path and the time of concentration for each sub-area in the watershed. The program has an interface that facilitates inputting the data. The interface uses a data tree style of organizing the watershed with its sub-areas and flow-paths and is a user-friendly tool to facilitate hydrologic studies in Ventura County.

The Tc Calculator program is a self-contained executable intended to be run from a folder on your local PC's harddrive that does not require a complex installation process. I**t cannot be launched across a network**. The following files are required for program execution:

- VenturaTc.exe – the program executable
- VCRAIN.DAT – data file containing soil and rainfall data compatible with VCRat 2.5-see Appendix A.

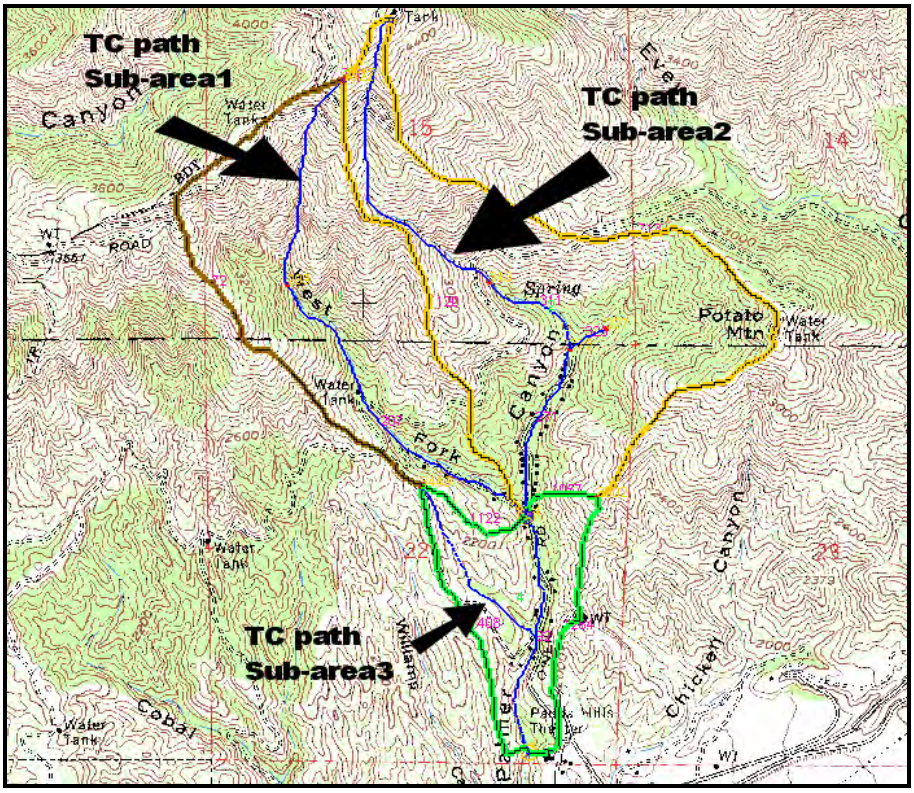
These two files may be placed in any folder on your local computer. The program is run by executing VenturaTc.exe (double-click this file or create a desktop shortcut that can be double-clicked). Note: This program cannot be used from a network drive!

The Tc Calculator was programmed with Microsoft Visual Studio .NET 2003 – Visual Basic. The Visual Studio project with all program code, images, and forms has been included in the delivery of this calculator to Ventura County Watershed Protection District. The program was designed to run on Microsoft Windows 2000/XP with .NET Framework, and should run on any newer Miscrosoft Windows OS platforms.

4.2.1 Tc Calculation Methodology

Information about the watershed and its subareas is collected according to the hydrology manual. It is then required that the subareas be subdivided into flow-paths segments. These flow-paths are created according to the type of flow that exists or the proposed type of flow. After suitable data are collected and the subarea is divided into an appropriate number of flow-paths according to the various types of flow, the calculation of a time of concentration is done. This process will be described briefly below along with a description of the preparatory work that is done to collect data. The process is described in more detail in the Tc Calculator Manual provided with the program.

Collection of data usually involves obtaining a representation of the terrain and creating a map of the watershed and subarea boundaries, sub-dividing the subareas into segments that contribute to each time of concentration flow-path.



Sub-areas with Tc flow-paths

As shown in the figure above, the longest flow-path in each subarea must be determined for Tc calculations. The flow-path in each subarea should be subdivided based on flow type (overland, natural channel, street, pipe, etc.) and the direct runoff area to each segment determined. This flow-path information and runoff data are the basics needed for the calculation of Tc with the Tc Calculator program.

Travel times are based on flow velocities associated with overland flow and flow in various watershed conveyance facilities modified by wave velocity considerations. Overland flow on a canyon side slope or undeveloped hillside is dependent upon slope, topography, cover conditions, and travel distance. Previous versions of this Manual did not provide a length limit on the overland flow-path used in the Tc calculation. Some calculations used flow-path lengths of 1,500-ft or more. The District is currently limiting the maximum overland flow-path for undeveloped areas to 1,000 ft for the following reasons:

1. The selection of an overland flow-path length is critical to the results because the overland flow-path portion of the calculation is generally responsible for most of the time in a resultant Tc, and because the resultant peak flow is very sensitive to the Tc.
2. It is likely that overland flow in undeveloped areas will be channelized after a flow distance of 1,000-ft.

Minimum overland flow velocity for undeveloped overland flow areas is shown in Exhibit 8 for various frequency storm events. These are minimum values that apply to slopes with dense vegetal growth. Using engineering judgment, velocities assumed for bare slopes and slopes with sparse vegetal growth should be increased consistent with the reduced surface resistance. The length of the undeveloped overland flow-path is further limited for mountain channels (slopes greater than five percent) by evaluating the point where there is sufficient tributary area to produce flow with a scouring velocity of six to eight feet per second in a natural mountain channel. If there is enough flow to exceed the scour velocity, it is assumed that channelization will develop and the overland flow assumption is invalid.

It is recognized that because the flow used to determine if the scour point has been reached is based on a pro-rated value from the entire subarea under evaluation, the scour velocity point will change depending on downstream conditions. The scour velocity point will also change with design storm due to the changes in peak intensities and their effects on peak flows. The current 1,000 ft limit will minimize these effects to some extent. The maximum overland flow-path length in developed areas is limited to 200-ft. These limits are embedded in the Tc Calculator Program and are discussed in more detail in the Manual provided with the Program.

Parking lots or large paved areas such as are found in commercial or industrial areas have a sheet flow velocity of a minimum of 1.0 foot per second for 50- and 100-yr storms. For these storms, sheet flow in areas of extreme low relief where overland flow at 1.0 foot per second may exceed street flow velocity, an overland flow velocity of 0.5 foot per second for these storms may be acceptable if previously approved by the Hydrology Section. The minimum velocity for these areas for 25- and 10-yr storms is 0.5 fps.

In determining average travel velocities for streets, pipes, and open channels, uniform flow is assumed. Average velocity data for natural mountain channels are shown in Exhibit 9; natural valley channel velocity data are shown in Exhibit 10. To account for drops and falls that develop in steep mountain channels, slopes greater than ten percent determined from topographic information must be adjusted. Effective slopes were determined empirically from a survey of typical steep mountain channels in the San Gabriel Mountains and a correction curve is shown in Exhibit 7.

Using Manning's Equation and typical street cross sections from the Ventura County Road Standards Manual, normal velocities in common street sections were determined. The velocities were related to discharge and slope, and graphs of the data are shown in Exhibits 11a-d for streets of 32- and 40-foot widths, and six- and eight-inch curbs. Since graphs, tables, and programs are readily available from a variety of sources for determining flow velocities in pipes and lined channels, these data were not included in this manual.

Because a hydrograph represents a translatory flood wave, travel time between subarea collection points is based on wave velocity. Wave velocities for rectangular channels, trapezoidal channels, and pipes were determined theoretically by the Los Angeles County Flood Control District and checked using controlled experiments. The relationships are shown in Exhibits 12a-c. Wave velocities for natural mountain channels, natural valley channels, and for street sections are considered to be 1.5 times the average velocity.

4.2.2 Calculation Process

Once a watershed has been delineated and flow-paths determined, the Tc calculation is performed based on flow-path properties (length, slope, type, etc.), rainfall, and soil data. Several parameters are needed for input as follows:

1. Zone number, rainfall zone, and soil type are obtained by locating the area on the maps included in this Manual.
2. A desired rainfall frequency storm is selected for analysis.
3. The fraction of effective impervious area is determined from the actual impervious area from calculations from development plans and Exhibit 14a and b (Appendix A).
4. A generalized development type of the area is needed (Residential, Commercial, Undeveloped, Industrial).
5. Total area of the basin. (40-80-acres recommended)

Each subarea is divided into flow-path segments and each flow-path is specified as one of the following types and required data must be entered: Overland Flow; Natural Channel; Street; Pipe; and Channel

A Tc between 5 and 30 minutes based on the required range in the Hydrology Manual is assumed. Rainfall intensity for the assumed Tc is obtained from the file VCRAIN.DAT compatible with VCRat 2.5 corresponding to the rainfall zone and design storm recurrence interval. A Runoff Coefficient for the basin for pervious area is determined automatically from the file VCRAIN.DAT through linear interpolation of the values in VCRAIN.DAT. The runoff coefficient is dependent on the given intensity and soil type. The runoff coefficient that is used for the subarea is altered by the given % effective impervious area as follows:

C total = C * (1-% Impervious/100) + 0.95*(%. Impervious/100)

Total flow for the assumed Tc is calculated using the rational equation.

Q total = C total * Intensity * Area

Amount of flow for each flow-path is calculated.

Q segment = Q total * Fraction of total area

Wave velocity is calculated for each flow-path except for the initial overland flow-path segment. Travel time for each flow-path is computed by:

Travel Time = Length / Wave Velocity

Summation of travel times is equal to the calculated Tc. If calculated Tc is within 0.5 minutes of the assumed Tc, Tc can be used in the hydrology calculation. If calculated Tc is not within 0.5 minutes of assumed Tc, the assumed Tc is adjusted as follows, then the above steps are repeated:

1. If calculated Tc is greater than the assumed Tc – increase assumed Tc
2. If calculated Tc is less than the assumed Tc – decrease assumed Tc

The resultant Tc from the calculations must be greater than or equal to 5.0 minutes and less than or equal to 30 minutes. Subarea extents may have to be adjusted to produce a Tc in this range. Specific steps in launching and using the Tc Calculator program are described in the Time of Concentration Calculation Report (EMSI, 2006).

4.3 VCRAT PROGRAM INPUT DATA

The structure of the VCRat 2.2 program is complex and input data must be in the correct fields in order to get the program to execute successfully. Input data must be included in the order shown in Appendix C. VCRat 2.5 has been designed to be a user-friendly program that does the required formatting and builds the input data file for the user with the following features:

a. System Data.
b. Page Heading Data.
c. Hydrograph Header Data. (Optional)
d. Hydrograph Import Data. (Optional).
e. Location Data.
f. Subarea Data
g. Confluence Data
h. Channel Routing Data
i. Runoff Coefficient Curve Data.
j. Rainfall Mass Curve Header Data.
k. Rainfall Mass Curve Data.

Additional features provided in the VCRat 2.5 program include the following:

1. Performs the yield calculation for a watershed given a rainfall depth and SCS Curve Number
2. Header information can be assigned to each model node as desired and are no longer limited to nodes where hydrograph data output is desired. Header information is printed in the output so that it is not necessary to refer to the input to find your hydrograph or node description information.
3. Can launch the Tc calculator in the VCRat 2.5 data input window
4. Provides additional channel routing and time-of-peak data in the output
5. Indicates in the output where a routing channel type has been changed by the program during machine routing
6. Provides additional reservoir routing info in the output
7. Can run an existing VCRat 2.2 file without altering it
8. Can import an existing VCRat 2.2 file, evaluate it to see if any complex routing assumptions were used, and provide a report to the modeler
9. Displays the input and output hydrographs in a data window
10. Has additional error checking capabilities over VCRat 2.2
11. Has an extensive help file that explains the various parameters and options
12. Can export hydrographs in Excel format for additional analysis

Detailed information about the program is provided in the VCRat 2.5 Help Manual available after launching the program. The technical details of how the program operates are still the same as provided in the description of VCRat 2.2 included in Appendix C.

4.4 COMPUTATION PROCEDURES

4.4.1 Storm Rainfall Relationships

The VCRat 2.2 and VCRat 2.5 interfaces construct an input data file from the subarea and mass curve data input files and launch the VCRATP.EXE FORTRAN executable. The VCRATP.EXE executable has numerous subroutines (names provided in Appendix C) that are called to perform the hydrologic calculations. The VCRat programs interpolate rainfall mass curve data entered as data input in the VCRAIN.DAT file and constructs a system storage table of accumulated total rainfall by one-minute increments from zero rainfall to the time of the last point indicated by input data. Design storm rainfall mass curve data included in VCRAIN.DAT have the following cumulative rainfall totals:

Design Storm Fourth Day Rainfall Total, Inches

Rainfall Zone	100-Year Storm	50-Year Storm	25-Year Storm	10-Year Storm
J	7.00	5.0	3.91	3.17
J' (J prime)	6.66	6.0	5.28	4.38
K	10.60	8.0	6.41	5.53
L	15.00	11.0	8.81	7.21

The average rainfall intensity for any specified duration at a specified storm time is calculated by subtracting from the cumulative storm rainfall at the specified storm time from the cumulative storm rainfall at the earlier storm time as determined by the specified duration. Rainfall intensity in inches per hour is calculated as the incremental cumulative storm total, times 60 (minutes in an hour) divided by the specified duration (time of concentration in minutes). These results are shown in Appendix A exhibits. For the design storm, rainfall intensities are reduced if computations for other than the fourth day (maximum day) rainfall are specified. The reduction factor is 0.10, 0.40, 0.35, and 1.00 for first through fourth day, respectively. Thunderstorm rainfall intensities are reduced by a reduction curve coded into the program by to decrease rainfall intensity with increasing watershed size and evaluate the reduction in peak flow. The reduction data are provided in Appendix A.

4.4.2 Rainfall-Runoff Relationships

The system linearly interpolates runoff coefficient curve data entered as data input in VCRAIN.DAT and constructs a system storage table with up to 14 points, expressing runoff rate as a function of rainfall intensity. Infiltration rate (loss rate) data may be specified as data input as an alternative to runoff coefficient curve data. Through use of this table, runoff rate may be computed from a specified rainfall intensity by either (a) runoff coefficient times rainfall intensity or (b) rainfall rate minus infiltration rate (loss rate).

The watershed acreage, effective impervious area of the watershed, and time of concentration data plus systems tables provide the information necessary for the system to compute watershed discharge using the rational formula. The following equations are used to compute runoff rates:

$Q = CIA$
$R = I-f$
$C = R/I = (I-f)/I$ (No Impervious Area)
$Cimp= P(0.95) + C(1-P)$
$Q = [P(0.95)I + (1-P)R]A$

where:
A = Watershed area in acres.
C = Runoff coefficient.
f = Infiltration rate in inches per hour.
I = Rainfall intensity in inches per hour, assumed to be constant
P = Percent imperviousness/100.
Q = Flow rate in cubic feet per second.
R = Runoff rate in inches per hour.

4.4.3 Effective Impervious Values

Effective imperviousness is defined as the impervious area that provides runoff without passing through a pervious area where some impervious area infiltration can occur. For example, roof drains that outlet into the front yard may see a reduction in runoff due to infiltration and thus the effective impervious area will be less than the actual impervious area. Roof drains that outlet into a street provide no opportunity for infiltration and thus the effective impervious area would be the same as the total impervious area. Compaction is also generally done uniformly across the development site, decreasing the amount of infiltration that can occur, even in a pervious area. These and other applicable factors should be evaluated by the engineer prior to performing the runoff calculations.

Computations evaluate runoff from pervious and impervious portions of the watershed separately. It is assumed that 5 percent of rain falling on impervious surfaces will not appear as runoff due to evaporation and surface storage. Previous versions of the Hydrology Manual only provided for three recommended values for effective imperviousness for residential, commercial, and industrial development. In this Manual, additional values are provided for various development densities and types. Recommended effective impervious percentages generally used for projected ultimate development are provided in Appendix A in Exhibits 14a and b for use in VCRat modeling. However, it is the responsibility of the hydrologist to evaluate the effective impervious area of their project if it is different than the recommended values.

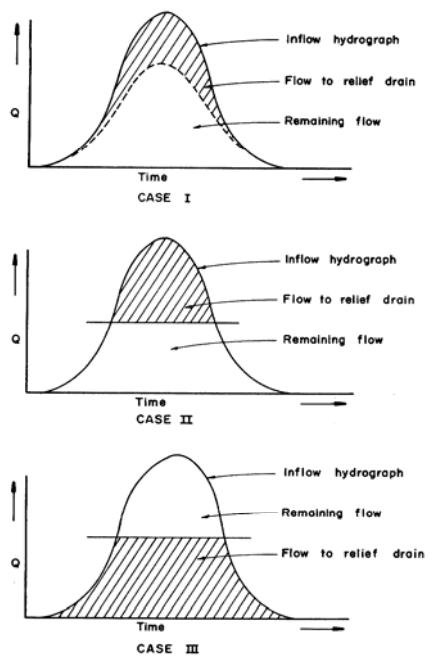
4.5 CONFLUENCE AND DIVERSION STRUCTURE FLOWS

Flow rates calculated for a subarea at specified storm times as described herein provide points describing the storm runoff hydrograph from the subarea. At each collection point, subarea hydrographs are added to the flow present in the drain system from upstream portions of the watershed. Where specified,

coincident peak flow rates are printed at the peak flow rate time of each hydrograph for use in hydraulic design of the drain system. Confluence inflow and outflow hydrographs are printed and output files generated as needed. Confluence information provided by the program includes the following three sets of data:

1. At the time of peak flow in primary drain, flow information includes primary peak flow, combined flow, and flow in lateral.
2. At the time of peak flow in lateral drain, flow information includes lateral drain peak flow, combined flow, and flow in primary drain.
3. At the time of peak combined flow in primary drain, flow information includes combined peak flow, primary drain flow, and lateral drain flow.

At the junction of two drains where one of the drains functions as a relief drain, the hydrograph may be separated into two parts. In Case I as shown below, flow I is proportioned on a percentage basis to not exceed the peak flow allowable to remain in the drain with residual transferred to the relief drain. In Case II, flow is separated such that all flow up to drain capacity remains in the drain with excess flow transferred to the relief drain. In Case III, flow is separated such that all flow up to a specified flow rate is transferred to the relief drain, and excess flow remains in the drain. The input data required to specify the various options are shown in Appendix C.



Split Flow Cases:

Case I- Specified percent of flow to relief drain
Case Ia- Program compares drain peak to specified value flow value (smaller than peak), calculates percent reduction, and transfers percent of flow to relief drain.

Case II – Flow in excess of specified value to relief drain

Case III – Flow in excess of specified value remains in channel, remainder to relief drain.

4.6 FLOOD ROUTING

Specific channel sections, including natural mountain channel, natural valley channel, standard street section, circular pipe and rectangular or trapezoidal channels, may be specified as water conveyances.

The pipe diameter or channel side slopes, bottom width, and depth may be specified. In the case of a trapezoidal section with an unlined bottom, the maximum velocity to control scour through use of drop structures, and various composite lining roughness values may be specified. The channel length and slope plus channel section data provide the information necessary for the system to route the hydrographs in a drain from one subarea to the next.

4.6.1 Machine Routing

If machine routing is specified, the system will begin flood routing in a drain at the upstream limits of the watershed using an assumed street section and will automatically change from street to pipe section when flow depth reaches the property line, from pipe to rectangular channel when pipe diameter of 8 feet is exceeded, and from the hydraulically most efficient rectangular section to a rectangular section with maximum depth of 13 feet when that depth is reached. To maintain consistency of drain type and size, the system checks the type of drain used in the preceding upstream channel reach, and retains that section if it is large enough to contain the flow. In a rectangular or trapezoidal section, the upstream reach bottom width is retained until flow depth increases by more than one foot. Pipe sizes used by the system increase in 3-inch increments from 2.0 to 8.0-feet. Rectangular and trapezoidal bottom widths used by the system increase in 2-foot increments from 2 to 30 feet, 10-foot increments from 30 to 80 feet, 50-foot increments from 100 to 300 feet, and 100-foot increments from 300 to 1000 feet.

Machine routing is selected by leaving the channel type blank in the 006 data line in VCRat 2.2 but entering a channel length and slope to be used in flow routing. Additionally, a channel type can be selected in the 006 card but the width or diameter left blank. In this case, the program will size the specified channel. If the flow is too large for the type of channel selected, the program will automatically select a larger channel type and size it appropriately.

4.6.2 Wave Velocity and Areal Reduction in Flood Routing

Since the hydrograph constitutes a translatory flood wave, routing is performed at wave velocity. At the lower end of each reach the hydrograph is checked for a time shift and redefined by interpolation to obtain flow rates at storm times as specified by hydrograph data points. The hydrograph, as affected by channel storage, is next computed using a reservoir routing method (Modified Puls), with time periods for routing determined by spacing of rainfall data input.

Hydrologic calculations for design of storm drain projects for areal reduction runs can use the thunderstorm rainfall (T01- similar to the 50-yr K zone rainfall) distribution or the A97, B98, or C99 100-yr storm distributions provided in the VCRAIN.DAT file. As watershed size increases, the recalculation of subarea hydrographs using the resulting decreased rainfall intensities may be specified, with flood routing recycled using previously computed drain sizes to determine appropriate hydrographs for downstream flood routing purposes. The areally-reduced (AR) flow result is only valid at the node where AR is specified in the data input line.

4.6.3 Flood Routing Equations

The following equations are used for flood routing purposes:

Equation	Application
$T=L/(60Vw)$	
$V=Q/A$	
$V=5.6Q^{0.333}S^{0.5}$	Natural Mountain Channels
$V=(7+8A^{0.352})S^{0.5}$	Natural Valley Channels
$V=11.9Q^{0.191}S^{0.411}$	40-ft Street Sections
$V=1.486R^{0.667}S^{0.5}/n$	Manning's Equation for pipes and rectangular and trapezoidal channels
$D=B/\{2[(Z^2+1)0.5-Z]\}$	Most Efficient Open Channel Section
$n=[n_1B+n_2(2\ell)]/(B+2\ell)$	Composite Lining of Trapezoidal Channel
$Vw=1.5V$	Wave Velocity- Natural Mountain and Valley Channels and Street
See Appendix A	Wave Velocity, Partially Full Pipe
See Appendix A	Wave Velocity, Rectangular and Trapezoidal Channels
$I_1+I_2+2S_1/t-O_1=2S_2/t+O_2$	Storage Routing Equation
$\Theta=4\sin^{-1}(D/d)^{0.5}$	Angle in Radians for Partially Full Pipe

Where:

A	=	cross section area in square feet
B	=	channel bottom width in feet
D	=	flow depth in feet
D	=	pipe diameter in feet
I	=	inflow to channel reach in cfs
I_1	=	instantaneous inflow at beginning of time period t.
I_2	=	instantaneous inflow at end of time period t.
L	=	length of channel reach in ft
ℓ	=	length of wetted channel wall in ft
n	=	channel roughness coefficient
n_1	=	roughness coefficient for channel bottom
n_2	=	roughness coefficient for channel walls
O	=	outflow from channel reach in cfs
O_1	=	instantaneous outflow at beginning of time period t
O_2	=	instantaneous outflow at end of time period t
Q	=	flow rate in cubic feet per second
R	=	hydraulic radius
S	=	slope of channel reach in feet per foot
S_1	=	channel storage at beginning of time period t
S_2	=	channel storage at end of time period t
T	=	travel time in minutes
t	=	time period for routing purposes in minutes
V	=	mean velocity in fps
Vw	=	wave velocity in fps
Z	=	channel side slope computed as horizontal projection of wall divided by depth in feet per foot

4.7 WATERSHED YIELD ADJUSTMENT

The hydrograph produced by application of the modified rational method produces a conservative peak flow for use in drainage system design through the development of the rainfall distribution using the maximum rainfall intensity data from across the watershed. Because of this, the volume under the hydrograph may not be consistent with the watershed yield obtained through application of other hydrological methods such as the SCS curve number approach. Because the hydrograph volume is critical in detention and storage facility design, the District has developed the VCRat 2.2 and 2.5 programs to adjust the yield of the resultant hydrograph (often called hydrograph "fattening") for use in basin design. This methodology should not be used in the design of regional detention and storage facilities. For those facilities, other standard hydrologic methods pre-approved by the District should be used to generate the design inflow hydrograph so that the outlet works design is done correctly. Design of these facilities should be done in conjunction with District staff.

For small developments and basins, however, the VCRat method can be used to generate a design hydrograph as follows:

1. Use VCRatX.X to produce an inflow hydrograph for your design storm and tributary watershed.
2. Find the total design storm rainfall depth (generally 24-hour, 10- or 25- or 50- or 100-yr rain total) at the centroid of the tributary watershed.
3. Use shapefile or maps supplied by the District to find the average soil type in the watershed.
4. Choose an SCS curve number that represents the soil type from Step 3 and your land use from Exhibit 14a and b.
5. Use Exhibit 13 to find the watershed yield in inches using the CN from Step 4 and the total design storm rainfall depth from Step 2.
6. Enter this as a yield adjustment factor in the model data input file above for VCRat 2.2 or VCRat 2.5. In 2.5 you can also enter the rainfall and curve number directly and the program will calculate the resultant yield for you.
7. As a check, the volume of the output hydrograph should equal the yield adjustment factor times the area of the tributary watershed after the units are converted.

VCRat 2.2 and VCRat 2.5 perform the yield adjustment by increasing or decreasing the hydrograph ordinates until the desired volume is achieved. The peak of the hydrograph is not changed but flow values in the vicinity of the peak can be increased up to the peak if necessary to provide the desired volume.

4.8 VCRAT 2.2 PROGRAM COMPLEXITIES

The flexibility of the VCRat 2.2 program has led to a number of possibly unexpected results from historic models as described in the following subsections.

4.8.1 Machine Routing Specified But n Value or Sideslope Specified

A model can be prepared using the machine routing capability by not specifying a channel type in a subarea data input line but providing a channel length and slope. If the user enters a channel side slope

and/or an n value, this information is ignored until the routing routine has enough flow to select the use of an open channel. At that point, any specified values are applied to the channel.

4.8.2 Stage-Storage-Discharge Curve

VCRat expects the first point on a stage-storage-discharge curve to correspond to 0.0 ac-ft. If it is not 0.0 ac-ft, the program cannot interpolate the stage-storage curve correctly and provides erroneous results for the maximum spill elevation reached during outflow. This error can also affect the length of spill and peak outflow information provided in the output.

VCRat 2.2 does not require the reservoir spillway elevation to be entered in the input file. This can result in inaccurate spill durations provided in the output because the program defaults to a spillway elevation of 0 feet. The peak flow of the output hydrograph is not affected by this.

VCRat 2.2 does not require sequential points in the stage-storage-discharge data to increase or be the same value. This allows the user to enter elevations that are lower than the previously entered values without causing a fatal error. This results in inaccurate routing through the reservoir by the program.

4.8.3 Incorrect Rainfall Mass Curve Information

In certain cases, an incorrect rainfall mass curve designation can be entered into the data input file for VCRat 2.2 and the program might still run and not indicate any problems. For example, a curve B97 can be specified which is not defined in VCRain.dat. VCRat 2.2, when using mass curves beginning with a letter between A-I, only checks the numerical value following the letter (in this case 97) and thus would use rainfall curve A97 in this example (J' Zone- 100-Yr) instead of B98 (K Zone-100-Yr) for this subarea. Currently, the VCRat 2.5 import program also uses the number following the letter designation to determine which mass curve to use for a subarea but adds an issue/warning message to let the user know that there may be an issue with the design storm specification.

4.8.4 Specifying Width for Road Routing

It is possible to enter a width while specifying routing type 3 (which by default in VCRat 2.2 uses the velocity-slope-discharge data for 40' road). The effect in VCRat 2.2 is to force the flow to stay in the road and not have the program automatically change to a pipe or a channel when the flow is large enough. This allows the modeler to simulate channel overflows that occur as street flow at road crossings such as in the Tapo Canyon channel in Simi Valley. It does not matter what the specified width value is- the resulting flow will be the same because the program uses the default 40' street velocity/flow depth info embedded in the program.

4.8.5 Pipe Diameter Not Specified But N Value Specified

VCRat 2.2 ignores the n value when it is entered and uses the default value of 0.012 when pipe flow is specified for the channel type but no diameter is specified. If flow is large enough for the program to select a channel, the n value is used by the program at that point.

4.8.6 Channel Type 5 with Depth or Velocity Specified

VCRat 2.2 ignores any maximum depth or velocity information associated with channel type 6 entered by the user if channel type 5 is specified. VCRat 2.5 provides a warning message about this if the file is imported.

4.8.7 Natural Valley or Mountain Channel Routing but N Value or Width Specified

If natural valley or mountain channel routing is specified but an n value or width is specified, VCRat ignores this information during the run.

4.8.8 Pipe Routing Specified and Diameter Specified

If pipe routing is selected and a specified pipe diameter is given, this forces the program to use that pipe size for the routing. If the diameter is not adequate to carry the calculated flow, the program will force flow through the pipe under pressure, with unrealistic velocities that affect travel times and routing calculations.

4.8.9 Clearing Hydrograph Bank

Clearing of a hydrograph should occur before any other operation for that node. This needs to be performed when importing a hydrograph or after performing a split and before using the lateral channel letter for a new subarea. Otherwise the hydrograph stored in the lateral will be added to the new subarea information and the peak flow results will be not be correct new subarea.

SECTION 5 DESIGN PROCEDURES AND TOPICS

The following sections provide information on topics affecting the design procedures. Several examples are provided to demonstrate the use of the design techniques to calculate peak flows in Appendix B.

5.1 USE OF VCRAT FOR FLOODPLAIN ROUTING AND BREAKOUT SIMULATION

Although the VCRat program has been upgraded over the years to provide limited routing capabilities, in some cases the program has been used to simulate floodplain routing and/or flow breakouts that occur as streetflow and confluence with the channel flow downstream of the breakout location. The District does not consider the VCRat program to be suitable to perform hydraulic routing where timing differences between the channel and breakout flow can reduce the channel peak flow significantly. If this occurs, the peak flows provided by the program should be transferred to a hydraulic program that provides routing methods that can adequately simulate complex flow patterns.

5.2 DISTRICT HYDROLOGY DATA AVAILABILITY

The streamflow, rainfall, and evaporation data available electronically at the District are available through the http://www.vcwatershed.org/hydrodata/htdocs/static/ website. This website allows the users to download formatted or text files of daily flows and rainfall for the District's gages. It also shows maps of the gage locations, graphs of the data, and provides station information. The Frequently Asked Questions file shown on the website provides a detailed description of the available data and quality control codes. Limited hourly flows and rainfall are also available through the website. Other data planned to be added to the website include station information, short- and long-term precipitation frequency analyses using the Pearson III model and flow frequency analysis results using the Log Pearson III model on annual peak flow data. If you need District data for your studies that are not currently available through the website, you can fill out the Data Request Form available on the website and email the request to HydroData@Ventura.Org. The Hydrology Section will review your request and provide a response and/or the data in a timely fashion. If you request data that requires extensive processing, costs for the processing will be charged according to the policy set in 2006 by the Ventura County Board of Supervisors.

5.3 PRO-RATING DESIGN FLOWS

When development projects consist of small areas that do not meet the Hydrology Manual minimum subarea guidelines of 40-80 acres, it is possible to estimate the change in peak flows from the project area using pro-rated values based on the unit runoff. The steps are as follows:

1. Find the subarea that incorporates the project area in a city Master Drainage Plan or official District VCRat hydrology model.
2. Find the peak flow for that subarea in the hydrology model results.
3. Calculate the unit runoff in cfs/acre for the subarea.
4. Multiply the unit runoff by the project area- this is the estimated peak flow for the project area.
5. Repeat the analysis for other design storms as necessary according to the conditions of your peak flow mitigation requirements.

If a detention basin is required for attenuating peak flows, contact the District Hydrology Section with information about your project and they will provide a design methodology for you.

5.4 USE OF HYDROLOGIC MULTIPLIERS

Time of Concentration (Tc) values required for each subarea in the VCRat model are a function of rainfall intensity and therefore design storm recurrence interval. Because of this, they have to be recalculated for each design storm. Because hand Tc calculations are time-intensive, in the past the District developed a table of hydrologic multipliers based on frequency analyses of flow to estimate other design storm flows once the results from one design storm were available. Additionally, the 1992 Hydrology Manual only provided the 50-yr 24-hr rainfall design storm depths for use in yield calculations, and there was a need to estimate other design storm values using average design storm rainfall ratio multipliers.

Currently, the Tc calculator has been automated so that it is relatively easy to calculate Tc's for all design storms of interest once the subarea physical data have been entered into the calculator. The current Hydrology Manual now provides the 24-hr rainfall depths for the 10-, 25-, 50-, and 100-yr storms. Therefore, there is no longer a need to use the Hydrology Multipliers in design calculations and these will no longer be provided.

5.5 TIME OF CONCENTRATION CALCULATIONS

Because hand calculations of the Time of Concentration (Tc) values required for each subarea in the VCRat model were time-intensive, previously the hydrologist was only required to calculate Tc's for 20 percent of the subareas. The hydrologist could then use those results to estimate Tc's for the other subareas if they were hydrologically-similar. In addition, Tc's for other design storms were often assumed based on engineering judgment instead of recalculating them. The current Tc calculator program automatically does the iterations necessary for the calculation and therefore greatly decreases the time necessary for a single Tc. Also, the program makes it easy calculate Tc's for all design storm levels once the Tc input data file is generated. Because of these factors, currently the hydrologist is required to calculate Tc for 75 percent of the developed subareas and 25 percent of the undeveloped subareas included in the hydrologic model. Engineering judgment can be used to estimate Tc's for the other subareas as long as they are hydrologically similar in slope and development type to the subareas where Tc's have been calculated directly.

5.6 DESIGN STUDY SUBMITTAL MATERIALS FOR PERMIT REVIEW APPLICATIONS

Often hydrology studies are performed to demonstrate the effects of development and required mitigation strategies on the District's jurisdictional channels and are submitted to the Permits Section for review. At a minimum, the required submittal materials for hydrology studies for encroachment and watercourse permit reviews by the Permits or Hydrology Section should include the following:

1. Hydrology report with Table of Contents clearly indicating the page numbers of the report sections including executive summary, hydrologic model input and output results , Tc calculations, summary result tables, hydraulic calculations, routing results, and NPDES calculations.

2. Report should be signed and stamped by a California Registered Civil Engineer
3. Statement of criteria used in the study and applicable agency (Example: Mitigate 100-yr developed condition peak flow to 10-year undeveloped peak flow as specified by the City of Moorpark).
4. Description of watershed and any special features in it, including undeveloped and developed hydrologic and hydraulic conditions.
5. Summary table of results clearly showing that the design has met the mitigation requirements.
6. Electronic files and/or hardcopies of Exhibits from VCWPD Hydrology Manual used in the study.
7. Electronic copies of the Tc Calculator and VCRat input and output files used in the study in addition to any hardcopy results provided.
8. Tc calculation documentation should show subarea boundaries and development type used in evaluation as well as various flowpaths and related subarea portions.
9. Hydraulic calculations used in study. If a proprietary detention basin routing program is used, provide electronic files.
10. If resubmitting a package in response to comments, provide a cover letter clearly indicating how the originally reviewed report has been changed and page numbers of any additional requested items. A copy of any comments received from the District should be included in the package.
11. Undeveloped and developed condition hydrology hardcopy maps showing subarea boundaries, node I.D.s used in modeling, Tc's, elevation contours, drainage system alignments and sizes, building locations, elevation datum, and other common map information included on engineering drawings. Maps should also be submitted electronic format.

This list is not meant to be comprehensive, and other materials may be required by the District to fulfill the requirements of the permit review.

5.7 DESIGN EXAMPLES

To illustrate use of the proposed method for computing design flow rates, two detailed examples are presented in Appendix B. The first example describes the recommended procedure for computing both a peak flow rate and runoff hydrograph considering the entire tributary drainage area as a single unit. This is appropriate only when channel routing is not necessary and only for watershed areas with a time of concentration between five minutes and 30 minutes. The first example also demonstrates a technique for adjusting the volume of runoff associated with a storm hydrograph. Reasonable storm volumes are important for the design of pumping stations and small detention basins.

Complete drainage areas with total times of concentration greater than 30 minutes must be subdivided into smaller subareas and a time of concentration computed for each. Runoff hydrographs are then computed for each subarea, routed, and combined with other subarea hydrographs to establish design flow rates. Because of the complex calculations required for the hydrograph routing, it is necessary to use the VCRat program to model multiple subareas with channel routing. Example Two in Appendix B describes the necessary procedures for use in subarea definition and model development using VCRat.

The Exhibits for the examples are provided in Appendix A.

SECTION 6 REFERENCES

Boyle Engineering, 1966 Program for Flood Control Improvements, Ventura County Flood Control District Zone III, November, 1965.

EMSI, 2006. Time of Concentration Calculator, Ventura County Watershed Protection District.

Larry Walker Associates, July, 2002. "Technical Guidance Manual for Stormwater Quality Control Measures"

Ventura County Flood Control District, 1967. Design Manual.

APPENDIX A: EXHIBITS

EXHIBIT 1A. DESIGN STORM RAINFALL CONTOURS- 100-YR STORM

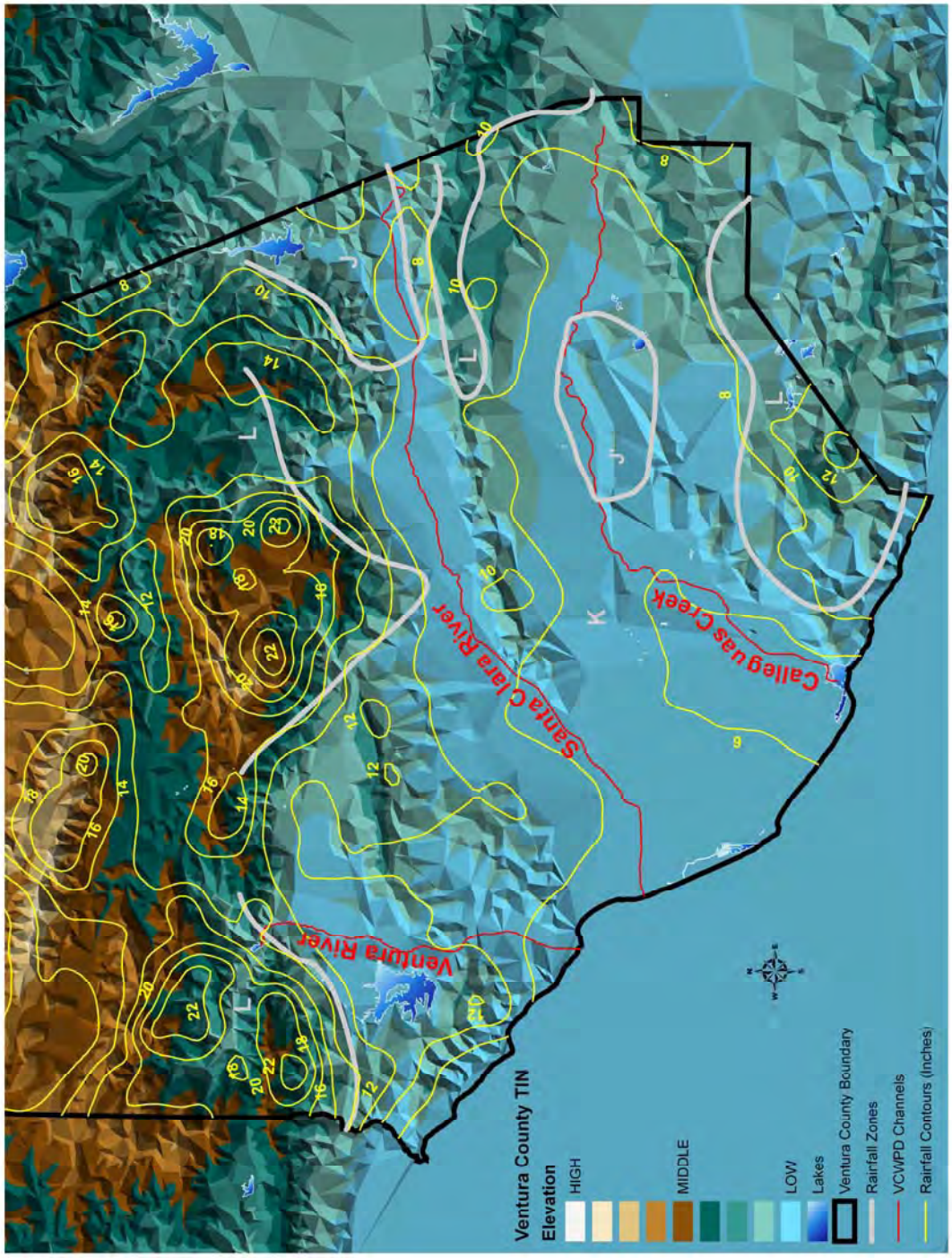


EXHIBIT 1B. DESIGN STORM RAINFALL CONTOURS- 50-YR STORM

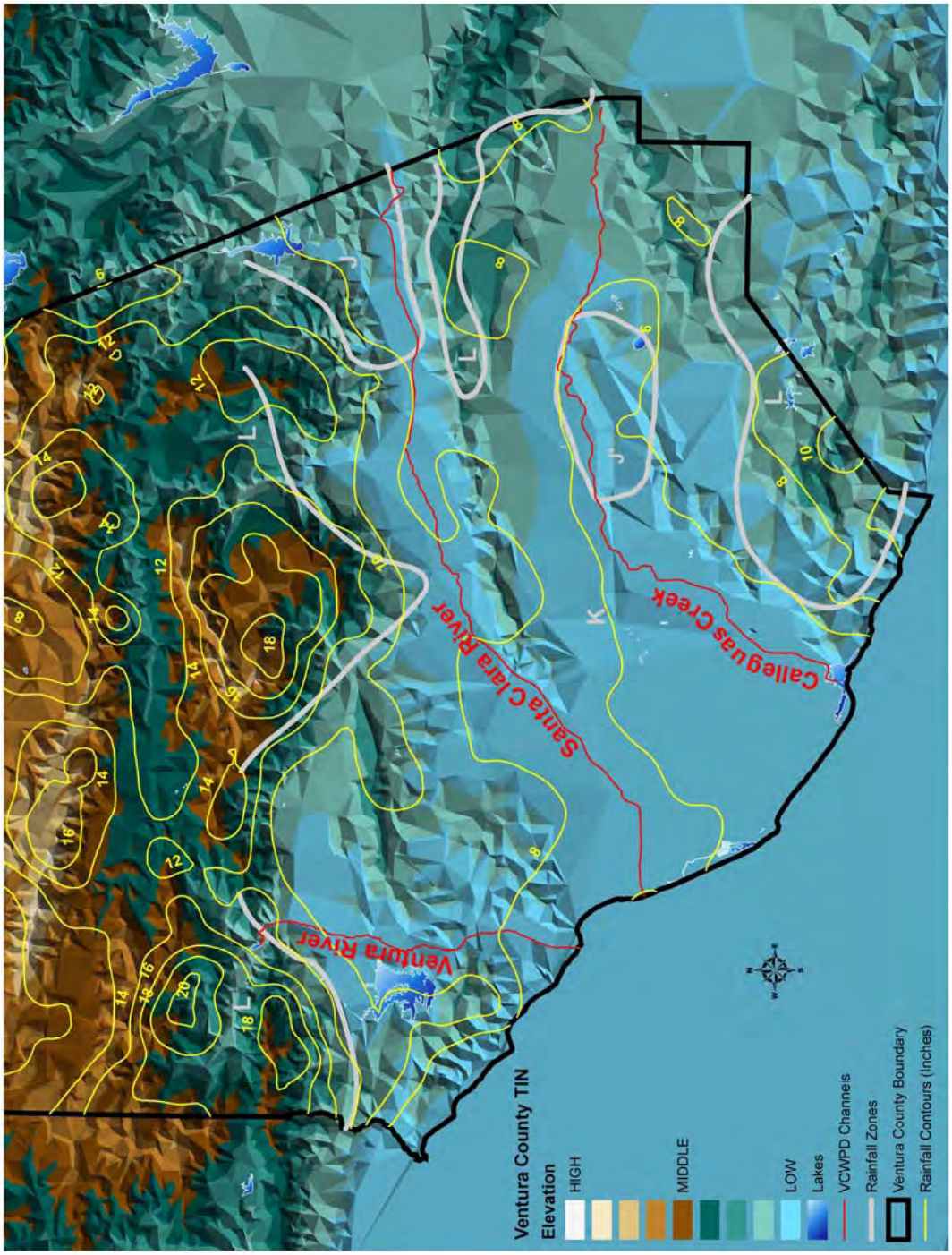


EXHIBIT 1C. DESIGN STORM RAINFALL CONTOURS- 25-YR STORM

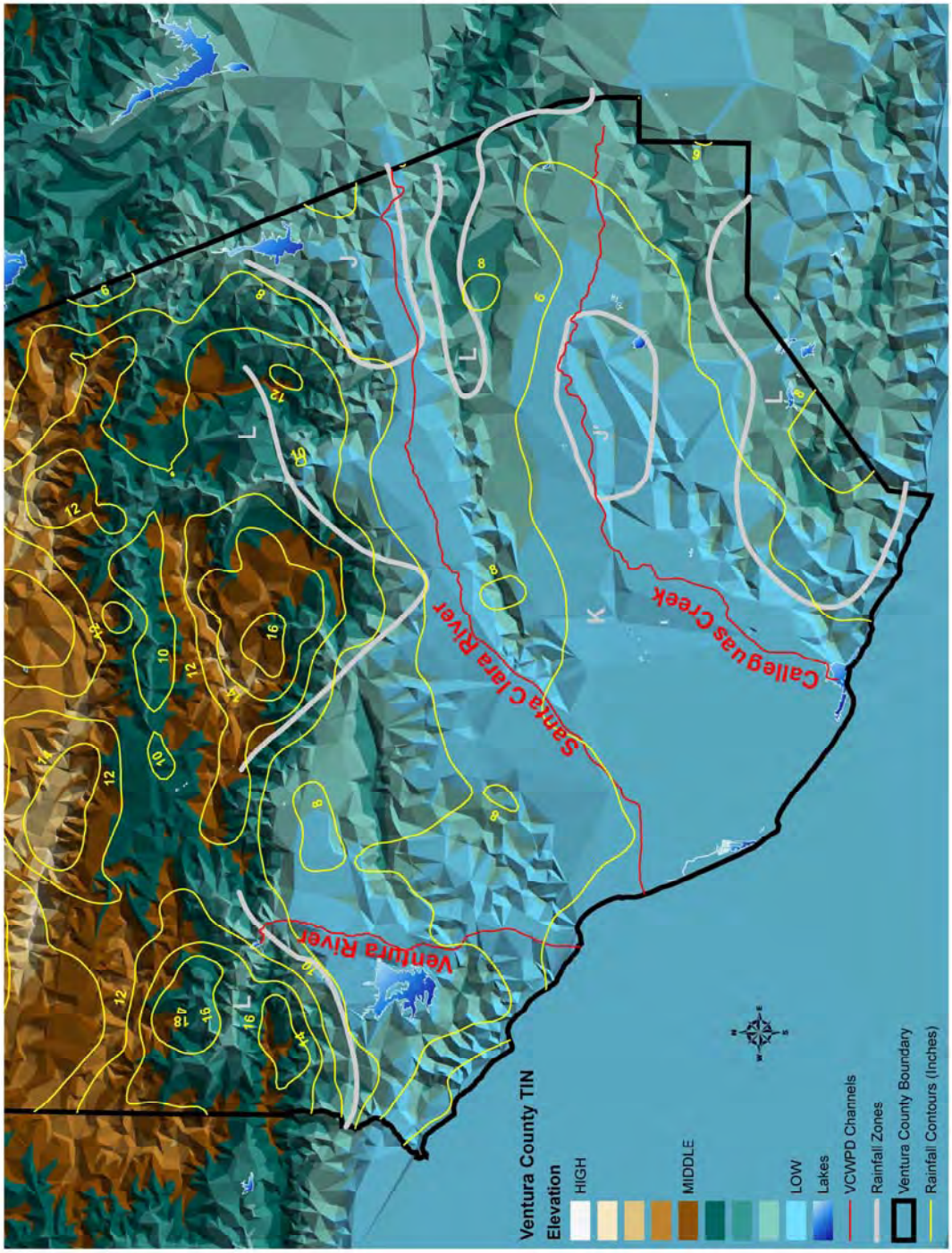


EXHIBIT 1D. DESIGN STORM RAINFALL CONTOURS- 10-YR STORM

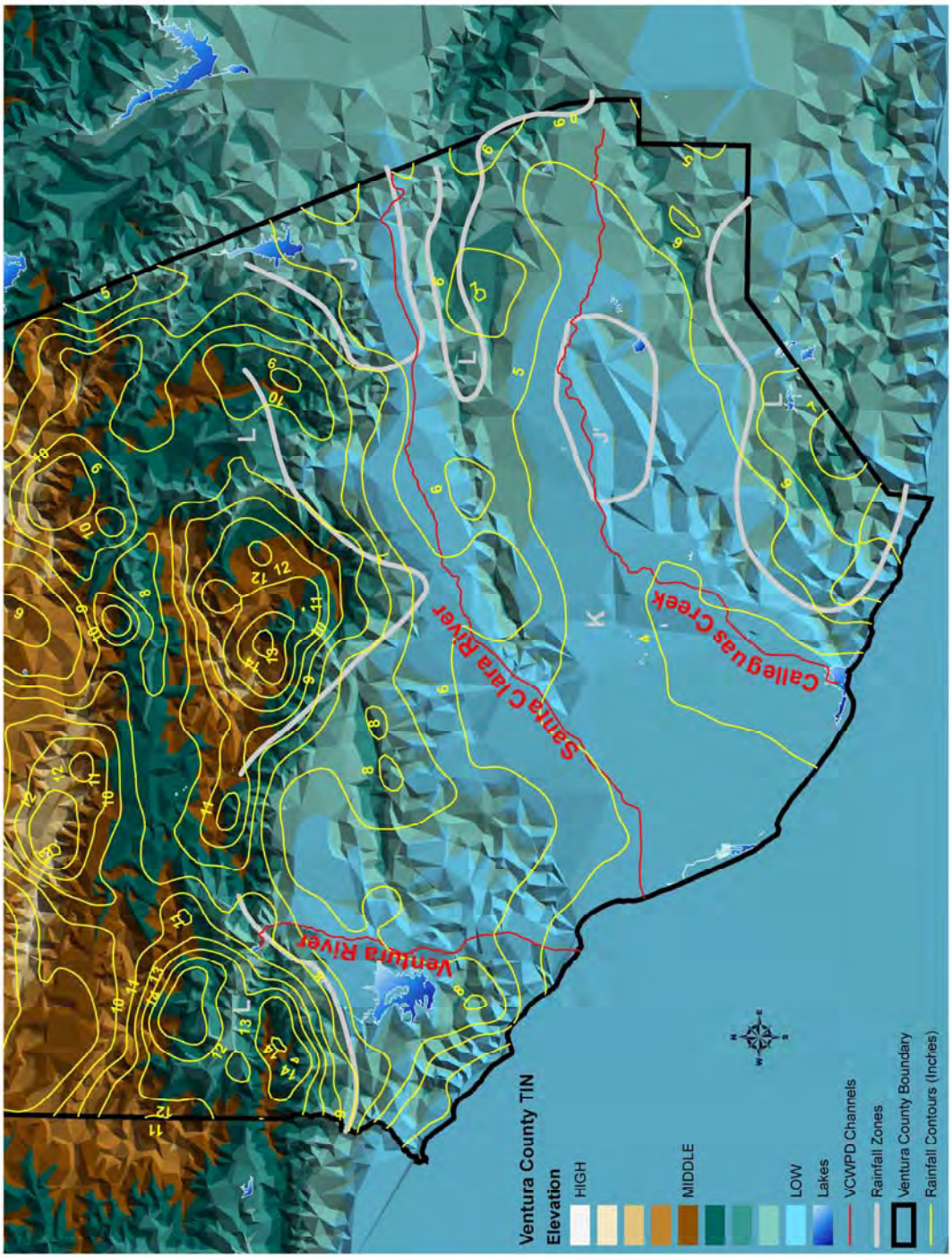


EXHIBIT 2. MAXIMUM RAINFALL INTENSITIES

Zone	J	Jp	K	L	J	Jp	K	L	J	Jp	K	L	J	Jp	K	L
Year	**10**	**10**	**10**	**10**	**25**	**25**	**25**	**25**	**50**	**50**	**50**	**50**	**100**	**100**	**100**	**100**
Cum. Rain (in.)	**3.17**	**4.38**	**5.53**	**7.21**	**3.91**	**5.28**	**6.41**	**8.81**	**5.0**	**6.0**	**8.0**	**11.0**	**7.0**	**6.66**	**10.6**	**15.0**
Tc (min)	**Maximum Rainfall Intensity (in/hr)**															
5	2.16	2.16	3.72	4.31	2.64	3.34	4.27	4.94	2.94	3.79	4.55	5.58	3.23	4.06	5.10	6.11
6	2.02	2.01	3.40	3.90	2.52	2.94	3.80	4.39	2.80	3.34	4.10	5.05	2.90	3.55	4.59	5.43
7	1.86	1.90	3.09	3.56	2.30	2.65	3.45	3.99	2.55	3.01	3.77	4.63	2.67	3.19	4.23	4.95
8	1.74	1.82	2.86	3.30	2.14	2.58	3.19	3.69	2.36	2.93	3.52	4.28	2.50	2.99	3.95	4.58
9	1.63	1.76	2.68	3.07	1.99	2.44	2.99	3.45	2.21	2.77	3.33	4.00	2.36	2.87	3.74	4.30
10	1.53	1.70	2.52	2.86	1.87	2.29	2.81	3.24	2.08	2.60	3.16	3.76	2.25	2.78	3.57	4.07
11	1.45	1.64	2.40	2.70	1.76	2.17	2.66	3.07	1.95	2.46	3.02	3.56	2.13	2.67	3.39	3.88
12	1.38	1.59	2.29	2.56	1.66	2.07	2.53	2.92	1.85	2.35	2.90	3.39	2.02	2.58	3.23	3.72
13	1.33	1.55	2.20	2.44	1.58	1.98	2.43	2.80	1.76	2.25	2.80	3.25	1.94	2.49	3.10	3.59
14	1.28	1.51	2.12	2.34	1.52	1.90	2.34	2.70	1.68	2.16	2.72	3.13	1.86	2.42	2.99	3.47
15	1.23	1.47	2.04	2.25	1.46	1.84	2.26	2.60	1.62	2.09	2.62	3.02	1.80	2.36	2.89	3.37
16	1.18	1.43	1.98	2.18	1.40	1.78	2.18	2.50	1.56	2.02	2.54	2.92	1.73	2.29	2.79	3.25
17	1.14	1.39	1.92	2.11	1.36	1.73	2.12	2.42	1.50	1.96	2.47	2.83	1.67	2.22	2.70	3.14
18	1.11	1.35	1.86	2.04	1.31	1.68	2.06	2.34	1.45	1.90	2.41	2.75	1.61	2.16	2.62	3.05
19	1.07	1.32	1.82	1.99	1.27	1.63	2.01	2.28	1.41	1.86	2.35	2.68	1.56	2.11	2.55	2.96
20	1.04	1.29	1.77	1.94	1.24	1.60	1.96	2.22	1.37	1.81	2.29	2.62	1.52	2.07	2.49	2.88
21	1.02	1.26	1.73	1.90	1.20	1.55	1.91	2.17	1.33	1.76	2.23	2.55	1.48	2.03	2.43	2.82
22	0.99	1.23	1.68	1.85	1.17	1.51	1.87	2.12	1.30	1.72	2.17	2.49	1.44	1.99	2.36	2.76
23	0.97	1.21	1.65	1.82	1.14	1.48	1.83	2.07	1.27	1.68	2.12	2.44	1.41	1.95	2.31	2.70
24	0.95	1.19	1.62	1.78	1.12	1.44	1.79	2.03	1.24	1.64	2.07	2.39	1.38	1.92	2.26	2.65
25	0.93	1.16	1.58	1.75	1.09	1.41	1.76	1.99	1.21	1.61	2.03	2.34	1.35	1.89	2.22	2.60
26	0.90	1.14	1.56	1.72	1.07	1.39	1.73	1.96	1.18	1.57	1.98	2.29	1.32	1.86	2.17	2.56
27	0.88	1.13	1.53	1.68	1.05	1.36	1.70	1.92	1.16	1.54	1.94	2.25	1.29	1.83	2.13	2.51
28	0.87	1.11	1.50	1.66	1.03	1.34	1.67	1.89	1.14	1.52	1.90	2.21	1.27	1.80	2.09	2.46
29	0.85	1.09	1.48	1.63	1.01	1.31	1.64	1.87	1.12	1.49	1.87	2.17	1.24	1.77	2.05	2.42
30	0.83	1.08	1.46	1.61	0.99	1.29	1.61	1.84	1.10	1.47	1.84	2.13	1.22	1.74	2.02	2.38

EXHIBIT 2A. RAINFALL INTENSITIES - J ZONE- 100-YR

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
200	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
400	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
600	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
900	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
1000	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
1050	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
1100	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
1110	0.44	0.44	0.44	0.44	0.44	0.44	0.43	0.43	0.42	0.42	0.42	0.42	0.41	0.41	0.41	0.41	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
1120	0.49	0.49	0.49	0.49	0.49	0.49	0.48	0.48	0.48	0.47	0.47	0.47	0.47	0.46	0.46	0.46	0.46	0.45	0.45	0.45	0.44	0.44	0.44	0.44	0.44	0.43
1130	0.58	0.58	0.58	0.58	0.58	0.58	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.51	0.51	0.51	0.50	0.50	0.50
1131	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.56	0.55	0.55	0.55	0.54	0.54	0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.51	0.51	0.51	0.51	0.50
1132	0.57	0.57	0.57	0.58	0.58	0.58	0.58	0.58	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.51	0.51	0.51
1133	0.59	0.59	0.59	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.57	0.56	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.52
1134	0.61	0.60	0.60	0.60	0.59	0.59	0.59	0.59	0.59	0.59	0.58	0.58	0.57	0.56	0.56	0.56	0.55	0.55	0.55	0.54	0.54	0.54	0.53	0.53	0.53	0.52
1135	0.64	0.63	0.62	0.61	0.61	0.61	0.60	0.60	0.60	0.60	0.60	0.59	0.58	0.58	0.57	0.57	0.56	0.56	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.53
1136	0.66	0.64	0.63	0.62	0.62	0.61	0.61	0.61	0.61	0.60	0.60	0.60	0.59	0.59	0.58	0.58	0.57	0.57	0.56	0.56	0.56	0.56	0.55	0.55	0.54	0.54
1137	0.67	0.66	0.64	0.64	0.63	0.62	0.62	0.62	0.61	0.61	0.61	0.60	0.60	0.60	0.59	0.59	0.58	0.58	0.57	0.57	0.57	0.56	0.56	0.56	0.55	0.55
1138	0.68	0.68	0.67	0.65	0.64	0.64	0.63	0.63	0.62	0.62	0.62	0.61	0.61	0.61	0.60	0.60	0.59	0.59	0.58	0.58	0.58	0.57	0.57	0.57	0.56	0.56
1139	0.68	0.68	0.68	0.67	0.65	0.65	0.64	0.63	0.63	0.63	0.62	0.62	0.62	0.62	0.61	0.61	0.60	0.60	0.59	0.59	0.58	0.58	0.58	0.57	0.57	0.56
1140	0.67	0.68	0.68	0.68	0.67	0.65	0.65	0.64	0.64	0.63	0.63	0.62	0.62	0.62	0.62	0.62	0.61	0.60	0.60	0.59	0.59	0.58	0.58	0.58	0.58	0.57
1141	0.72	0.71	0.71	0.70	0.70	0.69	0.68	0.67	0.66	0.66	0.65	0.64	0.64	0.64	0.63	0.63	0.63	0.62	0.62	0.61	0.61	0.60	0.60	0.59	0.59	0.59
1142	0.77	0.75	0.74	0.74	0.73	0.72	0.71	0.70	0.69	0.68	0.67	0.66	0.66	0.66	0.65	0.65	0.64	0.64	0.63	0.63	0.62	0.62	0.61	0.61	0.60	0.60
1143	0.80	0.79	0.77	0.76	0.75	0.74	0.74	0.72	0.71	0.70	0.69	0.69	0.68	0.67	0.67	0.66	0.66	0.66	0.68	0.64	0.64	0.63	0.62	0.62	0.62	0.61
1144	0.85	0.82	0.81	0.79	0.77	0.77	0.76	0.75	0.74	0.72	0.71	0.71	0.70	0.69	0.68	0.68	0.68	0.67	0.67	0.66	0.66	0.65	0.64	0.64	0.63	0.63
1145	0.97	0.92	0.88	0.86	0.84	0.82	0.81	0.80	0.79	0.78	0.76	0.75	0.74	0.73	0.72	0.71	0.71	0.70	0.70	0.69	0.69	0.68	0.67	0.66	0.66	0.65

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1146	1.04	1.02	0.97	0.93	0.91	0.88	0.86	0.85	0.84	0.82	0.81	0.79	0.78	0.77	0.76	0.75	0.74	0.73	0.73	0.72	0.71	0.71	0.70	0.69	0.69	0.68
1147	1.13	1.09	1.06	1.01	0.97	0.95	0.92	0.90	0.87	0.87	0.86	0.84	0.82	0.81	0.80	0.78	0.76	0.77	0.76	0.75	0.74	0.74	0.73	0.72	0.71	0.71
1148	1.20	1.15	1.11	1.09	1.04	1.00	0.98	0.95	0.93	0.91	0.90	0.88	0.86	0.85	0.83	0.82	0.81	0.80	0.79	0.78	0.77	0.76	0.76	0.75	0.74	0.73
1149	1.67	1.54	1.45	1.38	1.33	1.26	1.20	1.16	1.13	1.09	1.07	1.04	1.02	1.00	0.97	0.95	0.94	0.92	0.90	0.89	0.88	0.87	0.86	0.84	0.84	0.82
1150	2.05	1.92	1.77	1.66	1.58	1.51	1.44	1.37	1.32	1.27	1.23	1.20	1.17	1.14	1.11	1.08	1.06	1.04	1.02	1.00	0.98	0.97	0.95	0.94	0.93	0.91
1151	2.45	2.25	2.11	1.96	1.84	1.75	1.67	1.58	1.51	1.46	1.40	1.36	1.32	1.28	1.25	1.22	1.19	1.16	1.13	1.11	1.09	1.07	1.05	1.03	1.02	1.00
1152	2.83	2.58	2.39	2.25	2.10	1.98	1.88	1.80	1.71	1.64	1.58	1.52	1.47	1.43	1.39	1.35	1.31	1.28	1.25	1.22	1.20	1.17	1.15	1.13	1.11	1.09
1153	3.23	2.90	2.67	2.50	2.36	2.21	2.10	2.00	1.91	1.82	1.74	1.68	1.62	1.57	1.52	1.48	1.44	1.40	1.36	1.33	1.30	1.27	1.25	1.22	1.20	1.18
1154	2.83	2.90	2.67	2.50	2.36	2.25	2.13	2.02	1.94	1.86	1.78	1.71	1.66	1.60	1.55	1.51	1.47	1.43	1.40	1.36	1.33	1.30	1.27	1.25	1.22	1.20
1155	2.38	2.51	2.61	2.44	2.32	2.21	2.13	2.02	1.94	1.86	1.80	1.73	1.67	1.61	1.56	1.52	1.48	1.44	1.41	1.38	1.34	1.31	1.28	1.26	1.24	1.21
1156	1.86	2.09	2.25	2.37	2.25	2.15	2.07	2.00	1.92	1.85	1.78	1.73	1.67	1.61	1.56	1.52	1.48	1.44	1.41	1.38	1.35	1.32	1.29	1.26	1.24	1.22
1157	1.34	1.66	1.87	2.05	2.18	2.09	2.02	1.96	1.90	1.83	1.77	1.71	1.67	1.61	1.56	1.52	1.48	1.44	1.41	1.38	1.35	1.32	1.29	1.27	1.24	1.22
1158	0.80	1.21	1.50	1.72	1.88	2.02	1.95	1.90	1.85	1.80	1.74	1.69	1.64	1.60	1.55	1.51	1.47	1.44	1.40	1.37	1.34	1.32	1.29	1.26	1.24	1.22
1159	0.68	0.78	1.13	1.40	1.60	1.76	1.89	1.84	1.80	1.76	1.73	1.68	1.63	1.59	1.55	1.51	1.47	1.44	1.40	1.37	1.34	1.32	1.29	1.27	1.24	1.22
1160	0.61	0.66	0.75	1.06	1.30	1.49	1.65	1.78	1.74	1.71	1.68	1.65	1.61	1.57	1.54	1.50	1.46	1.43	1.40	1.36	1.34	1.31	1.29	1.27	1.24	1.22
1161	0.56	0.58	0.63	0.70	0.99	1.21	1.40	1.54	1.68	1.65	1.62	1.60	1.58	1.54	1.51	1.48	1.45	1.42	1.38	1.36	1.33	1.30	1.28	1.26	1.24	1.22
1162	0.55	0.57	0.58	0.62	0.69	0.95	1.16	1.33	1.47	1.60	1.58	1.56	1.54	1.53	1.49	1.46	1.44	1.41	1.38	1.35	1.32	1.30	1.28	1.26	1.24	1.22
1163	0.53	0.53	0.55	0.56	0.60	0.67	0.90	1.10	1.26	1.40	1.52	1.50	1.49	1.48	1.47	1.44	1.41	1.39	1.37	1.34	1.31	1.29	1.27	1.24	1.23	1.21
1164	0.48	0.51	0.51	0.53	0.55	0.58	0.64	0.86	1.04	1.20	1.33	1.45	1.44	1.43	1.42	1.42	1.39	1.37	1.35	1.33	1.30	1.28	1.26	1.24	1.22	1.20
1165	0.47	0.48	0.51	0.51	0.53	0.54	0.57	0.63	0.83	1.00	1.18	1.28	1.39	1.39	1.38	1.38	1.37	1.35	1.33	1.31	1.30	1.27	1.25	1.23	1.21	1.19
1166	0.47	0.47	0.47	0.50	0.50	0.52	0.53	0.56	0.61	0.80	0.96	1.11	1.23	1.34	1.34	1.34	1.33	1.33	1.31	1.29	1.28	1.26	1.24	1.22	1.20	1.18
1167	0.41	0.44	0.44	0.45	0.47	0.48	0.50	0.51	0.54	0.59	0.77	0.92	1.06	1.18	1.28	1.28	1.29	1.28	1.28	1.27	1.25	1.24	1.23	1.21	1.19	1.17
1168	0.42	0.42	0.45	0.45	0.45	0.47	0.48	0.50	0.51	0.54	0.58	0.75	0.90	1.03	1.14	1.24	1.25	1.25	1.25	1.25	1.25	1.24	1.23	1.21	1.19	1.17
1169	0.42	0.42	0.42	0.44	0.44	0.45	0.47	0.48	0.49	0.50	0.53	0.57	0.73	0.87	1.00	1.10	1.21	1.21	1.21	1.22	1.22	1.21	1.19	1.18	1.17	1.16
1170	0.32	0.35	0.36	0.37	0.39	0.40	0.41	0.43	0.44	0.45	0.47	0.50	0.54	0.69	0.82	0.94	1.05	1.15	1.16	1.16	1.17	1.17	1.16	1.15	1.14	1.13
1171	0.28	0.30	0.33	0.34	0.34	0.37	0.38	0.39	0.41	0.42	0.44	0.45	0.48	0.52	0.66	0.79	0.91	1.01	1.11	1.12	1.12	1.13	1.13	1.12	1.12	1.11
1172	0.25	0.26	0.28	0.31	0.32	0.33	0.36	0.36	0.37	0.39	0.40	0.42	0.43	0.46	0.50	0.64	0.76	0.88	0.98	1.07	1.08	1.09	1.09	1.10	1.09	1.09
1173	0.28	0.31	0.31	0.32	0.34	0.35	0.36	0.38	0.38	0.39	0.41	0.42	0.43	0.44	0.47	0.51	0.64	0.76	0.86	0.96	1.05	1.06	1.07	1.08	1.08	1.08

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1174	0.30	0.32	0.34	0.34	0.35	0.36	0.36	0.37	0.39	0.39	0.40	0.42	0.42	0.44	0.45	0.47	0.51	0.63	0.75	0.85	0.94	1.03	1.04	1.05	1.06	1.06
1175	0.42	0.35	0.36	0.38	0.37	0.37	0.38	0.38	0.39	0.40	0.40	0.41	0.43	0.43	0.44	0.46	0.48	0.51	0.63	0.74	0.84	0.94	1.02	1.02	1.03	1.04
1176	0.50	0.45	0.39	0.39	0.40	0.39	0.39	0.40	0.40	0.40	0.42	0.42	0.42	0.44	0.44	0.45	0.46	0.48	0.52	0.63	0.73	0.83	0.92	1.00	1.01	1.02
1177	0.52	0.46	0.42	0.37	0.37	0.38	0.38	0.38	0.39	0.39	0.39	0.40	0.41	0.41	0.43	0.43	0.44	0.45	0.47	0.50	0.61	0.72	0.81	0.89	0.97	0.98
1178	0.44	0.47	0.43	0.40	0.35	0.36	0.37	0.36	0.37	0.38	0.38	0.38	0.40	0.40	0.40	0.42	0.42	0.43	0.44	0.46	0.49	0.60	0.70	0.79	0.87	0.95
1179	0.41	0.43	0.45	0.42	0.39	0.35	0.36	0.37	0.36	0.37	0.38	0.38	0.38	0.39	0.40	0.40	0.41	0.42	0.43	0.44	0.46	0.49	0.59	0.69	0.77	0.85
1180	0.35	0.39	0.41	0.44	0.41	0.38	0.35	0.36	0.36	0.36	0.36	0.37	0.37	0.38	0.39	0.39	0.40	0.41	0.42	0.42	0.43	0.45	0.48	0.58	0.67	0.76
1185	0.44	0.42	0.41	0.39	0.37	0.40	0.42	0.42	0.44	0.42	0.40	0.40	0.38	0.39	0.38	0.38	0.39	0.39	0.39	0.40	0.40	0.41	0.42	0.42	0.43	0.44
1190	0.38	0.40	0.40	0.40	0.41	0.41	0.40	0.40	0.39	0.38	0.39	0.40	0.41	0.42	0.41	0.40	0.38	0.38	0.39	0.38	0.38	0.39	0.39	0.39	0.40	0.40
1195	0.30	0.30	0.30	0.32	0.33	0.34	0.36	0.36	0.36	0.37	0.38	0.37	0.37	0.36	0.36	0.37	0.38	0.39	0.40	0.39	0.38	0.36	0.37	0.37	0.37	0.37
1200	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.31	0.32	0.33	0.34	0.34	0.35	0.35	0.36	0.35	0.36	0.35	0.34	0.36	0.36	0.37	0.38	0.37	0.37
1225	0.25	0.25	0.25	0.26	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.28	0.25	0.25	0.25	0.25	0.26	0.26	0.26	0.26
1280	0.25	0.25	0.24	0.26	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
1300	0.25	0.25	0.25	0.26	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
1400	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
1440	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18

EXHIBIT 2B. RAINFALL INTENSITIES - J ZONE- 50-YR

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
200	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
400	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
600	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
900	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
1000	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
1050	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
1100	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
1110	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
1120	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.40	0.40	0.40	0.40	0.40	0.40	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.38	0.38	0.38	0.38	0.38
1130	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.45	0.45	0.45	0.45	0.44	0.44	0.44	0.44	0.44	0.44	0.43	0.43	0.43	0.42	0.42	0.42	0.42	0.42	0.42
1131	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.46	0.46	0.46	0.45	0.45	0.45	0.45	0.44	0.44	0.44	0.44	0.44	0.43	0.43	0.43	0.43	0.42	0.42	0.42
1132	0.48	0.48	0.48	0.48	0.47	0.47	0.47	0.47	0.47	0.46	0.46	0.46	0.45	0.45	0.45	0.45	0.45	0.44	0.44	0.44	0.44	0.43	0.43	0.43	0.43	0.43
1133	0.49	0.49	0.48	0.48	0.48	0.48	0.48	0.48	0.47	0.47	0.47	0.46	0.46	0.46	0.46	0.45	0.45	0.45	0.45	0.44	0.44	0.44	0.44	0.44	0.43	0.43
1134	0.50	0.50	0.49	0.49	0.49	0.48	0.48	0.48	0.48	0.48	0.47	0.47	0.47	0.46	0.46	0.46	0.46	0.45	0.45	0.45	0.45	0.44	0.44	0.44	0.44	0.44
1135	0.52	0.51	0.50	0.50	0.49	0.49	0.49	0.48	0.48	0.48	0.48	0.48	0.47	0.47	0.47	0.46	0.46	0.46	0.46	0.46	0.45	0.45	0.45	0.44	0.44	0.44
1136	0.53	0.53	0.52	0.51	0.50	0.50	0.50	0.49	0.49	0.49	0.49	0.49	0.48	0.48	0.48	0.47	0.47	0.47	0.46	0.46	0.46	0.46	0.46	0.45	0.45	0.45
1137	0.54	0.54	0.53	0.52	0.52	0.51	0.51	0.50	0.50	0.50	0.50	0.49	0.49	0.49	0.48	0.48	0.48	0.47	0.47	0.47	0.47	0.46	0.46	0.46	0.46	0.45
1138	0.55	0.55	0.54	0.54	0.53	0.52	0.52	0.51	0.51	0.51	0.50	0.50	0.50	0.50	0.49	0.49	0.48	0.48	0.48	0.48	0.47	0.47	0.47	0.47	0.46	0.46
1139	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.52	0.52	0.51	0.51	0.51	0.50	0.50	0.50	0.50	0.49	0.49	0.48	0.48	0.48	0.46	0.48	0.47	0.47	0.47
1140	0.58	0.57	0.56	0.55	0.55	0.55	0.54	0.53	0.53	0.52	0.52	0.52	0.51	0.51	0.51	0.50	0.50	0.50	0.49	0.49	0.49	0.48	0.48	0.48	0.48	0.47
1141	0.60	0.60	0.59	0.58	0.57	0.56	0.56	0.55	0.55	0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.51	0.51	0.50	0.50	0.50	0.50	0.49	0.49	0.49	0.48
1142	0.63	0.62	0.61	0.60	0.59	0.58	0.58	0.57	0.56	0.56	0.55	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.51	0.51	0.51	0.50	0.50	0.50	0.49
1143	0.66	0.64	0.63	0.62	0.61	0.60	0.60	0.59	0.58	0.58	0.57	0.56	0.56	0.55	0.54	0.54	0.54	0.53	0.53	0.53	0.52	0.52	0.51	0.51	0.51	0.50
1144	0.68	0.66	0.65	0.64	0.64	0.62	0.61	0.60	0.60	0.59	0.58	0.58	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.51
1145	0.71	0.69	0.67	0.66	0.65	0.64	0.63	0.62	0.61	0.61	0.60	0.59	0.58	0.58	0.57	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.53	0.53	0.52

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1146	0.77	0.76	0.73	0.71	0.70	0.69	0.68	0.66	0.65	0.64	0.63	0.63	0.62	0.61	0.60	0.59	0.59	0.58	0.58	0.57	0.57	0.56	0.56	0.55	0.55	0.54
1147	0.83	0.81	0.80	0.77	0.75	0.73	0.72	0.70	0.69	0.68	0.67	0.66	0.65	0.64	0.63	0.62	0.61	0.61	0.60	0.60	0.59	0.58	0.58	0.57	0.57	0.56
1148	1.11	1.04	1.00	0.96	0.92	0.88	0.86	0.83	0.81	0.79	0.77	0.76	0.74	0.73	0.72	0.70	0.69	0.68	0.67	0.66	0.66	0.65	0.64	0.63	0.63	0.62
1149	1.56	1.42	1.32	1.24	1.18	1.12	1.07	1.03	0.99	0.96	0.93	0.91	0.88	0.86	0.85	0.83	0.81	0.79	0.78	0.77	0.75	0.74	0.73	0.72	0.71	0.70
1150	2.00	1.79	1.63	1.52	1.43	1.36	1.28	1.23	1.18	1.13	1.10	1.06	1.03	1.00	0.97	0.95	0.93	0.91	0.89	0.87	0.85	0.84	0.82	0.81	0.80	0.79
1151	2.39	2.16	1.95	1.80	1.68	1.58	1.50	1.42	1.36	1.30	1.25	1.21	1.17	1.13	1.10	1.07	1.05	1.02	1.00	0.97	0.95	0.93	0.92	0.90	0.88	0.87
1152	2.77	2.48	2.27	2.08	1.92	1.80	1.70	1.62	1.54	1.47	1.41	1.36	1.31	1.27	1.23	1.19	1.16	1.13	1.10	1.08	1.05	1.03	1.01	0.99	0.97	0.95
1153	2.94	2.80	2.55	2.36	2.17	2.03	1.91	1.81	1.72	1.64	1.57	1.51	1.45	1.40	1.36	1.32	1.26	1.24	1.21	1.18	1.15	1.12	1.10	1.08	1.06	1.04
1154	2.56	2.62	2.55	2.36	2.21	2.06	1.93	1.83	1.75	1.67	1.60	1.54	1.48	1.43	1.38	1.34	1.30	1.26	1.23	1.20	1.17	1.15	1.12	1.10	1.08	1.05
1155	2.15	2.28	2.37	2.34	2.19	2.08	1.95	1.85	1.76	1.68	1.62	1.56	1.50	1.45	1.40	1.36	1.32	1.28	1.25	1.22	1.19	1.16	1.14	1.11	1.09	1.07
1156	1.68	1.89	2.04	2.16	2.15	2.04	1.94	1.84	1.75	1.68	1.61	1.56	1.50	1.45	1.40	1.36	1.32	1.29	1.25	1.22	1.20	1.17	1.14	1.12	1.10	1.07
1157	1.22	1.51	1.71	1.87	1.98	2.00	1.91	1.83	1.75	1.67	1.61	1.55	1.50	1.45	1.40	1.36	1.33	1.29	1.26	1.23	1.20	1.17	1.15	1.12	1.10	1.08
1158	0.76	1.12	1.38	1.58	1.73	1.85	1.87	1.80	1.74	1.67	1.60	1.55	1.50	1.45	1.41	1.37	1.33	1.29	1.26	1.23	1.20	1.18	1.15	1.13	1.11	1.08
1159	0.68	0.74	1.05	1.29	1.47	1.62	1.74	1.77	1.71	1.66	1.60	1.54	1.49	1.45	1.41	1.37	1.33	1.30	1.26	1.24	1.21	1.18	1.16	1.13	1.11	1.09
1160	0.62	0.67	0.72	1.00	1.21	1.39	1.53	1.64	1.68	1.63	1.59	1.54	1.49	1.44	1.41	1.37	1.33	1.30	1.27	1.24	1.21	1.18	1.16	1.14	1.12	1.10
1161	0.58	0.59	0.63	0.68	0.93	1.13	1.30	1.43	1.55	1.59	1.55	1.52	1.47	1.43	1.39	1.36	1.32	1.29	1.26	1.23	1.20	1.18	1.16	1.13	1.11	1.09
1162	0.53	0.55	0.56	0.60	0.65	0.88	1.06	1.22	1.35	1.47	1.51	1.48	1.45	1.41	1.37	1.34	1.31	1.28	1.25	1.22	1.20	1.17	1.15	1.13	1.11	1.09
1163	0.49	0.51	0.53	0.54	0.58	0.62	0.83	1.01	1.16	1.28	1.40	1.44	1.42	1.39	1.36	1.32	1.30	1.27	1.24	1.22	1.19	1.17	1.14	1.12	1.10	1.08
1164	0.44	0.47	0.49	0.51	0.52	0.56	0.60	0.80	0.96	1.10	1.23	1.33	1.38	1.36	1.34	1.31	1.28	1.25	1.23	1.21	1.18	1.16	1.14	1.12	1.10	1.08
1165	0.40	0.43	0.46	0.48	0.50	0.51	0.54	0.58	0.77	0.92	1.06	1.17	1.28	1.32	1.31	1.29	1.26	1.24	1.22	1.20	1.18	1.15	1.13	1.11	1.09	1.08
1166	0.40	0.40	0.43	0.45	0.47	0.49	0.50	0.53	0.57	0.74	0.89	1.02	1.13	1.23	1.28	1.26	1.25	1.23	1.20	1.16	1.16	1.15	1.12	1.10	1.09	1.07
1167	0.40	0.40	0.40	0.42	0.45	0.46	0.48	0.49	0.52	0.56	0.72	0.86	0.98	1.09	1.18	1.23	1.22	1.21	1.19	1.17	1.15	1.13	1.12	1.10	1.08	1.06
1168	0.40	0.40	0.40	0.40	0.42	0.44	0.46	0.47	0.48	0.51	0.55	0.70	0.83	0.95	1.05	1.14	1.19	1.18	1.18	1.16	1.14	1.12	1.11	1.09	1.08	1.06
1169	0.40	0.40	0.40	0.40	0.40	0.42	0.44	0.45	0.47	0.48	0.51	0.54	0.68	0.80	0.92	1.02	1.11	1.16	1.15	1.14	1.13	1.11	1.10	1.08	1.07	1.05
1170	0.40	0.40	0.40	0.40	0.40	0.40	0.42	0.43	0.45	0.46	0.47	0.50	0.53	0.66	0.78	0.89	0.99	1.08	1.12	1.12	1.11	1.10	1.08	1.07	1.06	1.05
1171	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.41	0.43	0.44	0.45	0.46	0.49	0.52	0.65	0.76	0.86	0.96	1.05	1.09	1.09	1.08	1.07	1.06	1.04	1.03
1172	0.38	0.38	0.38	0.38	0.38	0.39	0.39	0.39	0.41	0.42	0.44	0.45	0.46	0.48	0.51	0.63	0.74	0.84	0.93	1.02	1.06	1.06	1.06	1.04	1.03	1.02
1173	0.37	0.37	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.40	0.42	0.43	0.44	0.45	0.48	0.50	0.62	0.72	0.82	0.91	0.99	1.03	1.03	1.03	1.02	1.01

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1174	0.36	0.36	0.37	0.37	0.38	0.38	0.38	0.38	0.38	0.38	0.40	0.41	0.42	0.44	0.45	0.47	0.50	0.61	0.71	0.80	0.89	0.96	1.01	1.01	1.01	1.00
1175	0.35	0.36	0.36	0.37	0.37	0.37	0.37	0.38	0.38	0.38	0.38	0.40	0.41	0.42	0.43	0.44	0.46	0.49	0.60	0.69	0.78	0.86	0.94	0.98	0.98	0.99
1176	0.35	0.35	0.36	0.36	0.36	0.37	0.37	0.37	0.37	0.38	0.38	0.38	0.39	0.40	0.42	0.43	0.44	0.46	0.48	0.58	0.68	0.77	0.85	0.92	0.96	0.96
1177	0.35	0.35	0.35	0.35	0.36	0.36	0.36	0.37	0.37	0.37	0.37	0.38	0.38	0.39	0.40	0.41	0.42	0.43	0.45	0.48	0.58	0.67	0.75	0.83	0.90	0.94
1178	0.35	0.35	0.35	0.35	0.35	0.36	0.36	0.36	0.37	0.37	0.37	0.37	0.37	0.38	0.39	0.40	0.41	0.42	0.43	0.45	0.47	0.57	0.65	0.74	0.81	0.88
1179	0.35	0.35	0.35	0.35	0.35	0.35	0.36	0.36	0.36	0.36	0.37	0.37	0.37	0.37	0.37	0.39	0.40	0.41	0.42	0.42	0.44	0.47	0.56	0.64	0.72	0.80
1180	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.36	0.36	0.36	0.36	0.37	0.37	0.37	0.37	0.37	0.38	0.40	0.40	0.41	0.42	0.44	0.46	0.55	0.63	0.71
1185	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.35	0.35	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.38	0.38	0.39	0.40	0.41
1190	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.35	0.35	0.35	0.35	0.36	0.36	0.36	0.36	0.36
1195	0.32	0.32	0.32	0.32	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.35
1200	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
1225	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
1250	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.27	0.27	0.27	0.27	0.27
1300	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
1400	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
1440	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03

EXHIBIT 2C. RAINFALL INTENSITIES - J ZONE- 25-YR

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
200	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
400	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
600	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
900	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
1000	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
1050	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
1100	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
1110	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
1120	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.33	0.33	0.33	0.32	0.32	0.32	0.32	0.32	0.32	0.31	0.31	0.31	0.31	0.31	0.31	0.30	0.30	0.30	0.30
1130	0.41	0.41	0.41	0.41	0.41	0.41	0.40	0.40	0.39	0.39	0.39	0.38	0.38	0.38	0.38	0.38	0.37	0.37	0.36	0.36	0.36	0.36	0.35	0.35	0.35	0.35
1131	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.41	0.40	0.40	0.40	0.39	0.39	0.39	0.38	0.38	0.38	0.38	0.37	0.37	0.37	0.36	0.36	0.36	0.36	0.35
1132	0.44	0.44	0.43	0.43	0.43	0.42	0.42	0.42	0.42	0.41	0.41	0.40	0.40	0.40	0.39	0.39	0.39	0.39	0.38	0.38	0.37	0.37	0.37	0.36	0.36	0.36
1133	0.46	0.45	0.44	0.44	0.44	0.43	0.43	0.43	0.43	0.42	0.42	0.41	0.41	0.40	0.40	0.40	0.40	0.39	0.39	0.39	0.38	0.38	0.38	0.37	0.37	0.37
1134	0.48	0.46	0.46	0.45	0.44	0.44	0.44	0.44	0.43	0.43	0.43	0.42	0.42	0.41	0.41	0.40	0.40	0.40	0.40	0.39	0.39	0.39	0.38	0.38	0.38	0.37
1135	0.49	0.48	0.47	0.46	0.46	0.45	0.45	0.44	0.44	0.44	0.44	0.43	0.42	0.42	0.42	0.41	0.41	0.41	0.40	0.40	0.40	0.39	0.39	0.39	0.38	0.38
1136	0.51	0.50	0.49	0.48	0.47	0.47	0.46	0.46	0.45	0.45	0.45	0.44	0.44	0.43	0.43	0.42	0.42	0.42	0.41	0.41	0.41	0.40	0.40	0.40	0.39	0.39
1137	0.52	0.52	0.51	0.50	0.49	0.48	0.48	0.47	0.46	0.46	0.46	0.45	0.45	0.44	0.44	0.44	0.43	0.43	0.42	0.42	0.42	0.41	0.41	0.41	0.40	0.40
1138	0.54	0.53	0.52	0.52	0.51	0.50	0.49	0.48	0.48	0.47	0.47	0.46	0.46	0.46	0.45	0.45	0.44	0.44	0.43	0.43	0.42	0.42	0.42	0.42	0.41	0.41
1139	0.55	0.54	0.53	0.53	0.52	0.51	0.50	0.50	0.49	0.48	0.48	0.47	0.47	0.47	0.46	0.46	0.45	0.45	0.44	0.44	0.43	0.43	0.43	0.42	0.42	0.42
1140	0.56	0.55	0.54	0.54	0.53	0.53	0.52	0.51	0.50	0.49	0.49	0.48	0.48	0.48	0.48	0.47	0.46	0.46	0.45	0.45	0.44	0.44	0.44	0.43	0.43	0.43
1141	0.58	0.58	0.57	0.56	0.55	0.54	0.54	0.53	0.52	0.51	0.50	0.50	0.49	0.49	0.48	0.48	0.48	0.47	0.46	0.46	0.46	0.45	0.45	0.44	0.44	0.44
1142	0.60	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.54	0.53	0.52	0.51	0.51	0.50	0.50	0.49	0.49	0.48	0.48	0.47	0.47	0.46	0.46	0.45	0.45	0.45
1143	0.61	0.61	0.60	0.60	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.53	0.52	0.52	0.51	0.50	0.50	0.50	0.49	0.48	0.48	0.47	0.47	0.46	0.46	0.46
1144	0.63	0.62	0.61	0.61	0.60	0.59	0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.53	0.52	0.52	0.51	0.51	0.50	0.50	0.49	0.49	0.48	0.48	0.47	0.47
1145	0.65	0.63	0.62	0.62	0.61	0.61	0.60	0.59	0.58	0.57	0.57	0.56	0.55	0.54	0.53	0.53	0.52	0.52	0.51	0.51	0.50	0.50	0.49	0.49	0.48	0.48

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1146	0.72	0.70	0.68	0.67	0.66	0.65	0.64	0.63	0.62	0.61	0.60	0.59	0.58	0.57	0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.52	0.52	0.51	0.50	0.50
1147	0.78	0.76	0.75	0.72	0.70	0.69	0.68	0.67	0.66	0.64	0.63	0.63	0.62	0.61	0.60	0.59	0.58	0.57	0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.52
1148	1.04	0.97	0.93	0.89	0.86	0.83	0.80	0.78	0.77	0.75	0.73	0.72	0.70	0.69	0.68	0.66	0.65	0.64	0.63	0.62	0.61	0.60	0.60	0.59	0.58	0.57
1149	1.44	1.31	1.21	1.14	1.09	1.03	0.99	0.96	0.93	0.90	0.87	0.85	0.83	0.81	0.79	0.77	0.76	0.74	0.73	0.71	0.70	0.69	0.68	0.67	0.66	0.65
1150	1.84	1.64	1.50	1.39	1.31	1.24	1.18	1.13	1.09	1.05	1.02	0.98	0.95	0.93	0.91	0.88	0.86	0.84	0.82	0.81	0.79	0.78	0.76	0.75	0.74	0.73
1151	2.17	1.97	1.78	1.64	1.53	1.44	1.37	1.30	1.24	1.20	1.15	1.12	1.08	1.05	1.02	0.99	0.97	0.94	0.92	0.90	0.88	0.86	0.84	0.83	0.81	0.80
1152	2.50	2.24	2.07	1.89	1.75	1.64	1.55	1.48	1.40	1.34	1.29	1.25	1.21	1.17	1.13	1.10	1.07	1.04	1.02	0.99	0.97	0.95	0.93	0.91	0.89	0.88
1153	2.64	2.52	2.30	2.14	1.97	1.84	1.73	1.64	1.56	1.49	1.43	1.38	1.33	1.29	1.24	1.21	1.17	1.14	1.11	1.08	1.06	1.03	1.01	0.99	0.97	0.95
1154	2.28	2.34	2.28	2.12	1.99	1.86	1.75	1.66	1.58	1.51	1.45	1.39	1.34	1.30	1.26	1.22	1.19	1.16	1.13	1.10	1.08	1.05	1.02	1.00	0.98	0.96
1155	1.90	2.02	2.11	2.08	1.96	1.87	1.76	1.66	1.58	1.52	1.46	1.40	1.36	1.31	1.27	1.24	1.20	1.17	1.14	1.11	1.09	1.06	1.04	1.01	0.99	0.97
1156	1.47	1.67	1.80	1.91	1.91	1.82	1.74	1.65	1.58	1.51	1.45	1.40	1.35	1.31	1.27	1.23	1.20	1.17	1.14	1.11	1.09	1.06	1.04	1.02	1.00	0.98
1157	1.05	1.31	1.50	1.64	1.76	1.77	1.70	1.64	1.56	1.50	1.44	1.39	1.35	1.30	1.27	1.23	1.20	1.17	1.14	1.11	1.09	1.07	1.04	1.02	1.00	0.98
1158	0.62	0.96	1.20	1.38	1.52	1.63	1.66	1.60	1.55	1.49	1.43	1.38	1.34	1.30	1.26	1.23	1.20	1.17	1.14	1.12	1.09	1.07	1.05	1.03	1.00	0.98
1159	0.56	0.60	0.90	1.11	1.28	1.42	1.53	1.56	1.52	1.48	1.42	1.38	1.33	1.30	1.26	1.23	1.20	1.17	1.14	1.12	1.09	1.07	1.05	1.03	1.01	0.99
1160	0.52	0.55	0.59	0.85	1.05	1.21	1.34	1.44	1.48	1.45	1.42	1.37	1.33	1.29	1.25	1.22	1.19	1.16	1.14	1.11	1.09	1.07	1.05	1.03	1.01	0.99
1161	0.48	0.49	0.52	0.56	0.79	0.98	1.13	1.25	1.36	1.40	1.37	1.35	1.31	1.27	1.24	1.21	1.18	1.15	1.13	1.10	1.08	1.06	1.04	1.02	1.00	0.99
1162	0.45	0.46	0.47	0.50	0.54	0.75	0.92	1.06	1.18	1.29	1.33	1.31	1.29	1.26	1.22	1.20	1.17	1.14	1.12	1.10	1.08	1.06	1.04	1.02	1.00	0.98
1163	0.42	0.44	0.45	0.46	0.48	0.52	0.71	0.87	1.01	1.13	1.23	1.27	1.25	1.24	1.21	1.18	1.16	1.13	1.11	1.09	1.07	1.05	1.03	1.01	1.00	0.98
1164	0.39	0.41	0.42	0.44	0.44	0.47	0.50	0.68	0.83	0.96	1.07	1.17	1.22	1.20	1.19	1.16	1.14	1.12	1.10	1.08	1.06	1.04	1.02	1.00	0.99	0.97
1165	0.35	0.38	0.40	0.42	0.43	0.44	0.46	0.49	0.66	0.80	0.92	1.03	1.12	1.17	1.16	1.15	1.13	1.10	1.08	1.07	1.05	1.03	1.01	1.00	0.98	0.97
1166	0.35	0.35	0.38	0.39	0.41	0.42	0.43	0.45	0.48	0.64	0.77	0.89	0.99	1.08	1.12	1.12	1.11	1.09	1.07	1.05	1.04	1.02	1.01	0.99	0.98	0.96
1167	0.35	0.35	0.35	0.37	0.39	0.40	0.41	0.42	0.44	0.47	0.62	0.74	0.86	0.95	1.04	1.09	1.08	1.08	1.06	1.04	1.03	1.01	1.00	0.98	0.97	0.96
1168	0.35	0.35	0.35	0.35	0.37	0.39	0.40	0.41	0.42	0.44	0.46	0.60	0.72	0.83	0.92	1.01	1.05	1.05	1.05	1.03	1.02	1.00	0.99	0.98	0.99	0.95
1169	0.35	0.35	0.35	0.35	0.35	0.37	0.38	0.39	0.40	0.41	0.43	0.46	0.59	0.70	0.80	0.89	0.98	1.02	1.02	1.02	1.00	0.99	0.98	0.96	0.95	0.94
1170	0.35	0.35	0.35	0.35	0.35	0.35	0.37	0.38	0.39	0.40	0.41	0.43	0.45	0.57	0.68	0.78	0.87	0.95	0.99	0.99	0.99	0.98	0.97	0.95	0.94	0.93
1171	0.34	0.34	0.34	0.34	0.34	0.35	0.35	0.36	0.37	0.38	0.39	0.40	0.42	0.44	0.56	0.66	0.76	0.84	0.92	0.96	0.96	0.96	0.95	0.94	0.93	0.92
1172	0.32	0.33	0.33	0.34	0.34	0.34	0.34	0.34	0.36	0.37	0.38	0.39	0.39	0.41	0.43	0.54	0.64	0.74	0.82	0.89	0.94	0.94	0.94	0.93	0.92	0.91
1173	0.31	0.32	0.32	0.33	0.33	0.33	0.33	0.34	0.34	0.35	0.36	0.37	0.38	0.39	0.40	0.43	0.53	0.63	0.72	0.80	0.87	0.91	0.91	0.92	0.91	0.90

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1174	0.30	0.31	0.31	0.32	0.32	0.32	0.33	0.33	0.33	0.33	0.35	0.36	0.37	0.37	0.38	0.40	0.42	0.52	0.61	0.70	0.78	0.85	0.89	0.89	0.89	0.88
1175	0.28	0.29	0.30	0.31	0.31	0.32	0.32	0.32	0.33	0.33	0.33	0.34	0.35	0.36	0.37	0.38	0.39	0.41	0.51	0.60	0.68	0.76	0.83	0.86	0.87	0.87
1176	0.28	0.28	0.29	0.30	0.31	0.31	0.32	0.32	0.32	0.32	0.32	0.33	0.34	0.35	0.36	0.36	0.37	0.39	0.41	0.50	0.59	0.66	0.74	0.81	0.84	0.85
1177	0.28	0.28	0.28	0.29	0.30	0.30	0.31	0.31	0.32	0.32	0.32	0.32	0.32	0.34	0.34	0.35	0.36	0.37	0.38	0.40	0.49	0.57	0.65	0.72	0.79	0.83
1178	0.28	0.28	0.28	0.28	0.29	0.30	0.30	0.31	0.31	0.31	0.32	0.32	0.32	0.32	0.33	0.34	0.35	0.36	0.36	0.38	0.40	0.48	0.56	0.64	0.71	0.77
1179	0.28	0.28	0.28	0.28	0.28	0.29	0.30	0.30	0.30	0.31	0.31	0.31	0.32	0.32	0.32	0.33	0.34	0.35	0.35	0.36	0.38	0.39	0.48	0.55	0.62	0.69
1180	0.28	0.28	0.28	0.28	0.28	0.28	0.29	0.29	0.30	0.30	0.31	0.31	0.31	0.31	0.32	0.32	0.33	0.34	0.34	0.35	0.36	0.37	0.39	0.47	0.54	0.61
1185	0.25	0.26	0.26	0.26	0.26	0.27	0.27	0.27	0.27	0.27	0.27	0.28	0.28	0.29	0.29	0.29	0.30	0.30	0.30	0.30	0.30	0.31	0.32	0.33	0.33	0.34
1190	0.25	0.25	0.25	0.25	0.25	0.25	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.27	0.27	0.27	0.28	0.28	0.28	0.28	0.29	0.29	0.29	0.29	0.30
1195	0.24	0.24	0.24	0.24	0.24	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.27	0.27	0.27	0.28
1200	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.26	0.26	0.26	0.26
1225	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
1250	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
1300	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
1400	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
1440	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

EXHIBIT 2D. RAINFALL INTENSITIES - J ZONE- 10-YR

Time of Concentration (Minutes)																										
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
200	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
400	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
600	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
900	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
1000	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
1050	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
1100	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
1110	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
1120	0.25	0.25	0.25	0.25	0.25	0.25	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.23
1130	0.29	0.29	0.29	0.29	0.29	0.29	0.28	0.28	0.28	0.28	0.27	0.27	0.27	0.27	0.27	0.27	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.25
1131	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.29	0.29	0.28	0.28	0.28	0.28	0.28	0.27	0.27	0.27	0.27	0.27	0.27	0.26	0.26	0.26	0.26	0.26	0.26
1132	0.32	0.31	0.31	0.31	0.30	0.30	0.30	0.30	0.30	0.29	0.29	0.29	0.28	0.28	0.28	0.28	0.28	0.28	0.27	0.27	0.27	0.27	0.27	0.26	0.26	0.26
1133	0.33	0.32	0.32	0.32	0.31	0.31	0.31	0.31	0.30	0.30	0.30	0.29	0.29	0.29	0.29	0.28	0.28	0.28	0.28	0.28	0.28	0.27	0.27	0.27	0.27	0.27
1134	0.35	0.34	0.33	0.32	0.32	0.32	0.31	0.31	0.31	0.31	0.30	0.30	0.30	0.30	0.29	0.29	0.29	0.29	0.28	0.28	0.28	0.28	0.28	0.28	0.27	0.27
1135	0.36	0.35	0.34	0.33	0.33	0.32	0.32	0.32	0.32	0.31	0.31	0.31	0.30	0.30	0.30	0.30	0.29	0.29	0.29	0.29	0.29	0.28	0.28	0.28	0.28	0.28
1136	0.38	0.38	0.37	0.36	0.35	0.34	0.34	0.33	0.33	0.33	0.32	0.32	0.32	0.31	0.31	0.31	0.30	0.30	0.30	0.30	0.30	0.29	0.29	0.29	0.29	0.28
1137	0.41	0.40	0.39	0.38	0.37	0.36	0.36	0.35	0.34	0.34	0.34	0.33	0.33	0.33	0.32	0.32	0.32	0.31	0.31	0.31	0.30	0.30	0.30	0.30	0.30	0.29
1138	0.43	0.42	0.41	0.40	0.39	0.38	0.37	0.37	0.36	0.36	0.35	0.35	0.34	0.34	0.34	0.33	0.33	0.32	0.32	0.32	0.31	0.31	0.31	0.31	0.30	0.30
1139	0.46	0.44	0.43	0.42	0.41	0.40	0.39	0.38	0.38	0.37	0.36	0.36	0.35	0.35	0.35	0.34	0.34	0.33	0.33	0.33	0.32	0.32	0.32	0.32	0.31	0.31
1140	0.48	0.46	0.45	0.44	0.43	0.42	0.41	0.40	0.39	0.38	0.38	0.37	0.37	0.36	0.36	0.35	0.35	0.34	0.34	0.34	0.33	0.33	0.33	0.32	0.32	0.32
1141	0.51	0.51	0.49	0.47	0.46	0.45	0.44	0.43	0.42	0.41	0.40	0.39	0.39	0.38	0.38	0.37	0.37	0.36	0.36	0.35	0.35	0.34	0.34	0.34	0.33	0.33
1142	0.55	0.54	0.53	0.51	0.49	0.48	0.47	0.46	0.44	0.43	0.42	0.42	0.41	0.40	0.40	0.39	0.38	0.38	0.38	0.37	0.36	0.36	0.36	0.35	0.35	0.34
1143	0.58	0.56	0.55	0.54	0.52	0.51	0.49	0.48	0.47	0.46	0.45	0.44	0.43	0.42	0.41	0.41	0.40	0.40	0.39	0.39	0.38	0.38	0.37	0.37	0.36	0.36
1144	0.61	0.59	0.58	0.56	0.56	0.54	0.52	0.51	0.50	0.48	0.47	0.46	0.45	0.44	0.43	0.43	0.42	0.41	0.41	0.40	0.40	0.39	0.39	0.38	0.38	0.37
1145	0.65	0.62	0.60	0.58	0.57	0.56	0.54	0.53	0.52	0.51	0.50	0.48	0.47	0.46	0.45	0.44	0.44	0.43	0.42	0.42	0.41	0.41	0.40	0.40	0.39	0.38

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1146	0.70	0.69	0.66	0.64	0.62	0.61	0.60	0.58	0.56	0.54	0.53	0.52	0.51	0.50	0.48	0.48	0.47	0.46	0.45	0.44	0.44	0.43	0.42	0.42	0.41	0.41
1147	0.75	0.73	0.72	0.69	0.67	0.65	0.63	0.62	0.60	0.58	0.57	0.56	0.54	0.53	0.52	0.50	0.50	0.48	0.48	0.47	0.46	0.46	0.45	0.44	0.44	0.43
1148	0.88	0.84	0.82	0.80	0.76	0.73	0.71	0.69	0.67	0.65	0.63	0.62	0.60	0.59	0.57	0.56	0.54	0.53	0.52	0.51	0.50	0.50	0.49	0.48	0.47	0.46
1149	1.19	1.10	1.03	0.98	0.95	0.90	0.86	0.83	0.80	0.78	0.75	0.73	0.71	0.69	0.67	0.65	0.63	0.62	0.60	0.59	0.58	0.57	0.56	0.55	0.54	0.53
1150	1.49	1.35	1.25	1.17	1.12	1.07	1.02	0.97	0.93	0.90	0.87	0.84	0.81	0.79	0.76	0.74	0.72	0.70	0.68	0.67	0.65	0.64	0.63	0.61	0.60	0.59
1151	1.74	1.60	1.46	1.36	1.28	1.22	1.17	1.11	1.06	1.02	0.98	0.95	0.92	0.89	0.86	0.83	0.81	0.79	0.77	0.75	0.73	0.71	0.70	0.68	0.67	0.65
1152	1.99	1.81	1.68	1.55	1.45	1.37	1.30	1.25	1.19	1.14	1.10	1.06	1.02	0.99	0.95	0.92	0.90	0.87	0.85	0.82	0.80	0.78	0.76	0.75	0.73	0.72
1153	2.16	2.02	1.86	1.74	1.62	1.52	1.44	1.38	1.32	1.26	1.21	1.16	1.12	1.09	1.05	1.01	0.98	0.96	0.93	0.90	0.88	0.86	0.83	0.81	0.80	0.78
1154	1.87	1.92	1.83	1.72	1.63	1.53	1.45	1.38	1.33	1.28	1.22	1.18	1.14	1.10	1.07	1.03	1.00	0.97	0.94	0.92	0.90	0.87	0.85	0.83	0.81	0.79
1155	1.56	1.66	1.73	1.68	1.59	1.52	1.44	1.38	1.32	1.27	1.23	1.18	1.14	1.11	1.07	1.04	1.01	0.98	0.96	0.93	0.91	0.88	0.86	0.84	0.82	0.80
1156	1.22	1.38	1.49	1.57	1.54	1.48	1.43	1.36	1.31	1.26	1.22	1.18	1.14	1.10	1.07	1.04	1.02	0.99	0.96	0.93	0.91	0.89	0.87	0.85	0.83	0.81
1157	0.88	1.09	1.24	1.36	1.45	1.44	1.39	1.35	1.29	1.25	1.21	1.17	1.14	1.10	1.07	1.04	1.02	0.99	0.96	0.94	0.92	0.89	0.87	0.85	0.83	0.82
1158	0.54	0.81	1.00	1.15	1.26	1.35	1.35	1.31	1.28	1.23	1.19	1.16	1.13	1.10	1.07	1.04	1.01	0.99	0.97	0.94	0.92	0.90	0.88	0.86	0.84	0.82
1159	0.48	0.52	0.76	0.93	1.07	1.18	1.27	1.27	1.24	1.22	1.18	1.15	1.12	1.09	1.07	1.04	1.01	0.99	0.97	0.95	0.92	0.90	0.88	0.86	0.84	0.83
1160	0.46	0.48	0.51	0.72	0.88	1.01	1.11	1.20	1.21	1.19	1.17	1.14	1.11	1.08	1.06	1.04	1.01	0.99	0.96	0.94	0.93	0.90	0.88	0.87	0.85	0.83
1161	0.43	0.43	0.46	0.49	0.68	0.82	0.94	1.05	1.13	1.14	1.13	1.11	1.09	1.06	1.04	1.02	1.00	0.98	0.96	0.94	0.92	0.90	0.88	0.86	0.85	0.83
1162	0.40	0.41	0.42	0.44	0.47	0.64	0.78	0.89	0.99	1.07	1.09	1.08	1.07	1.04	1.02	1.00	0.99	0.97	0.95	0.93	0.91	0.90	0.88	0.86	0.84	0.83
1163	0.37	0.38	0.39	0.40	0.42	0.45	0.61	0.74	0.85	0.94	1.02	1.04	1.03	1.02	1.00	0.99	0.97	0.96	0.94	0.92	0.91	0.89	0.88	0.86	0.84	0.83
1164	0.34	0.36	0.37	0.38	0.39	0.41	0.44	0.58	0.70	0.81	0.90	0.98	1.00	0.99	0.99	0.97	0.96	0.94	0.93	0.92	0.90	0.88	0.87	0.86	0.84	0.83
1165	0.31	0.34	0.35	0.37	0.38	0.38	0.40	0.43	0.56	0.68	0.78	0.86	0.94	0.96	0.96	0.95	0.94	0.93	0.91	0.90	0.89	0.88	0.86	0.85	0.84	0.82
1166	0.31	0.31	0.33	0.35	0.36	0.37	0.38	0.40	0.42	0.54	0.65	0.75	0.83	0.90	0.93	0.92	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.84	0.83	0.82
1167	0.31	0.31	0.31	0.33	0.34	0.36	0.36	0.37	0.39	0.41	0.53	0.63	0.72	0.80	0.87	0.90	0.90	0.90	0.88	0.88	0.87	0.86	0.85	0.84	0.82	0.81
1168	0.31	0.31	0.31	0.31	0.33	0.34	0.35	0.36	0.37	0.38	0.41	0.52	0.61	0.70	0.78	0.84	0.87	0.87	0.87	0.86	0.85	0.84	0.84	0.83	0.82	0.81
1169	0.31	0.31	0.31	0.31	0.31	0.33	0.34	0.35	0.36	0.36	0.38	0.40	0.50	0.60	0.68	0.75	0.82	0.84	0.84	0.85	0.84	0.83	0.82	0.82	0.81	0.80
1170	0.31	0.31	0.31	0.31	0.31	0.31	0.32	0.34	0.34	0.35	0.36	0.38	0.40	0.49	0.58	0.66	0.73	0.80	0.82	0.82	0.83	0.82	0.81	0.81	0.80	0.80
1171	0.29	0.30	0.30	0.30	0.30	0.30	0.30	0.32	0.33	0.34	0.34	0.35	0.36	0.38	0.48	0.56	0.64	0.71	0.77	0.79	0.80	0.80	0.80	0.79	0.79	0.78
1172	0.27	0.28	0.28	0.29	0.29	0.29	0.29	0.30	0.31	0.32	0.33	0.34	0.34	0.36	0.38	0.46	0.55	0.62	0.69	0.75	0.77	0.78	0.78	0.78	0.77	0.77
1173	0.25	0.26	0.27	0.27	0.28	0.28	0.28	0.29	0.29	0.30	0.31	0.32	0.33	0.34	0.35	0.37	0.45	0.53	0.60	0.67	0.73	0.75	0.75	0.76	0.76	0.75

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1174	0.23	0.24	0.25	0.26	0.27	0.27	0.28	0.28	0.28	0.28	0.29	0.30	0.31	0.32	0.33	0.34	0.36	0.44	0.52	0.58	0.65	0.71	0.73	0.74	0.74	0.74
1175	0.21	0.23	0.24	0.25	0.26	0.26	0.27	0.27	0.27	0.28	0.28	0.29	0.30	0.31	0.32	0.32	0.34	0.35	0.43	0.50	0.57	0.63	0.69	0.71	0.72	0.72
1176	0.21	0.21	0.22	0.24	0.24	0.25	0.26	0.26	0.26	0.27	0.27	0.27	0.28	0.29	0.30	0.31	0.32	0.33	0.35	0.42	0.49	0.56	0.62	0.67	0.69	0.70
1177	0.21	0.21	0.21	0.22	0.23	0.24	0.25	0.25	0.26	0.26	0.26	0.27	0.27	0.28	0.29	0.30	0.30	0.31	0.32	0.34	0.41	0.48	0.54	0.60	0.66	0.68
1178	0.21	0.21	0.21	0.21	0.22	0.23	0.24	0.24	0.25	0.25	0.26	0.26	0.26	0.27	0.28	0.29	0.29	0.30	0.31	0.32	0.34	0.41	0.47	0.53	0.59	0.64
1179	0.21	0.21	0.21	0.21	0.21	0.22	0.23	0.24	0.24	0.25	0.25	0.26	0.26	0.26	0.26	0.27	0.28	0.29	0.30	0.30	0.32	0.33	0.40	0.46	0.52	0.58
1180	0.21	0.21	0.21	0.21	0.21	0.21	0.22	0.23	0.23	0.24	0.24	0.25	0.25	0.26	0.26	0.26	0.27	0.28	0.29	0.29	0.30	0.31	0.33	0.39	0.45	0.51
1185	0.20	0.20	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.22	0.22	0.22	0.23	0.23	0.24	0.24	0.24	0.25	0.25	0.26	0.26	0.27	0.28	0.28
1190	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.22	0.22	0.22	0.23	0.23	0.23	0.24	0.24	0.24
1195	0.19	0.19	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.21	0.21	0.22	0.22	0.22
1200	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
1225	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
1250	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
1300	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
1400	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
1440	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

EXHIBIT 3A. RAINFALL INTENSITIES - J-PRIME ZONE- 100-YR

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
200	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
400	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
600	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
900	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
1000	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
1050	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47
1100	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
1110	0.74	0.74	0.74	0.74	0.74	0.74	0.73	0.72	0.71	0.70	0.69	0.68	0.68	0.67	0.67	0.66	0.66	0.66	0.65	0.65	0.65	0.65	0.64	0.64	0.64	0.64
1120	0.90	0.90	0.90	0.90	0.90	0.90	0.89	0.87	0.86	0.86	0.85	0.84	0.84	0.83	0.83	0.82	0.81	0.80	0.79	0.78	0.77	0.77	0.76	0.75	0.75	0.74
1130	0.78	0.78	0.78	0.78	0.78	0.78	0.79	0.80	0.81	0.81	0.82	0.83	0.83	0.83	0.84	0.84	0.84	0.83	0.83	0.82	0.82	0.82	0.82	0.81	0.81	0.81
1131	0.86	0.85	0.84	0.83	0.83	0.82	0.82	0.83	0.83	0.84	0.84	0.84	0.85	0.85	0.85	0.86	0.86	0.85	0.85	0.84	0.84	0.84	0.83	0.83	0.83	0.82
1132	0.95	0.92	0.90	0.89	0.87	0.86	0.86	0.85	0.85	0.86	0.86	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87	0.86	0.86	0.85	0.85	0.85	0.84	0.84
1133	1.02	0.98	0.95	0.93	0.91	0.90	0.89	0.88	0.87	0.87	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.87	0.87	0.86	0.86	0.86	0.85
1134	1.10	1.05	1.01	0.98	0.96	0.94	0.93	0.92	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.89	0.89	0.88	0.88	0.87	0.87
1135	1.19	1.12	1.07	1.04	1.01	0.98	0.97	0.95	0.94	0.93	0.92	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.90	0.90	0.89	0.89	0.88
1136	1.19	1.19	1.13	1.09	1.05	1.03	1.00	0.99	0.97	0.96	0.94	0.93	0.93	0.93	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.90	0.90
1137	1.19	1.19	1.19	1.14	1.10	1.07	1.04	1.02	1.00	0.99	0.97	0.96	0.95	0.95	0.94	0.94	0.94	0.94	0.94	0.93	0.93	0.93	0.93	0.92	0.92	0.91
1138	1.19	1.18	1.18	1.19	1.14	1.10	1.07	1.05	1.03	1.01	1.00	0.98	0.97	0.96	0.96	0.95	0.95	0.95	0.95	0.95	0.94	0.94	0.94	0.94	0.93	0.93
1139	1.19	1.19	1.18	1.19	1.19	1.15	1.11	1.09	1.06	1.04	1.02	1.01	1.00	0.98	0.97	0.97	0.97	0.96	0.96	0.96	0.96	0.95	0.95	0.95	0.95	0.94
1140	1.19	1.19	1.19	1.19	1.19	1.19	1.15	1.12	1.09	1.07	1.05	1.04	1.02	1.01	0.99	0.98	0.98	0.98	0.97	0.97	0.97	0.96	0.96	0.96	0.96	0.96
1141	1.25	1.24	1.23	1.23	1.22	1.22	1.22	1.18	1.15	1.12	1.10	1.08	1.06	1.05	1.03	1.02	1.01	1.00	1.00	1.00	0.99	0.99	0.98	0.98	0.98	0.98
1142	1.31	1.29	1.28	1.27	1.26	1.25	1.24	1.24	1.20	1.17	1.15	1.13	1.10	1.09	1.07	1.06	1.04	1.03	1.03	1.02	1.02	1.01	1.01	1.00	1.00	1.00
1143	1.38	1.34	1.32	1.31	1.29	1.28	1.27	1.27	1.26	1.23	1.20	1.17	1.15	1.13	1.11	1.09	1.08	1.06	1.05	1.05	1.04	1.03	1.03	1.02	1.02	1.02
1144	1.45	1.41	1.37	1.35	1.33	1.32	1.31	1.30	1.29	1.28	1.25	1.22	1.19	1.17	1.15	1.13	1.11	1.10	1.09	1.07	1.07	1.06	1.05	1.05	1.04	1.04
1145	1.61	1.54	1.49	1.45	1.42	1.40	1.38	1.37	1.35	1.34	1.33	1.29	1.26	1.24	1.21	1.19	1.17	1.15	1.14	1.12	1.11	1.10	1.09	1.09	1.08	1.07

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1146	1.69	1.66	1.59	1.55	1.50	1.47	1.45	1.43	1.41	1.39	1.38	1.37	1.33	1.30	1.27	1.25	1.23	1.21	1.19	1.17	1.15	1.14	1.13	1.12	1.12	1.11
1147	1.79	1.74	1.71	1.64	1.59	1.55	1.52	1.49	1.47	1.45	1.43	1.41	1.40	1.37	1.34	1.31	1.28	1.26	1.24	1.22	1.20	1.19	1.17	1.16	1.15	1.14
1148	1.88	1.82	1.77	1.74	1.68	1.63	1.59	1.56	1.53	1.50	1.48	1.46	1.45	1.43	1.40	1.37	1.34	1.31	1.29	1.27	1.25	1.23	1.22	1.20	1.19	1.18
1149	1.69	1.67	1.65	1.63	1.61	1.57	1.54	1.51	1.48	1.46	1.44	1.43	1.41	1.40	1.39	1.36	1.33	1.31	1.28	1.26	1.24	1.23	1.21	1.19	1.18	1.17
1150	1.42	1.51	1.52	1.52	1.51	1.51	1.48	1.46	1.44	1.42	1.40	1.39	1.38	1.37	1.36	1.35	1.32	1.30	1.28	1.26	1.24	1.22	1.20	1.19	1.17	1.16
1151	1.76	1.79	1.82	1.79	1.75	1.73	1.71	1.67	1.63	1.59	1.57	1.55	1.52	1.51	1.49	1.47	1.46	1.43	1.40	1.38	1.35	1.33	1.31	1.29	1.27	1.26
1152	3.28	3.06	2.90	2.78	2.65	2.53	2.44	2.36	2.27	2.19	2.12	2.07	2.02	1.97	1.93	1.89	1.86	1.83	1.78	1.74	1.70	1.67	1.63	1.60	1.57	1.55
1153	3.60	3.33	3.14	2.99	2.87	2.74	2.63	2.54	2.46	2.37	2.29	2.22	2.16	2.10	2.06	2.01	1.97	1.94	1.90	1.86	1.81	1.77	1.74	1.70	1.67	1.64
1154	3.88	3.33	3.14	2.99	2.87	2.78	2.67	2.58	2.49	2.42	2.34	2.27	2.20	2.15	2.10	2.05	2.01	1.97	1.94	1.91	1.86	1.82	1.78	1.75	1.71	1.68
1155	4.06	3.48	3.07	2.93	2.83	2.74	2.67	2.58	2.49	2.42	2.36	2.29	2.22	2.16	2.11	2.07	2.03	1.99	1.95	1.92	1.89	1.85	1.81	1.77	1.74	1.71
1156	3.53	3.55	3.13	2.81	2.72	2.65	2.58	2.53	2.46	2.39	2.33	2.28	2.21	2.16	2.10	2.06	2.02	1.98	1.95	1.91	1.88	1.86	1.82	1.78	1.75	1.71
1157	1.82	3.11	3.19	2.87	2.61	2.55	2.50	2.45	2.41	2.35	2.30	2.25	2.20	2.15	2.10	2.05	2.01	1.97	1.94	1.91	1.88	1.85	1.83	1.79	1.75	1.72
1158	1.34	1.72	2.84	2.94	2.68	2.47	2.43	2.39	2.35	2.33	2.28	2.23	2.18	2.15	2.10	2.05	2.01	1.97	1.94	1.91	1.88	1.85	1.83	1.80	1.77	1.74
1159	1.09	1.24	1.58	2.57	2.69	2.48	2.31	2.29	2.26	2.24	2.22	2.18	2.14	2.10	2.07	2.03	1.99	1.95	1.92	1.89	1.86	1.83	1.81	1.79	1.77	1.73
1160	0.98	1.07	1.20	1.50	2.39	2.52	2.35	2.20	2.18	2.17	2.15	2.14	2.11	2.07	2.04	2.02	1.98	1.94	1.91	1.88	1.85	1.83	1.80	1.78	1.76	1.74
1161	0.95	0.96	1.04	1.16	1.43	2.24	2.37	2.22	2.10	2.09	2.08	2.07	2.06	2.04	2.01	1.98	1.96	1.93	1.89	1.86	1.84	1.81	1.79	1.77	1.75	1.73
1162	0.94	0.95	0.96	1.03	1.13	1.38	2.12	2.25	2.12	2.01	2.01	2.01	2.00	2.00	1.98	1.96	1.93	1.91	1.88	1.86	1.83	1.80	1.78	1.76	1.74	1.72
1163	0.84	0.90	0.92	0.93	0.99	1.09	1.32	2.01	2.13	2.02	1.93	1.93	1.93	1.93	1.94	1.92	1.90	1.88	1.86	1.84	1.81	1.78	1.76	1.74	1.72	1.71
1164	0.86	0.84	0.89	0.91	0.92	0.98	1.07	1.28	1.92	2.04	1.94	1.86	1.87	1.87	1.88	1.88	1.87	1.85	1.83	1.82	1.80	1.77	1.75	1.73	1.71	1.69
1165	0.83	0.85	0.83	0.88	0.89	0.91	0.96	1.05	1.24	1.83	1.96	1.87	1.80	1.81	1.82	1.82	1.83	1.82	1.80	1.79	1.78	1.76	1.74	1.71	1.70	1.68
1166	0.79	0.80	0.82	0.81	0.85	0.87	0.88	0.93	1.02	1.20	1.76	1.88	1.80	1.73	1.75	1.76	1.77	1.78	1.77	1.76	1.74	1.74	1.72	1.70	1.68	1.66
1167	0.72	0.76	0.77	0.80	0.79	0.83	0.85	0.86	0.91	0.99	1.16	1.68	1.80	1.73	1.67	1.69	1.70	1.71	1.72	1.72	1.71	1.70	1.69	1.68	1.66	1.64
1168	0.71	0.71	0.75	0.76	0.78	0.77	0.81	0.83	0.84	0.89	0.96	1.13	1.62	1.74	1.68	1.62	1.64	1.66	1.67	1.68	1.68	1.67	1.66	1.66	1.64	1.63
1169	0.56	0.61	0.63	0.67	0.69	0.71	0.71	0.75	0.78	0.79	0.84	0.91	1.07	1.54	1.65	1.60	1.55	1.57	1.59	1.60	1.62	1.62	1.61	1.61	1.60	1.59
1170	0.66	0.68	0.70	0.71	0.73	0.74	0.76	0.76	0.79	0.81	0.82	0.87	0.93	1.08	1.53	1.63	1.58	1.54	1.56	1.58	1.59	1.60	1.60	1.60	1.60	1.59
1171	0.65	0.65	0.67	0.69	0.69	0.72	0.73	0.75	0.75	0.78	0.80	0.81	0.85	0.91	1.05	1.48	1.58	1.54	1.50	1.52	1.54	1.55	1.57	1.57	1.56	1.56
1172	0.64	0.63	0.63	0.65	0.67	0.68	0.70	0.72	0.73	0.73	0.76	0.78	0.79	0.83	0.89	1.03	1.43	1.54	1.49	1.46	1.48	1.50	1.51	1.53	1.53	1.53

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1173	0.61	0.62	0.62	0.62	0.64	0.66	0.67	0.69	0.70	0.72	0.72	0.75	0.77	0.78	0.82	0.88	1.01	1.39	1.49	1.46	1.42	1.44	1.46	1.48	1.50	1.50
1174	0.71	0.61	0.62	0.62	0.62	0.64	0.65	0.66	0.68	0.69	0.71	0.71	0.74	0.76	0.77	0.81	0.86	0.99	1.36	1.46	1.42	1.39	1.41	1.43	1.45	1.47
1175	0.56	0.68	0.60	0.61	0.61	0.61	0.63	0.64	0.65	0.67	0.68	0.70	0.70	0.73	0.75	0.76	0.79	0.85	0.97	1.33	1.42	1.39	1.36	1.38	1.40	1.42
1176	0.55	0.56	0.66	0.59	0.60	0.60	0.61	0.62	0.64	0.64	0.66	0.68	0.69	0.69	0.72	0.74	0.75	0.78	0.83	0.95	1.29	1.38	1.36	1.33	1.35	1.37
1177	0.55	0.55	0.56	0.64	0.59	0.59	0.59	0.60	0.61	0.63	0.64	0.66	0.67	0.68	0.69	0.71	0.73	0.74	0.77	0.82	0.93	1.26	1.35	1.33	1.30	1.32
1178	0.56	0.56	0.56	0.56	0.64	0.59	0.59	0.60	0.60	0.61	0.63	0.63	0.65	0.66	0.68	0.68	0.71	0.72	0.73	0.77	0.81	0.92	1.24	1.33	1.30	1.28
1179	0.53	0.54	0.54	0.54	0.55	0.62	0.57	0.58	0.58	0.59	0.60	0.61	0.62	0.64	0.65	0.67	0.67	0.69	0.71	0.72	0.75	0.80	0.90	1.21	1.30	1.27
1180	0.53	0.53	0.54	0.54	0.54	0.55	0.61	0.57	0.58	0.58	0.58	0.60	0.61	0.62	0.63	0.65	0.66	0.66	0.69	0.70	0.71	0.74	0.79	0.89	1.19	1.27
1185	0.40	0.42	0.42	0.44	0.45	0.46	0.47	0.48	0.48	0.49	0.50	0.54	0.52	0.53	0.53	0.54	0.55	0.56	0.57	0.59	0.60	0.61	0.61	0.63	0.65	0.66
1190	0.42	0.41	0.41	0.41	0.41	0.41	0.42	0.42	0.43	0.44	0.45	0.45	0.46	0.47	0.47	0.48	0.51	0.50	0.50	0.51	0.51	0.52	0.54	0.54	0.56	0.57
1195	0.47	0.46	0.46	0.46	0.45	0.44	0.44	0.43	0.43	0.43	0.43	0.43	0.43	0.44	0.45	0.45	0.46	0.46	0.47	0.47	0.48	0.51	0.49	0.50	0.50	0.51
1200	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.45	0.45	0.44	0.44	0.44	0.44	0.43	0.44	0.44	0.45	0.45	0.45	0.46	0.46	0.46	0.47	0.47
1225	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.37	0.38	0.39	0.40	0.40	0.41	0.42	0.42	0.43	0.43	0.43	0.43	0.43	0.44	0.44
1280	0.30	0.30	0.30	0.30	0.30	0.30	0.31	0.31	0.31	0.32	0.32	0.32	0.32	0.33	0.33	0.33	0.33	0.33	0.33	0.34	0.34	0.34	0.34	0.34	0.34	0.34
1300	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
1400	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10
1440	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03

EXHIBIT 3B. RAINFALL INTENSITIES - J-PRIME ZONE- 50-YR

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
200	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
400	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
600	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
900	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
1000	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
1050	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
1100	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
1110	0.48	0.48	0.48	0.48	0.48	0.48	0.49	0.49	0.49	0.50	0.50	0.50	0.50	0.51	0.51	0.51	0.51	0.51	0.51	0.52	0.52	0.52	0.52	0.52	0.52	0.52
1120	0.56	0.56	0.56	0.56	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.53
1130	0.67	0.67	0.67	0.67	0.67	0.67	0.66	0.65	0.65	0.64	0.63	0.63	0.63	0.62	0.62	0.62	0.61	0.60	0.60	0.59	0.59	0.58	0.58	0.58	0.57	0.57
1131	0.69	0.69	0.69	0.69	0.68	0.68	0.68	0.67	0.66	0.66	0.65	0.64	0.64	0.63	0.63	0.63	0.62	0.62	0.61	0.61	0.60	0.60	0.59	0.59	0.58	0.58
1132	0.72	0.71	0.70	0.70	0.70	0.69	0.69	0.69	0.68	0.67	0.66	0.66	0.65	0.65	0.64	0.64	0.63	0.63	0.62	0.62	0.61	0.61	0.60	0.60	0.59	0.59
1133	0.74	0.73	0.72	0.71	0.71	0.70	0.70	0.70	0.70	0.69	0.68	0.67	0.66	0.66	0.65	0.65	0.64	0.64	0.64	0.63	0.62	0.62	0.61	0.61	0.60	0.60
1134	0.76	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71	0.70	0.69	0.68	0.68	0.67	0.66	0.66	0.65	0.65	0.65	0.64	0.64	0.63	0.62	0.62	0.61	0.61
1135	0.78	0.76	0.75	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71	0.70	0.69	0.68	0.68	0.67	0.67	0.66	0.66	0.65	0.65	0.64	0.64	0.63	0.62	0.62
1136	0.82	0.81	0.79	0.78	0.77	0.76	0.75	0.74	0.74	0.73	0.73	0.73	0.72	0.71	0.70	0.69	0.69	0.68	0.67	0.67	0.67	0.66	0.65	0.65	0.64	0.64
1137	0.86	0.85	0.84	0.82	0.80	0.79	0.78	0.77	0.76	0.76	0.75	0.74	0.74	0.73	0.72	0.71	0.71	0.70	0.69	0.69	0.68	0.68	0.67	0.67	0.66	0.65
1138	0.90	0.88	0.87	0.86	0.84	0.82	0.81	0.79	0.79	0.78	0.77	0.76	0.76	0.75	0.74	0.73	0.73	0.72	0.71	0.70	0.70	0.69	0.69	0.68	0.68	0.67
1139	0.94	0.92	0.90	0.88	0.87	0.85	0.83	0.82	0.81	0.80	0.79	0.78	0.78	0.77	0.77	0.76	0.75	0.74	0.73	0.72	0.72	0.71	0.70	0.70	0.69	0.69
1140	0.98	0.95	0.93	0.91	0.89	0.88	0.86	0.85	0.83	0.82	0.81	0.80	0.80	0.79	0.78	0.78	0.77	0.76	0.75	0.74	0.73	0.73	0.72	0.71	0.71	0.70
1141	1.00	1.00	0.97	0.94	0.92	0.91	0.90	0.88	0.86	0.85	0.84	0.83	0.82	0.81	0.80	0.80	0.79	0.78	0.77	0.76	0.75	0.75	0.74	0.73	0.73	0.72
1142	1.01	1.01	1.00	0.98	0.95	0.94	0.92	0.91	0.89	0.88	0.86	0.85	0.84	0.83	0.82	0.82	0.81	0.80	0.79	0.78	0.77	0.76	0.76	0.75	0.74	0.74
1143	1.03	1.02	1.01	1.01	0.99	0.96	0.95	0.93	0.92	0.90	0.89	0.88	0.86	0.85	0.84	0.83	0.83	0.82	0.81	0.80	0.79	0.78	0.78	0.77	0.76	0.75
1144	1.04	1.03	1.03	1.02	1.02	0.99	0.97	0.96	0.94	0.93	0.91	0.90	0.89	0.87	0.86	0.85	0.85	0.84	0.83	0.82	0.81	0.80	0.79	0.79	0.78	0.77
1145	1.06	1.04	1.04	1.03	1.02	1.02	1.00	0.98	0.96	0.95	0.94	0.92	0.91	0.90	0.88	0.87	0.86	0.85	0.85	0.84	0.83	0.82	0.81	0.80	0.79	0.79

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1146	1.32	1.28	1.24	1.21	1.18	1.16	1.15	1.12	1.09	1.07	1.05	1.03	1.01	0.99	0.97	0.96	0.95	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85
1147	1.59	1.50	1.44	1.38	1.34	1.30	1.27	1.25	1.21	1.18	1.16	1.13	1.11	1.09	1.07	1.05	1.03	1.01	1.00	0.98	0.97	0.96	0.95	0.93	0.92	0.91
1148	1.42	1.36	1.31	1.28	1.25	1.22	1.20	1.18	1.17	1.14	1.12	1.10	1.08	1.06	1.04	1.02	1.00	0.99	0.98	0.96	0.95	0.94	0.93	0.92	0.91	0.90
1149	1.41	1.35	1.31	1.28	1.25	1.23	1.20	1.19	1.17	1.16	1.13	1.11	1.09	1.07	1.06	1.04	1.02	1.01	0.99	0.98	0.97	0.95	0.94	0.93	0.92	0.91
1150	1.58	1.50	1.43	1.39	1.35	1.32	1.29	1.26	1.24	1.22	1.21	1.18	1.16	1.14	1.12	1.10	1.08	1.06	1.05	1.03	1.02	1.00	0.99	0.98	0.97	0.96
1151	1.32	1.50	1.44	1.39	1.35	1.32	1.30	1.27	1.25	1.23	1.21	1.20	1.18	1.15	1.13	1.12	1.10	1.08	1.06	1.05	1.03	1.02	1.00	0.99	0.98	0.97
1152	3.00	2.90	2.83	2.61	2.43	2.30	2.18	2.09	2.00	1.93	1.87	1.81	1.76	1.71	1.66	1.62	1.58	1.54	1.50	1.47	1.44	1.41	1.38	1.35	1.33	1.31
1153	3.70	3.11	3.01	2.93	2.72	2.56	2.42	2.31	2.21	2.12	2.05	1.98	1.92	1.87	1.81	1.76	1.71	1.67	1.63	1.59	1.56	1.52	1.49	1.46	1.43	1.41
1154	3.79	3.33	2.88	2.82	2.77	2.60	2.46	2.34	2.24	2.16	2.08	2.01	1.95	1.90	1.85	1.80	1.75	1.70	1.66	1.63	1.59	1.55	1.52	1.49	1.46	1.44
1155	3.62	3.34	3.01	2.66	2.63	2.60	2.46	2.35	2.25	2.16	2.09	2.02	1.96	1.90	1.86	1.81	1.76	1.72	1.68	1.64	1.61	1.57	1.54	1.51	1.48	1.45
1156	3.56	3.15	2.97	2.73	2.45	2.44	2.44	2.32	2.23	2.14	2.07	2.01	1.95	1.89	1.84	1.80	1.76	1.72	1.68	1.64	1.61	1.57	1.54	1.51	1.48	1.45
1157	1.56	3.10	2.81	2.70	2.51	2.28	2.29	2.30	2.20	2.12	2.05	1.99	1.93	1.88	1.83	1.79	1.75	1.72	1.68	1.64	1.61	1.57	1.54	1.51	1.48	1.46
1158	0.98	1.43	2.77	2.56	2.49	2.34	2.14	2.17	2.18	2.10	2.03	1.97	1.92	1.87	1.82	1.78	1.74	1.71	1.68	1.64	1.61	1.57	1.54	1.52	1.49	1.46
1159	0.84	0.95	1.34	2.52	2.36	2.32	2.20	2.03	2.06	2.08	2.01	1.95	1.90	1.85	1.81	1.77	1.73	1.70	1.67	1.64	1.61	1.57	1.54	1.52	1.49	1.46
1160	0.78	0.83	0.93	1.27	2.33	2.20	2.18	2.08	1.93	1.97	2.00	1.94	1.89	1.84	1.80	1.76	1.72	1.69	1.66	1.63	1.61	1.57	1.54	1.52	1.49	1.47
1161	0.72	0.73	0.78	0.87	1.18	2.14	2.05	2.04	1.96	1.83	1.87	1.90	1.85	1.81	1.77	1.73	1.70	1.67	1.64	1.61	1.59	1.56	1.53	1.51	1.48	1.46
1162	0.66	0.68	0.69	0.74	0.83	1.11	1.99	1.92	1.92	1.85	1.74	1.78	1.82	1.78	1.74	1.70	1.67	1.64	1.62	1.59	1.57	1.54	1.52	1.50	1.47	1.45
1163	0.60	0.63	0.65	0.67	0.71	0.79	1.05	1.87	1.80	1.81	1.76	1.66	1.70	1.74	1.71	1.67	1.65	1.62	1.59	1.57	1.55	1.52	1.50	1.49	1.46	1.44
1164	0.54	0.58	0.61	0.63	0.65	0.69	0.76	1.01	1.76	1.71	1.72	1.68	1.59	1.64	1.68	1.65	1.62	1.59	1.57	1.55	1.52	1.50	1.48	1.47	1.45	1.43
1165	0.48	0.53	0.57	0.59	0.61	0.63	0.67	0.74	0.96	1.67	1.63	1.65	1.61	1.53	1.58	1.62	1.59	1.57	1.54	1.52	1.50	1.48	1.47	1.45	1.43	1.42
1166	0.48	0.48	0.52	0.55	0.58	0.60	0.62	0.66	0.72	0.93	1.59	1.56	1.58	1.55	1.47	1.52	1.56	1.54	1.52	1.50	1.48	1.47	1.45	1.43	1.42	1.40
1167	0.48	0.48	0.48	0.52	0.55	0.57	0.59	0.61	0.64	0.70	0.90	1.52	1.49	1.52	1.49	1.43	1.47	1.51	1.49	1.48	1.46	1.44	1.43	1.41	1.40	1.38
1168	0.48	0.48	0.48	0.48	0.51	0.54	0.56	0.58	0.60	0.63	0.69	0.87	1.46	1.44	1.46	1.44	1.38	1.43	1.47	1.45	1.44	1.42	1.41	1.40	1.38	1.37
1169	0.48	0.48	0.48	0.48	0.48	0.51	0.53	0.56	0.57	0.59	0.62	0.68	0.85	1.40	1.39	1.41	1.39	1.34	1.39	1.43	1.41	1.40	1.39	1.37	1.36	1.35
1170	0.48	0.48	0.48	0.48	0.48	0.48	0.51	0.53	0.55	0.57	0.58	0.61	0.66	0.83	1.35	1.34	1.37	1.35	1.30	1.35	1.39	1.38	1.36	1.35	1.34	1.33
1171	0.51	0.50	0.50	0.50	0.49	0.49	0.49	0.52	0.54	0.55	0.57	0.58	0.61	0.66	0.82	1.32	1.31	1.33	1.32	1.27	1.32	1.36	1.35	1.34	1.33	1.32
1172	0.53	0.52	0.52	0.51	0.51	0.51	0.50	0.50	0.52	0.54	0.56	0.57	0.58	0.61	0.66	0.81	1.28	1.27	1.30	1.29	1.25	1.29	1.33	1.32	1.31	1.30

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1173	0.56	0.54	0.53	0.53	0.52	0.52	0.51	0.51	0.51	0.53	0.55	0.56	0.57	0.58	0.61	0.65	0.80	1.25	1.25	1.27	1.26	1.22	1.27	1.31	1.30	1.29
1174	0.58	0.56	0.55	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.55	0.56	0.57	0.59	0.61	0.65	0.79	1.22	1.22	1.25	1.24	1.20	1.24	1.28	1.27
1175	0.61	0.59	0.57	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.52	0.54	0.55	0.57	0.58	0.59	0.61	0.65	0.78	1.20	1.19	1.22	1.21	1.18	1.22	1.26
1176	0.61	0.61	0.59	0.57	0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.56	0.57	0.58	0.59	0.61	0.65	0.77	1.18	1.17	1.20	1.19	1.16	1.20
1177	0.61	0.61	0.61	0.59	0.58	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.53	0.55	0.56	0.57	0.58	0.59	0.61	0.65	0.77	1.15	1.15	1.18	1.17	1.14
1178	0.61	0.61	0.61	0.61	0.59	0.58	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.55	0.56	0.57	0.58	0.59	0.61	0.65	0.76	1.13	1.13	1.16	1.15
1179	0.61	0.61	0.61	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.55	0.56	0.57	0.58	0.59	0.61	0.64	0.76	1.11	1.11	1.14
1180	0.61	0.61	0.61	0.61	0.61	0.61	0.59	0.59	0.58	0.57	0.56	0.56	0.55	0.55	0.55	0.54	0.55	0.56	0.57	0.58	0.59	0.61	0.64	0.75	1.10	1.10
1185	0.42	0.45	0.47	0.49	0.50	0.51	0.52	0.53	0.53	0.54	0.54	0.54	0.54	0.53	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.53	0.54	0.55	0.55	0.56
1190	0.42	0.42	0.42	0.42	0.42	0.42	0.44	0.45	0.46	0.47	0.48	0.49	0.50	0.50	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.50	0.50	0.50	0.50
1195	0.45	0.45	0.44	0.44	0.44	0.43	0.43	0.43	0.43	0.43	0.43	0.44	0.45	0.46	0.47	0.47	0.48	0.49	0.49	0.50	0.50	0.50	0.50	0.50	0.50	0.50
1200	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.43	0.44	0.45	0.46	0.46	0.47	0.47	0.48	0.48	0.49	0.49
1225	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.40	0.40	0.40	0.41	0.41	0.41	0.41	0.41	0.41	0.42	0.42	0.42	0.42	0.42
1250	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.37	0.37	0.37	0.37	0.37	0.37	0.37
1300	0.28	0.29	0.28	0.29	0.28	0.29	0.28	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.28	0.29	0.28	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
1400	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
1440	0.01	0.02	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.02	0.02

EXHIBIT 3C. RAINFALL INTENSITIES - J-PRIME ZONE- 25-YR

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
200	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
400	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
600	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
900	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
1000	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
1050	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1100	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
1110	0.42	0.42	0.42	0.42	0.42	0.42	0.43	0.43	0.43	0.44	0.44	0.44	0.44	0.44	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.46	0.46	0.46
1120	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.48	0.48	0.47	0.47	0.47	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
1130	0.59	0.59	0.59	0.59	0.59	0.59	0.58	0.58	0.57	0.56	0.56	0.56	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.52	0.52	0.51	0.51	0.51	0.5	0.5
1131	0.61	0.61	0.61	0.61	0.6	0.6	0.6	0.59	0.59	0.58	0.57	0.57	0.56	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.51	0.51
1132	0.63	0.62	0.62	0.62	0.61	0.61	0.61	0.61	0.6	0.59	0.59	0.58	0.57	0.57	0.57	0.56	0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.52	0.52
1133	0.65	0.64	0.63	0.63	0.62	0.62	0.62	0.62	0.61	0.61	0.6	0.59	0.59	0.58	0.58	0.57	0.57	0.56	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.53
1134	0.67	0.65	0.65	0.64	0.63	0.63	0.63	0.62	0.62	0.62	0.61	0.6	0.6	0.59	0.59	0.58	0.58	0.57	0.57	0.57	0.56	0.56	0.55	0.55	0.54	0.54
1135	0.68	0.67	0.66	0.65	0.64	0.64	0.63	0.63	0.63	0.63	0.62	0.62	0.61	0.6	0.6	0.59	0.59	0.58	0.58	0.57	0.57	0.57	0.56	0.56	0.55	0.55
1136	0.72	0.71	0.7	0.68	0.67	0.67	0.66	0.65	0.65	0.65	0.64	0.64	0.63	0.62	0.62	0.61	0.6	0.6	0.59	0.59	0.59	0.58	0.58	0.57	0.57	0.56
1137	0.76	0.74	0.74	0.72	0.7	0.69	0.68	0.68	0.67	0.66	0.66	0.66	0.65	0.64	0.64	0.63	0.62	0.62	0.61	0.61	0.6	0.6	0.59	0.59	0.58	0.58
1138	0.79	0.77	0.76	0.75	0.73	0.72	0.71	0.7	0.69	0.68	0.68	0.67	0.67	0.66	0.65	0.65	0.64	0.63	0.63	0.62	0.62	0.61	0.61	0.6	0.6	0.59
1139	0.83	0.8	0.79	0.77	0.76	0.75	0.73	0.72	0.71	0.7	0.7	0.69	0.68	0.68	0.67	0.67	0.66	0.65	0.64	0.64	0.63	0.63	0.62	0.62	0.61	0.61
1140	0.86	0.83	0.81	0.8	0.78	0.77	0.76	0.74	0.73	0.72	0.71	0.71	0.7	0.69	0.69	0.68	0.67	0.67	0.66	0.65	0.65	0.64	0.63	0.63	0.62	0.62
1141	0.88	0.88	0.85	0.83	0.81	0.8	0.79	0.77	0.76	0.75	0.74	0.73	0.72	0.71	0.71	0.7	0.7	0.69	0.68	0.67	0.66	0.66	0.65	0.65	0.64	0.63
1142	0.89	0.89	0.88	0.86	0.84	0.82	0.81	0.8	0.79	0.77	0.76	0.75	0.74	0.73	0.72	0.72	0.71	0.71	0.7	0.69	0.68	0.67	0.67	0.66	0.66	0.65
1143	0.91	0.9	0.89	0.89	0.87	0.85	0.83	0.82	0.81	0.8	0.78	0.77	0.76	0.75	0.74	0.74	0.73	0.72	0.72	0.71	0.7	0.69	0.68	0.68	0.67	0.66
1144	0.92	0.91	0.91	0.9	0.9	0.87	0.86	0.84	0.83	0.82	0.81	0.79	0.78	0.77	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.71	0.7	0.69	0.69	0.68
1145	0.94	0.92	0.92	0.91	0.9	0.9	0.88	0.86	0.85	0.84	0.83	0.81	0.8	0.79	0.78	0.77	0.76	0.75	0.75	0.74	0.73	0.73	0.72	0.71	0.7	0.69

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1146	1.17	1.13	1.09	1.06	1.04	1.02	1.01	0.98	0.96	0.94	0.92	0.91	0.89	0.87	0.86	0.84	0.83	0.82	0.81	0.8	0.79	0.79	0.78	0.77	0.76	0.75
1147	1.4	1.32	1.27	1.22	1.18	1.15	1.12	1.1	1.07	1.04	1.02	1	0.98	0.96	0.94	0.92	0.9	0.89	0.88	0.87	0.85	0.84	0.84	0.82	0.81	0.8
1148	1.25	1.2	1.16	1.13	1.1	1.08	1.06	1.04	1.03	1	0.98	0.96	0.95	0.93	0.92	0.9	0.88	0.87	0.86	0.85	0.84	0.83	0.82	0.81	0.8	0.79
1149	1.24	1.19	1.16	1.13	1.11	1.08	1.06	1.05	1.03	1.02	1	0.98	0.96	0.95	0.93	0.91	0.9	0.89	0.87	0.86	0.85	0.84	0.83	0.82	0.82	0.8
1150	1.39	1.32	1.26	1.22	1.19	1.16	1.14	1.11	1.09	1.08	1.06	1.04	1.02	1	0.98	0.97	0.95	0.93	0.92	0.91	0.89	0.88	0.87	0.86	0.85	0.84
1151	1.16	1.32	1.27	1.22	1.19	1.17	1.15	1.12	1.1	1.09	1.07	1.06	1.04	1.02	1	0.98	0.97	0.95	0.94	0.92	0.91	0.9	0.89	0.87	0.87	0.86
1152	2.64	2.55	2.49	2.29	2.14	2.02	1.92	1.84	1.76	1.7	1.64	1.6	1.55	1.5	1.46	1.42	1.39	1.36	1.32	1.29	1.26	1.24	1.21	1.19	1.17	1.15
1153	3.25	2.74	2.65	2.58	2.4	2.25	2.13	2.03	1.95	1.87	1.8	1.74	1.69	1.65	1.6	1.55	1.51	1.47	1.44	1.4	1.37	1.34	1.31	1.29	1.26	1.24
1154	3.34	2.93	2.54	2.48	2.44	2.29	2.17	2.06	1.98	1.9	1.83	1.77	1.72	1.67	1.63	1.58	1.54	1.5	1.47	1.43	1.4	1.37	1.34	1.31	1.29	1.26
1155	3.19	2.94	2.65	2.34	2.31	2.29	2.17	2.07	1.98	1.9	1.84	1.78	1.73	1.68	1.63	1.6	1.55	1.51	1.48	1.44	1.41	1.38	1.35	1.33	1.3	1.28
1156	3.14	2.77	2.62	2.4	2.16	2.15	2.15	2.05	1.96	1.89	1.82	1.77	1.71	1.67	1.63	1.59	1.55	1.51	1.48	1.44	1.41	1.39	1.36	1.33	1.3	1.28
1157	1.38	2.73	2.48	2.38	2.21	2.01	2.02	2.02	1.94	1.87	1.81	1.75	1.7	1.66	1.62	1.58	1.54	1.51	1.48	1.44	1.41	1.39	1.36	1.33	1.31	1.28
1158	0.87	1.26	2.44	2.25	2.19	2.06	1.89	1.91	1.92	1.85	1.79	1.74	1.69	1.65	1.61	1.57	1.54	1.5	1.48	1.44	1.41	1.39	1.36	1.34	1.31	1.29
1159	0.74	0.84	1.18	2.22	2.08	2.04	1.93	1.79	1.81	1.83	1.77	1.72	1.67	1.63	1.6	1.56	1.53	1.5	1.47	1.44	1.41	1.39	1.36	1.34	1.31	1.29
1160	0.68	0.73	0.81	1.12	2.05	1.94	1.91	1.83	1.7	1.73	1.76	1.7	1.66	1.62	1.58	1.55	1.52	1.49	1.46	1.44	1.41	1.39	1.36	1.34	1.31	1.29
1161	0.63	0.64	0.69	0.77	1.04	1.88	1.8	1.79	1.72	1.61	1.64	1.67	1.63	1.59	1.56	1.53	1.5	1.47	1.44	1.42	1.4	1.38	1.35	1.33	1.3	1.28
1162	0.58	0.6	0.61	0.65	0.73	0.98	1.75	1.69	1.68	1.63	1.53	1.57	1.6	1.56	1.53	1.5	1.47	1.45	1.42	1.4	1.38	1.36	1.34	1.32	1.29	1.27
1163	0.53	0.55	0.57	0.59	0.63	0.7	0.93	1.64	1.59	1.59	1.55	1.46	1.5	1.53	1.5	1.47	1.45	1.42	1.4	1.38	1.36	1.34	1.32	1.31	1.29	1.27
1164	0.47	0.51	0.53	0.55	0.57	0.61	0.67	0.88	1.55	1.5	1.52	1.48	1.4	1.44	1.47	1.45	1.42	1.4	1.38	1.36	1.34	1.32	1.31	1.29	1.28	1.26
1165	0.42	0.46	0.5	0.52	0.54	0.55	0.59	0.65	0.85	1.47	1.43	1.45	1.42	1.35	1.39	1.42	1.4	1.38	1.36	1.34	1.32	1.31	1.29	1.28	1.26	1.25
1166	0.42	0.42	0.46	0.49	0.51	0.53	0.54	0.58	0.63	0.82	1.4	1.37	1.39	1.36	1.3	1.34	1.37	1.35	1.34	1.32	1.3	1.29	1.27	1.26	1.25	1.23
1167	0.42	0.42	0.42	0.45	0.48	0.5	0.52	0.53	0.56	0.62	0.79	1.34	1.31	1.33	1.31	1.25	1.29	1.33	1.31	1.3	1.28	1.27	1.26	1.24	1.23	1.22
1168	0.42	0.42	0.42	0.42	0.45	0.47	0.49	0.51	0.52	0.55	0.6	0.77	1.28	1.26	1.29	1.27	1.21	1.25	1.29	1.28	1.26	1.25	1.24	1.23	1.22	1.2
1169	0.42	0.42	0.42	0.42	0.42	0.45	0.47	0.49	0.5	0.51	0.54	0.59	0.75	1.23	1.22	1.24	1.23	1.18	1.22	1.26	1.24	1.23	1.22	1.21	1.2	1.19
1170	0.42	0.42	0.42	0.42	0.42	0.42	0.44	0.46	0.48	0.5	0.51	0.54	0.58	0.73	1.19	1.18	1.2	1.19	1.15	1.19	1.22	1.21	1.2	1.19	1.18	1.17
1171	0.44	0.44	0.44	0.43	0.43	0.43	0.43	0.45	0.47	0.48	0.5	0.51	0.54	0.58	0.72	1.16	1.15	1.17	1.16	1.12	1.16	1.2	1.19	1.18	1.17	1.16
1172	0.47	0.46	0.45	0.45	0.45	0.44	0.44	0.44	0.46	0.47	0.49	0.5	0.51	0.54	0.58	0.71	1.13	1.12	1.14	1.13	1.1	1.13	1.17	1.16	1.15	1.15

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1173	0.49	0.48	0.47	0.46	0.46	0.45	0.45	0.45	0.45	0.46	0.48	0.49	0.5	0.51	0.54	0.58	0.7	1.1	1.09	1.12	1.11	1.07	1.11	1.15	1.14	1.13
1174	0.51	0.5	0.49	0.48	0.47	0.47	0.46	0.46	0.46	0.45	0.47	0.48	0.49	0.5	0.51	0.54	0.57	0.69	1.08	1.07	1.1	1.09	1.05	1.09	1.13	1.12
1175	0.53	0.51	0.5	0.49	0.48	0.48	0.47	0.47	0.46	0.46	0.46	0.47	0.48	0.5	0.51	0.51	0.54	0.57	0.69	1.05	1.05	1.07	1.07	1.04	1.07	1.11
1176	0.53	0.53	0.52	0.51	0.5	0.49	0.48	0.48	0.47	0.47	0.47	0.46	0.48	0.49	0.5	0.51	0.52	0.54	0.57	0.68	1.03	1.03	1.05	1.05	1.02	1.05
1177	0.53	0.53	0.53	0.52	0.51	0.5	0.49	0.49	0.48	0.48	0.47	0.47	0.47	0.48	0.49	0.5	0.51	0.52	0.54	0.57	0.68	1.01	1.01	1.04	1.03	1
1178	0.53	0.53	0.53	0.53	0.52	0.51	0.5	0.5	0.49	0.49	0.48	0.48	0.47	0.47	0.48	0.49	0.5	0.51	0.52	0.54	0.57	0.67	1	0.99	1.02	1.01
1179	0.53	0.53	0.53	0.53	0.53	0.52	0.51	0.51	0.5	0.49	0.49	0.48	0.48	0.48	0.47	0.48	0.49	0.5	0.51	0.52	0.54	0.57	0.66	0.98	0.98	1
1180	0.53	0.53	0.53	0.53	0.53	0.53	0.52	0.52	0.51	0.5	0.5	0.49	0.49	0.48	0.48	0.48	0.49	0.5	0.5	0.51	0.52	0.54	0.56	0.66	0.96	0.96
1185	0.37	0.4	0.42	0.43	0.44	0.45	0.46	0.47	0.47	0.48	0.48	0.48	0.47	0.47	0.47	0.47	0.46	0.46	0.46	0.46	0.46	0.46	0.47	0.48	0.49	0.49
1190	0.37	0.37	0.37	0.37	0.37	0.37	0.39	0.4	0.41	0.42	0.43	0.43	0.44	0.44	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.44	0.44	0.44	0.44
1195	0.4	0.39	0.39	0.39	0.39	0.38	0.38	0.38	0.38	0.38	0.38	0.39	0.4	0.41	0.41	0.42	0.42	0.43	0.43	0.44	0.44	0.44	0.44	0.44	0.44	0.44
1200	0.4	0.4	0.4	0.4	0.4	0.4	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.38	0.38	0.39	0.4	0.4	0.41	0.41	0.42	0.42	0.43	0.43	0.43
1225	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.35	0.35	0.35	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.37	0.37	0.37	0.37
1250	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
1300	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
1400	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
1440	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

EXHIBIT 3D. RAINFALL INTENSITIES - J-PRIME ZONE- 10-YR

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
200	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
400	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
600	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
900	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
1000	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
1050	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
1100	0.51	0.51	0.51	0.51	0.51	0.52	0.52	0.52	0.53	0.53	0.54	0.54	0.54	0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.51	0.51	0.51	0.50	0.50
1110	0.55	0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.53	0.54	0.53	0.53	0.53	0.53
1120	0.51	0.53	0.53	0.54	0.55	0.56	0.57	0.58	0.57	0.56	0.56	0.55	0.55	0.55	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.53	0.53	0.53	0.53
1130	0.57	0.57	0.56	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.54	0.54	0.54	0.54	0.55	0.55	0.56	0.56	0.56	0.56	0.55	0.55	0.55	0.55	0.55	0.54
1131	0.60	0.59	0.58	0.57	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.54	0.55	0.55	0.55	0.55	0.56	0.56	0.57	0.56	0.56	0.56	0.55	0.55	0.55	0.55
1132	0.63	0.61	0.60	0.59	0.58	0.57	0.57	0.57	0.56	0.55	0.55	0.55	0.55	0.55	0.55	0.56	0.56	0.56	0.57	0.57	0.57	0.56	0.56	0.56	0.56	0.55
1133	0.66	0.64	0.62	0.61	0.60	0.59	0.58	0.58	0.57	0.57	0.56	0.56	0.55	0.56	0.56	0.56	0.56	0.56	0.57	0.57	0.57	0.57	0.57	0.56	0.56	0.56
1134	0.66	0.66	0.64	0.62	0.61	0.60	0.60	0.59	0.58	0.58	0.57	0.57	0.56	0.56	0.56	0.56	0.56	0.56	0.57	0.57	0.57	0.58	0.57	0.57	0.57	0.56
1135	0.66	0.66	0.66	0.64	0.63	0.62	0.61	0.60	0.59	0.59	0.58	0.58	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.58	0.58	0.58	0.57	0.57
1136	0.66	0.66	0.66	0.66	0.64	0.63	0.62	0.61	0.61	0.60	0.59	0.59	0.58	0.58	0.57	0.57	0.57	0.57	0.57	0.57	0.58	0.58	0.58	0.58	0.58	0.58
1137	0.67	0.67	0.67	0.67	0.67	0.65	0.64	0.63	0.62	0.61	0.61	0.60	0.60	0.59	0.59	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.59	0.59	0.58
1138	0.68	0.68	0.68	0.67	0.67	0.67	0.66	0.65	0.64	0.63	0.62	0.61	0.61	0.60	0.60	0.59	0.59	0.58	0.58	0.58	0.58	0.58	0.59	0.59	0.59	0.59
1139	0.70	0.69	0.69	0.68	0.68	0.68	0.68	0.66	0.65	0.64	0.63	0.63	0.62	0.61	0.61	0.60	0.60	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
1140	0.71	0.70	0.69	0.69	0.69	0.68	0.68	0.68	0.67	0.66	0.65	0.64	0.63	0.63	0.62	0.62	0.61	0.60	0.60	0.60	0.59	0.59	0.59	0.59	0.60	0.60
1141	0.78	0.76	0.75	0.74	0.73	0.72	0.72	0.71	0.71	0.69	0.68	0.67	0.66	0.65	0.65	0.64	0.63	0.63	0.62	0.62	0.61	0.61	0.61	0.61	0.61	0.61
1142	0.85	0.83	0.80	0.78	0.77	0.76	0.75	0.74	0.74	0.73	0.72	0.70	0.69	0.68	0.67	0.67	0.66	0.65	0.65	0.64	0.63	0.63	0.63	0.63	0.62	0.62
1143	0.91	0.88	0.86	0.83	0.81	0.80	0.78	0.77	0.77	0.76	0.75	0.74	0.72	0.71	0.70	0.69	0.68	0.68	0.67	0.66	0.66	0.65	0.64	0.64	0.64	0.64
1144	0.97	0.93	0.90	0.88	0.85	0.83	0.82	0.81	0.79	0.78	0.78	0.77	0.75	0.74	0.73	0.72	0.71	0.70	0.69	0.69	0.68	0.67	0.66	0.66	0.66	0.65
1145	1.08	1.02	0.98	0.94	0.92	0.89	0.87	0.85	0.84	0.83	0.82	0.81	0.80	0.78	0.77	0.75	0.74	0.73	0.72	0.72	0.71	0.70	0.69	0.68	0.68	0.68

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1146	1.12	1.11	1.05	1.01	0.98	0.95	0.92	0.90	0.88	0.87	0.85	0.84	0.83	0.82	0.81	0.79	0.78	0.77	0.76	0.75	0.74	0.73	0.72	0.71	0.70	0.70
1147	1.16	1.14	1.13	1.07	1.04	1.00	0.98	0.95	0.93	0.91	0.89	0.88	0.87	0.85	0.84	0.83	0.81	0.80	0.79	0.78	0.77	0.76	0.75	0.74	0.73	0.72
1148	1.20	1.18	1.16	1.14	1.09	1.06	1.03	1.00	0.97	0.95	0.93	0.91	0.90	0.89	0.87	0.86	0.85	0.83	0.82	0.81	0.79	0.78	0.77	0.77	0.76	0.75
1149	1.43	1.36	1.32	1.28	1.25	1.20	1.16	1.12	1.09	1.06	1.03	1.01	0.99	0.97	0.95	0.94	0.93	0.91	0.89	0.87	0.86	0.85	0.84	0.82	0.81	0.80
1150	1.61	1.55	1.48	1.42	1.38	1.34	1.29	1.24	1.20	1.17	1.13	1.10	1.08	1.05	1.03	1.01	1.00	0.98	0.96	0.94	0.93	0.91	0.90	0.88	0.87	0.86
1151	1.79	1.70	1.64	1.56	1.50	1.46	1.42	1.36	1.31	1.27	1.23	1.20	1.16	1.14	1.11	1.09	1.07	1.05	1.03	1.01	0.99	0.97	0.96	0.94	0.93	0.91
1152	1.98	1.86	1.77	1.70	1.63	1.57	1.52	1.48	1.42	1.37	1.33	1.29	1.25	1.22	1.19	1.16	1.14	1.12	1.10	1.08	1.06	1.04	1.02	1.00	0.98	0.97
1153	2.16	2.01	1.90	1.82	1.75	1.68	1.62	1.57	1.53	1.47	1.42	1.38	1.34	1.30	1.27	1.24	1.21	1.19	1.16	1.14	1.12	1.10	1.08	1.06	1.04	1.02
1154	1.98	2.01	1.90	1.82	1.76	1.70	1.64	1.59	1.55	1.51	1.46	1.41	1.37	1.34	1.30	1.27	1.24	1.21	1.19	1.17	1.15	1.13	1.11	1.08	1.07	1.05
1155	1.72	1.80	1.85	1.77	1.71	1.67	1.63	1.58	1.54	1.50	1.47	1.42	1.38	1.35	1.31	1.28	1.25	1.22	1.20	1.18	1.16	1.14	1.12	1.10	1.08	1.06
1156	1.46	1.58	1.66	1.73	1.67	1.63	1.59	1.57	1.52	1.49	1.46	1.43	1.39	1.35	1.32	1.29	1.26	1.23	1.21	1.19	1.16	1.14	1.13	1.11	1.09	1.07
1157	1.16	1.33	1.45	1.54	1.61	1.57	1.54	1.52	1.50	1.46	1.43	1.41	1.39	1.35	1.32	1.29	1.26	1.23	1.21	1.19	1.16	1.14	1.13	1.11	1.09	1.08
1158	0.86	1.08	1.23	1.35	1.44	1.51	1.49	1.47	1.45	1.44	1.41	1.39	1.37	1.35	1.31	1.28	1.26	1.23	1.21	1.19	1.16	1.14	1.13	1.11	1.09	1.08
1159	0.67	0.77	0.96	1.11	1.23	1.32	1.40	1.39	1.38	1.37	1.36	1.34	1.32	1.30	1.29	1.26	1.24	1.21	1.19	1.17	1.15	1.13	1.11	1.10	1.08	1.07
1160	0.55	0.60	0.69	0.88	1.02	1.13	1.23	1.31	1.30	1.30	1.29	1.29	1.28	1.26	1.25	1.24	1.21	1.19	1.17	1.15	1.13	1.11	1.10	1.08	1.07	1.05
1161	0.52	0.58	0.62	0.70	0.86	0.99	1.10	1.19	1.26	1.26	1.26	1.26	1.26	1.25	1.23	1.22	1.22	1.19	1.17	1.15	1.14	1.12	1.10	1.09	1.07	1.06
1162	0.54	0.56	0.60	0.64	0.70	0.85	0.97	1.07	1.15	1.22	1.23	1.23	1.23	1.23	1.22	1.21	1.20	1.19	1.17	1.15	1.14	1.12	1.10	1.09	1.07	1.06
1163	0.55	0.57	0.58	0.62	0.65	0.71	0.84	0.95	1.04	1.12	1.19	1.20	1.20	1.20	1.20	1.19	1.19	1.18	1.17	1.16	1.14	1.12	1.11	1.09	1.08	1.06
1164	0.61	0.55	0.57	0.58	0.61	0.64	0.69	0.81	0.92	1.01	1.08	1.15	1.16	1.16	1.17	1.17	1.16	1.16	1.15	1.15	1.13	1.11	1.10	1.09	1.07	1.06
1165	0.66	0.59	0.55	0.56	0.57	0.60	0.63	0.68	0.79	0.89	0.98	1.05	1.12	1.12	1.13	1.13	1.14	1.14	1.13	1.13	1.12	1.11	1.09	1.08	1.07	1.05
1166	0.61	0.63	0.58	0.54	0.55	0.56	0.59	0.62	0.66	0.77	0.86	0.95	1.02	1.08	1.09	1.10	1.10	1.11	1.11	1.10	1.10	1.10	1.08	1.07	1.06	1.05
1167	0.56	0.59	0.61	0.57	0.53	0.55	0.56	0.58	0.60	0.65	0.75	0.84	0.92	0.99	1.05	1.06	1.07	1.08	1.08	1.08	1.08	1.08	1.08	1.06	1.05	1.04
1168	0.50	0.54	0.57	0.59	0.55	0.52	0.54	0.55	0.57	0.59	0.64	0.73	0.82	0.89	0.96	1.02	1.03	1.04	1.05	1.06	1.06	1.05	1.05	1.05	1.04	1.03
1169	0.48	0.49	0.52	0.55	0.57	0.54	0.52	0.53	0.54	0.56	0.58	0.62	0.72	0.80	0.87	0.93	0.99	1.00	1.01	1.02	1.03	1.03	1.03	1.03	1.03	1.02
1170	0.46	0.47	0.48	0.51	0.54	0.56	0.53	0.51	0.52	0.53	0.55	0.57	0.61	0.70	0.78	0.85	0.91	0.97	0.98	0.99	1.00	1.01	1.01	1.01	1.01	1.01
1171	0.44	0.45	0.46	0.47	0.50	0.53	0.55	0.52	0.50	0.51	0.52	0.55	0.56	0.60	0.69	0.76	0.83	0.89	0.94	0.95	0.97	0.98	0.99	0.99	0.99	0.99
1172	0.43	0.44	0.45	0.46	0.47	0.49	0.52	0.53	0.51	0.50	0.51	0.52	0.54	0.56	0.59	0.67	0.74	0.81	0.87	0.92	0.93	0.94	0.96	0.97	0.97	0.97

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1173	0.43	0.43	0.44	0.44	0.45	0.46	0.49	0.51	0.53	0.51	0.49	0.50	0.51	0.53	0.55	0.59	0.66	0.73	0.79	0.85	0.90	0.91	0.93	0.94	0.95	0.95
1174	0.42	0.43	0.43	0.43	0.44	0.45	0.46	0.48	0.50	0.52	0.50	0.49	0.50	0.51	0.53	0.54	0.58	0.65	0.71	0.78	0.83	0.88	0.90	0.91	0.92	0.93
1175	0.42	0.42	0.43	0.43	0.43	0.44	0.45	0.45	0.48	0.50	0.51	0.50	0.48	0.49	0.50	0.52	0.54	0.57	0.64	0.70	0.76	0.81	0.86	0.88	0.89	0.90
1176	0.42	0.42	0.42	0.42	0.43	0.43	0.44	0.45	0.45	0.47	0.49	0.51	0.49	0.48	0.49	0.50	0.52	0.53	0.56	0.63	0.69	0.75	0.80	0.85	0.86	0.87
1177	0.42	0.42	0.42	0.42	0.42	0.43	0.43	0.43	0.44	0.45	0.47	0.49	0.50	0.49	0.48	0.49	0.49	0.51	0.53	0.56	0.62	0.68	0.74	0.79	0.83	0.85
1178	0.42	0.42	0.42	0.42	0.42	0.42	0.43	0.43	0.43	0.44	0.45	0.47	0.48	0.50	0.48	0.47	0.48	0.49	0.51	0.52	0.55	0.61	0.67	0.72	0.77	0.82
1179	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.43	0.43	0.44	0.45	0.46	0.48	0.49	0.48	0.47	0.48	0.49	0.50	0.52	0.55	0.61	0.66	0.71	0.76
1180	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.43	0.43	0.44	0.44	0.46	0.48	0.49	0.48	0.47	0.48	0.49	0.50	0.51	0.54	0.60	0.65	0.70
1185	0.34	0.35	0.36	0.37	0.37	0.38	0.38	0.39	0.39	0.39	0.39	0.40	0.40	0.40	0.40	0.41	0.41	0.42	0.43	0.45	0.46	0.45	0.44	0.45	0.46	0.47
1190	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.35	0.36	0.36	0.36	0.37	0.37	0.37	0.38	0.38	0.38	0.38	0.39	0.39	0.39	0.40	0.40	0.42	0.43	0.44
1195	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.35	0.35	0.35	0.36	0.36	0.36	0.37	0.37	0.37	0.37	0.37	0.38	0.38	0.38
1200	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.35	0.35	0.35	0.36	0.36	0.36	0.36	0.36
1225	0.23	0.23	0.23	0.23	0.23	0.23	0.22	0.22	0.22	0.21	0.21	0.21	0.21	0.21	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.21	0.21	0.22	0.22
1250	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.22
1300	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.13	0.13	0.13	0.13	0.13
1400	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04
1440	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

EXHIBIT 4A. RAINFALL INTENSITIES - K ZONE- 100-YR

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
200	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
400	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
600	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
900	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
1000	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
1050	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61
1100	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
1110	0.84	0.84	0.84	0.84	0.84	0.84	0.82	0.81	0.80	0.78	0.78	0.77	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.73	0.72	0.72	0.72	0.71	0.71	0.71
1120	0.77	0.77	0.77	0.77	0.77	0.77	0.78	0.78	0.79	0.79	0.80	0.80	0.80	0.80	0.80	0.81	0.80	0.79	0.79	0.78	0.77	0.77	0.77	0.76	0.76	0.75
1130	1.02	1.02	1.02	1.02	1.02	1.02	1.00	0.98	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.90	0.89	0.89	0.89	0.89	0.89	0.88	0.88	0.88	0.88	0.88
1131	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.00	0.98	0.97	0.95	0.94	0.93	0.92	0.92	0.91	0.90	0.90	0.90	0.90	0.89	0.89	0.89	0.89	0.89	0.88
1132	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.00	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.92	0.91	0.90	0.90	0.90	0.90	0.90	0.89	0.89	0.89
1133	1.06	1.05	1.05	1.04	1.04	1.04	1.04	1.04	1.03	1.02	1.00	0.98	0.97	0.96	0.95	0.94	0.94	0.93	0.92	0.92	0.91	0.91	0.91	0.91	0.90	0.90
1134	1.10	1.09	1.08	1.07	1.07	1.06	1.06	1.06	1.05	1.05	1.03	1.02	1.00	0.99	0.98	0.97	0.96	0.95	0.94	0.94	0.93	0.93	0.92	0.92	0.92	0.92
1135	1.14	1.12	1.11	1.10	1.09	1.08	1.08	1.07	1.07	1.06	1.06	1.04	1.03	1.01	1.00	0.99	0.98	0.97	0.96	0.95	0.95	0.94	0.94	0.94	0.93	0.93
1136	1.12	1.10	1.09	1.08	1.07	1.07	1.06	1.06	1.06	1.05	1.05	1.05	1.03	1.02	1.01	1.00	0.98	0.98	0.97	0.96	0.95	0.94	0.94	0.94	0.93	0.93
1137	1.18	1.15	1.13	1.12	1.11	1.10	1.09	1.08	1.08	1.08	1.07	1.07	1.07	1.05	1.04	1.02	1.01	1.00	0.99	0.98	0.97	0.96	0.96	0.95	0.95	0.95
1138	1.19	1.19	1.17	1.15	1.13	1.12	1.11	1.10	1.10	1.09	1.09	1.08	1.08	1.08	1.06	1.05	1.03	1.02	1.01	1.00	0.99	0.98	0.98	0.97	0.96	0.96
1139	1.19	1.20	1.20	1.18	1.16	1.15	1.14	1.12	1.12	1.11	1.10	1.10	1.09	1.09	1.09	1.07	1.06	1.04	1.03	1.02	1.01	1.00	0.99	0.99	0.98	0.97
1140	1.21	1.21	1.22	1.22	1.19	1.18	1.16	1.15	1.14	1.13	1.12	1.12	1.11	1.11	1.10	1.10	1.08	1.07	1.06	1.04	1.03	1.02	1.01	1.00	1.00	0.99
1141	1.34	1.27	1.26	1.26	1.25	1.23	1.21	1.20	1.18	1.17	1.16	1.15	1.14	1.14	1.13	1.12	1.12	1.10	1.09	1.08	1.06	1.05	1.04	1.03	1.02	1.02
1142	1.38	1.37	1.30	1.29	1.29	1.28	1.26	1.24	1.22	1.20	1.19	1.18	1.17	1.16	1.16	1.15	1.14	1.14	1.12	1.11	1.09	1.08	1.08	1.06	1.05	1.04
1143	1.43	1.40	1.39	1.33	1.31	1.31	1.30	1.28	1.26	1.24	1.22	1.21	1.20	1.19	1.18	1.17	1.17	1.16	1.15	1.14	1.12	1.11	1.10	1.08	1.08	1.06
1144	1.49	1.45	1.42	1.41	1.35	1.34	1.33	1.32	1.30	1.28	1.26	1.24	1.23	1.22	1.21	1.20	1.19	1.18	1.18	1.17	1.15	1.14	1.13	1.11	1.10	1.09
1145	1.63	1.58	1.53	1.50	1.48	1.42	1.40	1.39	1.38	1.35	1.33	1.31	1.29	1.28	1.26	1.25	1.24	1.23	1.22	1.21	1.20	1.19	1.17	1.16	1.14	1.13

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1146	1.73	1.70	1.65	1.60	1.56	1.54	1.48	1.46	1.44	1.42	1.40	1.37	1.35	1.33	1.32	1.30	1.29	1.28	1.26	1.26	1.25	1.24	1.22	1.20	1.19	1.18
1147	1.84	1.78	1.75	1.70	1.65	1.61	1.58	1.52	1.50	1.48	1.46	1.44	1.41	1.39	1.37	1.35	1.34	1.32	1.31	1.30	1.29	1.28	1.27	1.25	1.23	1.22
1148	1.94	1.87	1.82	1.78	1.73	1.69	1.65	1.62	1.56	1.54	1.52	1.50	1.47	1.45	1.42	1.40	1.39	1.37	1.35	1.34	1.33	1.32	1.30	1.29	1.28	1.26
1149	2.65	2.47	2.33	2.23	2.18	2.07	2.00	1.94	1.89	1.82	1.78	1.74	1.71	1.67	1.64	1.61	1.58	1.56	1.53	1.51	1.49	1.47	1.46	1.44	1.43	1.40
1150	3.26	3.06	2.84	2.68	2.55	2.45	2.34	2.26	2.18	2.18	2.04	1.98	1.94	1.90	1.85	1.81	1.77	1.74	1.71	1.68	1.65	1.63	1.61	1.59	1.57	1.55
1151	3.06	2.89	2.77	2.62	2.49	2.39	2.32	2.24	2.16	2.10	2.04	1.97	1.93	1.89	1.85	1.81	1.77	1.74	1.71	1.68	1.65	1.63	1.61	1.59	1.57	1.55
1152	4.49	4.08	3.79	3.57	3.35	3.16	3.01	2.89	2.77	2.66	2.57	2.49	2.40	2.33	2.27	2.22	2.16	2.11	2.06	2.02	1.98	1.94	1.91	1.88	1.85	1.82
1153	5.10	4.59	4.23	3.95	3.74	3.52	3.34	3.18	3.06	2.94	2.82	2.73	2.64	2.55	2.48	2.42	2.36	2.30	2.24	2.19	2.14	2.10	2.06	2.02	1.99	1.96
1154	4.49	4.59	4.23	3.95	3.74	3.57	3.39	3.23	3.10	2.99	2.88	2.78	2.69	2.61	2.52	2.45	2.40	2.34	2.28	2.23	2.18	2.14	2.10	2.06	2.02	1.99
1155	3.77	3.99	4.15	3.88	3.68	3.52	3.38	3.23	3.10	2.98	2.89	2.79	2.70	2.62	2.55	2.47	2.41	2.36	2.31	2.25	2.20	2.16	2.12	2.08	2.04	2.01
1156	3.83	3.36	3.61	3.80	3.60	3.44	3.32	3.21	3.08	2.97	2.87	2.79	2.70	2.62	2.55	2.49	2.41	2.36	2.31	2.26	2.22	2.17	2.13	2.09	2.05	2.02
1157	2.22	3.38	3.04	3.30	3.50	3.35	3.24	3.14	3.05	2.94	2.85	2.76	2.69	2.62	2.54	2.48	2.43	2.36	2.31	2.26	2.22	2.17	2.13	2.09	2.05	2.02
1158	1.40	2.02	3.04	2.79	3.05	3.25	3.14	3.05	2.97	2.91	2.82	2.73	2.66	2.60	2.53	2.47	2.41	2.36	2.30	2.25	2.21	2.17	2.13	2.09	2.05	2.02
1159	1.19	1.33	1.87	2.78	2.59	2.84	3.04	2.96	2.89	2.83	2.78	2.70	2.63	2.57	2.51	2.45	2.40	2.34	2.30	2.24	2.20	2.16	2.13	2.09	2.05	2.02
1160	1.10	1.17	1.29	1.77	2.59	2.44	2.68	2.88	2.82	2.76	2.71	2.67	2.60	2.54	2.49	2.44	2.39	2.34	2.29	2.25	2.20	2.16	2.12	2.09	2.05	2.02
1161	1.00	1.05	1.11	1.23	1.66	2.41	2.28	2.52	2.72	2.67	2.63	2.59	2.56	2.50	2.45	2.40	2.36	2.32	2.27	2.23	2.19	2.14	2.11	2.08	2.05	2.01
1162	0.92	0.96	1.01	1.07	1.18	1.57	2.26	2.16	2.39	2.58	2.54	2.51	2.48	2.46	2.41	2.37	2.33	2.29	2.25	2.21	2.17	2.14	2.09	2.06	2.03	2.00
1163	0.88	0.90	0.93	0.98	1.04	1.14	1.50	2.14	2.05	2.27	2.46	2.43	2.41	2.39	2.37	2.33	2.29	2.26	2.22	2.19	2.15	2.12	2.09	2.04	2.02	1.99
1164	0.91	0.92	0.93	0.96	1.00	1.05	1.14	1.47	2.06	1.99	2.20	2.38	2.36	2.34	2.32	2.31	2.27	2.24	2.21	2.18	2.15	2.11	2.08	2.05	2.01	1.99
1165	0.80	0.85	0.87	0.89	0.91	0.95	1.00	1.09	1.40	1.95	1.89	2.09	2.27	2.26	2.24	2.24	2.23	2.20	2.16	2.14	2.11	2.08	2.05	2.02	2.00	1.96
1166	0.79	0.79	0.83	0.85	0.87	0.89	0.93	0.98	1.06	1.35	1.87	1.82	2.01	2.18	2.18	2.17	2.16	2.16	2.13	2.10	2.08	2.06	2.03	2.01	1.98	1.96
1167	0.76	0.76	0.76	0.80	0.82	0.84	0.87	0.90	0.95	1.03	1.30	1.79	1.75	1.93	2.10	2.10	2.09	2.09	2.09	2.07	2.04	2.02	2.01	1.98	1.96	1.93
1168	0.74	0.75	0.75	0.76	0.79	0.81	0.83	0.86	0.89	0.93	1.01	1.26	1.73	1.69	1.87	2.03	2.03	2.03	2.03	2.03	2.01	1.99	1.98	1.96	1.94	1.92
1169	0.72	0.79	0.79	0.79	0.79	0.82	0.83	0.84	0.87	0.90	0.94	1.01	1.25	1.69	1.66	1.83	1.98	1.98	1.99	1.99	1.99	1.98	1.96	1.94	1.93	1.91
1170	0.68	0.66	0.73	0.74	0.74	0.74	0.78	0.79	0.81	0.83	0.86	0.91	0.97	1.20	1.62	1.59	1.76	1.91	1.92	1.92	1.92	1.93	1.92	1.90	1.89	1.88
1171	0.68	0.69	0.67	0.73	0.73	0.74	0.74	0.77	0.78	0.80	0.82	0.86	0.89	0.96	1.18	1.58	1.55	1.71	1.86	1.86	1.87	1.88	1.88	1.87	1.86	1.85
1172	0.70	0.68	0.69	0.67	0.72	0.73	0.73	0.74	0.76	0.78	0.79	0.81	0.84	0.88	0.94	1.15	1.53	1.51	1.66	1.81	1.82	1.82	1.83	1.84	1.83	1.82
1173	0.67	0.68	0.67	0.68	0.66	0.71	0.72	0.72	0.72	0.75	0.76	0.78	0.80	0.83	0.86	0.92	1.12	1.49	1.47	1.62	1.76	1.77	1.78	1.79	1.80	1.79

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1174	0.60	0.67	0.68	0.67	0.67	0.66	0.70	0.71	0.72	0.72	0.74	0.76	0.77	0.79	0.82	0.86	0.91	1.10	1.45	1.44	1.58	1.72	1.73	1.74	1.75	1.76
1175	0.65	0.60	0.66	0.67	0.66	0.67	0.66	0.70	0.70	0.71	0.71	0.74	0.75	0.76	0.78	0.81	0.84	0.90	1.08	1.42	1.40	1.54	1.68	1.69	1.70	1.71
1176	0.62	0.64	0.60	0.65	0.66	0.65	0.66	0.65	0.69	0.69	0.70	0.70	0.73	0.74	0.76	0.77	0.80	0.83	0.88	1.06	1.38	1.37	1.51	1.64	1.65	1.66
1177	0.60	0.61	0.63	0.59	0.64	0.65	0.64	0.65	0.64	0.68	0.68	0.69	0.70	0.72	0.73	0.74	0.76	0.79	0.82	0.87	1.04	1.35	1.34	1.47	1.60	1.61
1178	0.59	0.59	0.60	0.62	0.59	0.63	0.64	0.64	0.64	0.63	0.67	0.68	0.68	0.69	0.71	0.72	0.73	0.78	0.78	0.81	0.86	1.02	1.32	1.31	1.44	1.56
1179	0.58	0.59	0.59	0.60	0.61	0.59	0.63	0.64	0.63	0.64	0.63	0.66	0.67	0.68	0.68	0.70	0.71	0.73	0.75	0.77	0.80	0.85	1.00	1.30	1.29	1.41
1180	0.58	0.58	0.59	0.59	0.60	0.61	0.59	0.62	0.63	0.63	0.64	0.63	0.66	0.67	0.67	0.68	0.70	0.71	0.72	0.74	0.76	0.79	0.84	0.99	1.27	1.26
1185	0.58	0.59	0.59	0.58	0.58	0.58	0.58	0.59	0.59	0.60	0.60	0.59	0.61	0.62	0.62	0.62	0.62	0.64	0.65	0.66	0.66	0.68	0.69	0.70	0.71	0.73
1190	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.59	0.59	0.59	0.60	0.59	0.60	0.61	0.61	0.61	0.61	0.63	0.64	0.64	0.65
1195	0.58	0.58	0.58	0.58	0.59	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.59	0.58	0.58	0.58	0.58	0.59	0.59	0.59	0.60	0.59	0.60	0.61	0.71	0.61
1200	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.59	0.59
1225	0.52	0.52	0.51	0.51	0.51	0.52	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.52	0.52	0.52
1250	0.50	0.50	0.51	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
1300	0.46	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
1400	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
1440	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24

Note: Highlighted cells do not follow expected progression but data were verified- appears to be related to variations in the mass curve used to calculate intensities.

EXHIBIT 4B. RAINFALL INTENSITIES - K ZONE- 50-YR

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
200	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
400	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
600	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
900	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
1000	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
1050	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
1100	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
1110	0.69	0.69	0.69	0.69	0.69	0.69	0.68	0.68	0.68	0.67	0.67	0.67	0.67	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.65	0.65	0.65	0.65
1120	0.80	0.80	0.80	0.80	0.80	0.80	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.72	0.71	0.71	0.71
1130	0.85	0.85	0.85	0.85	0.85	0.85	0.84	0.84	0.84	0.83	0.83	0.83	0.83	0.83	0.83	0.82	0.81	0.82	0.81	0.80	0.80	0.79	0.79	0.79	0.78	0.78
1131	0.86	0.86	0.85	0.85	0.85	0.85	0.85	0.85	0.84	0.84	0.84	0.84	0.83	0.83	0.83	0.83	0.83	0.82	0.82	0.81	0.81	0.80	0.80	0.79	0.79	0.79
1132	0.87	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.85	0.85	0.84	0.84	0.84	0.84	0.84	0.84	0.83	0.83	0.83	0.82	0.82	0.81	0.81	0.80	0.80	0.79
1133	0.88	0.87	0.87	0.87	0.86	0.86	0.86	0.86	0.86	0.86	0.85	0.85	0.85	0.84	0.84	0.84	0.84	0.84	0.84	0.83	0.82	0.82	0.81	0.81	0.80	0.80
1134	0.89	0.88	0.88	0.87	0.87	0.87	0.87	0.86	0.86	0.86	0.86	0.85	0.85	0.85	0.85	0.84	0.84	0.84	0.84	0.84	0.83	0.83	0.82	0.82	0.81	0.81
1135	0.90	0.89	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.86	0.86	0.86	0.86	0.85	0.85	0.85	0.85	0.84	0.84	0.84	0.84	0.83	0.83	0.82	0.82	0.82
1136	0.98	0.97	0.95	0.94	0.93	0.92	0.91	0.91	0.90	0.90	0.90	0.89	0.89	0.88	0.88	0.88	0.87	0.87	0.87	0.86	0.86	0.86	0.85	0.85	0.84	0.84
1137	1.07	1.04	1.02	1.00	0.98	0.97	0.96	0.95	0.94	0.93	0.93	0.92	0.92	0.91	0.91	0.90	0.90	0.89	0.89	0.88	0.88	0.88	0.88	0.87	0.86	0.86
1138	1.15	1.11	1.08	1.06	1.03	1.02	1.00	0.99	0.98	0.97	0.96	0.95	0.95	0.94	0.93	0.93	0.92	0.92	0.91	0.91	0.90	0.90	0.90	0.89	0.88	0.88
1139	1.24	1.18	1.14	1.11	1.09	1.06	1.04	1.03	1.01	1.00	0.99	0.98	0.97	0.97	0.96	0.95	0.94	0.94	0.93	0.93	0.92	0.92	0.91	0.91	0.91	0.90
1140	1.32	1.25	1.20	1.16	1.13	1.11	1.09	1.07	1.05	1.04	1.02	1.01	1.00	0.99	0.98	0.98	0.97	0.96	0.96	0.95	0.94	0.94	0.93	0.93	0.92	0.92
1141	1.38	1.37	1.30	1.25	1.21	1.18	1.16	1.13	1.11	1.09	1.07	1.06	1.05	1.04	1.02	1.02	1.01	1.00	0.99	0.98	0.98	0.97	0.96	0.96	0.95	0.95
1142	1.44	1.42	1.40	1.34	1.29	1.25	1.22	1.19	1.17	1.14	1.12	1.11	1.09	1.08	1.06	1.05	1.04	1.04	1.02	1.02	1.01	1.00	0.99	0.99	0.98	0.97
1143	1.49	1.46	1.44	1.43	1.37	1.32	1.28	1.25	1.22	1.20	1.17	1.15	1.14	1.12	1.10	1.09	1.08	1.07	1.06	1.05	1.04	1.03	1.02	1.01	1.01	1.00
1144	1.55	1.51	1.48	1.46	1.45	1.39	1.35	1.31	1.28	1.25	1.22	1.20	1.18	1.16	1.14	1.13	1.12	1.10	1.09	1.08	1.07	1.06	1.05	1.04	1.04	1.03
1145	1.61	1.56	1.53	1.50	1.48	1.46	1.41	1.37	1.33	1.30	1.28	1.25	1.22	1.20	1.18	1.17	1.15	1.14	1.13	1.12	1.10	1.09	1.08	1.07	1.06	1.05

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1146	1.65	1.64	1.59	1.56	1.53	1.51	1.50	1.44	1.40	1.37	1.34	1.31	1.28	1.26	1.24	1.22	1.20	1.18	1.17	1.16	1.14	1.13	1.12	1.11	1.10	1.09
1147	1.68	1.67	1.66	1.62	1.59	1.56	1.54	1.52	1.47	1.43	1.40	1.36	1.34	1.31	1.29	1.26	1.24	1.23	1.21	1.19	1.18	1.17	1.16	1.14	1.13	1.12
1148	1.74	1.71	1.70	1.69	1.65	1.61	1.59	1.56	1.55	1.50	1.46	1.42	1.39	1.37	1.34	1.32	1.29	1.27	1.25	1.24	1.22	1.21	1.19	1.18	1.17	1.16
1149	1.83	1.80	1.77	1.75	1.73	1.69	1.66	1.63	1.61	1.59	1.54	1.50	1.46	1.43	1.40	1.38	1.35	1.33	1.31	1.29	1.27	1.26	1.24	1.22	1.21	1.20
1150	2.10	2.02	1.96	1.92	1.88	1.85	1.80	1.76	1.73	1.70	1.68	1.63	1.58	1.55	1.51	1.48	1.45	1.42	1.40	1.38	1.36	1.34	1.32	1.30	1.28	1.27
1151	2.88	2.70	2.54	2.43	2.34	2.26	2.20	2.13	2.07	2.01	1.97	1.93	1.87	1.81	1.76	1.72	1.68	1.64	1.61	1.58	1.55	1.52	1.50	1.47	1.45	1.43
1152	3.84	3.50	3.26	3.05	2.89	2.76	2.66	2.57	2.47	2.39	2.32	2.26	2.20	2.13	2.06	2.01	1.95	1.91	1.86	1.82	1.78	1.74	1.71	1.68	1.65	1.62
1153	4.55	4.10	3.77	3.52	3.31	3.14	3.00	2.89	2.79	2.68	2.59	2.51	2.44	2.38	2.30	2.23	2.17	2.11	2.06	2.01	1.96	1.92	1.88	1.84	1.81	1.78
1154	4.49	4.09	3.77	3.52	3.33	3.16	3.02	2.90	2.80	2.72	2.62	2.54	2.47	2.41	2.35	2.28	2.21	2.15	2.10	2.05	2.00	1.96	1.91	1.88	1.84	1.81
1155	4.14	3.94	3.68	3.45	3.27	3.12	2.98	2.87	2.77	2.69	2.62	2.54	2.46	2.40	2.34	2.29	2.23	2.16	2.11	2.06	2.01	1.97	1.93	1.89	1.85	1.82
1156	3.19	3.61	3.51	3.34	3.17	3.04	2.92	2.81	2.72	2.64	2.57	2.51	2.44	2.38	2.32	2.27	2.23	2.17	2.11	2.06	2.02	1.97	1.93	1.89	1.86	1.82
1157	2.06	2.82	3.23	3.20	3.07	2.95	2.85	2.76	2.67	2.60	2.53	2.47	2.42	2.36	2.30	2.26	2.21	2.17	2.12	2.06	2.02	1.98	1.94	1.90	1.86	1.83
1158	1.18	1.88	2.55	2.95	2.95	2.86	2.77	2.69	2.62	2.55	2.49	2.43	2.38	2.34	2.29	2.24	2.19	2.16	2.12	2.07	2.02	1.98	1.94	1.90	1.86	1.83
1159	1.01	1.14	1.75	2.36	2.73	2.75	2.69	2.62	2.56	2.50	2.44	2.39	2.34	2.30	2.27	2.22	2.18	2.14	2.10	2.07	2.02	1.98	1.94	1.90	1.87	1.83
1160	0.96	1.00	1.11	1.65	2.20	2.55	2.58	2.54	2.49	2.44	2.40	2.35	2.31	2.27	2.23	2.20	2.16	2.12	2.09	2.06	2.03	1.98	1.94	1.90	1.87	1.84
1161	0.90	0.91	0.95	1.06	1.54	2.05	2.38	2.42	2.40	2.36	2.32	2.29	2.25	2.22	2.18	2.16	2.13	2.09	2.06	2.03	2.00	1.97	1.93	1.90	1.86	1.83
1162	0.84	0.86	0.87	0.92	1.01	1.45	1.92	2.24	2.29	2.28	2.25	2.22	2.20	2.16	2.13	2.11	2.08	2.06	2.03	2.00	1.97	1.95	1.92	1.89	1.85	1.82
1163	0.78	0.81	0.83	0.85	0.89	0.98	1.38	1.82	2.11	2.17	2.17	2.15	2.13	2.11	2.08	2.06	2.04	2.02	2.00	1.97	1.95	1.92	1.90	1.88	1.85	1.81
1164	0.72	0.76	0.79	0.81	0.83	0.86	0.95	1.32	1.73	2.01	2.07	2.07	2.06	2.05	2.03	2.01	1.99	1.98	1.96	1.94	1.92	1.90	1.88	1.86	1.84	1.81
1165	0.66	0.71	0.75	0.77	0.79	0.81	0.84	0.92	1.27	1.65	1.92	1.98	1.99	1.98	1.97	1.96	1.95	1.93	1.92	1.91	1.89	1.87	1.85	1.83	1.81	1.80
1166	0.66	0.66	0.70	0.74	0.76	0.78	0.80	0.83	0.90	1.23	1.58	1.84	1.91	1.92	1.91	1.91	1.90	1.89	1.88	1.87	1.86	1.85	1.83	1.81	1.79	1.78
1167	0.66	0.66	0.66	0.70	0.73	0.75	0.77	0.78	0.82	0.89	1.19	1.53	1.77	1.84	1.85	1.85	1.85	1.85	1.84	1.83	1.82	1.81	1.80	1.78	1.77	1.75
1168	0.66	0.66	0.66	0.66	0.69	0.72	0.74	0.76	0.78	0.81	0.87	1.16	1.48	1.71	1.78	1.79	1.79	1.80	1.80	1.79	1.78	1.77	1.77	1.76	1.75	1.73
1169	0.66	0.66	0.66	0.66	0.66	0.69	0.72	0.74	0.75	0.77	0.80	0.86	1.13	1.43	1.66	1.72	1.74	1.74	1.74	1.75	1.74	1.74	1.73	1.73	1.72	1.71
1170	0.66	0.66	0.66	0.66	0.66	0.66	0.69	0.71	0.73	0.75	0.76	0.79	0.85	1.10	1.39	1.60	1.67	1.69	1.70	1.70	1.70	1.70	1.70	1.69	1.69	1.69
1171	0.65	0.65	0.65	0.65	0.65	0.65	0.66	0.68	0.70	0.72	0.74	0.75	0.78	0.83	1.07	1.35	1.56	1.62	1.64	1.65	1.66	1.66	1.66	1.66	1.66	1.65
1172	0.64	0.64	0.64	0.64	0.65	0.65	0.65	0.65	0.67	0.69	0.71	0.73	0.74	0.77	0.82	1.05	1.31	1.51	1.58	1.60	1.61	1.62	1.62	1.62	1.62	1.62
1173	0.62	0.63	0.63	0.64	0.64	0.64	0.64	0.64	0.65	0.67	0.69	0.70	0.72	0.73	0.76	0.81	1.03	1.28	1.47	1.54	1.56	1.57	1.58	1.59	1.59	1.59

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1174	0.61	0.62	0.63	0.63	0.63	0.64	0.64	0.64	0.64	0.64	0.66	0.68	0.70	0.71	0.73	0.75	0.80	1.01	1.25	1.44	1.50	1.52	1.53	1.54	1.55	1.55
1175	0.60	0.61	0.62	0.62	0.63	0.63	0.63	0.64	0.64	0.64	0.64	0.66	0.68	0.69	0.71	0.72	0.74	0.79	0.99	1.22	1.40	1.46	1.49	1.50	1.51	1.52
1176	0.60	0.60	0.61	0.62	0.62	0.62	0.63	0.63	0.63	0.63	0.64	0.64	0.66	0.67	0.69	0.70	0.71	0.74	0.78	0.98	1.20	1.37	1.43	1.45	1.47	1.48
1177	0.60	0.60	0.60	0.61	0.61	0.62	0.62	0.62	0.63	0.63	0.63	0.63	0.64	0.65	0.67	0.68	0.70	0.71	0.73	0.78	0.96	1.18	1.34	1.40	1.43	1.44
1178	0.60	0.60	0.60	0.60	0.61	0.61	0.62	0.62	0.62	0.63	0.63	0.63	0.63	0.63	0.65	0.67	0.68	0.69	0.70	0.72	0.77	0.95	1.16	1.32	1.37	1.40
1179	0.60	0.60	0.60	0.60	0.60	0.61	0.61	0.62	0.62	0.62	0.62	0.63	0.63	0.63	0.63	0.65	0.66	0.68	0.69	0.70	0.72	0.76	0.93	1.14	1.29	1.35
1180	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.61	0.61	0.62	0.62	0.62	0.62	0.63	0.63	0.63	0.65	0.66	0.67	0.68	0.70	0.72	0.76	0.92	1.12	1.27
1185	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.61	0.61	0.61	0.62	0.62	0.62	0.62	0.62	0.62	0.64	0.65	0.66	0.67	0.68
1190	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.61	0.61	0.61	0.61	0.62	0.62	0.62	0.62
1195	0.51	0.52	0.54	0.54	0.55	0.56	0.56	0.56	0.56	0.57	0.57	0.57	0.57	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.59	0.59	0.59	0.60
1200	0.51	0.51	0.51	0.51	0.51	0.51	0.52	0.52	0.53	0.54	0.54	0.54	0.55	0.55	0.55	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.57	0.57	0.57	0.57
1225	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.43	0.43	0.44	0.44	0.44	0.45	0.45	0.45	0.45	0.46	0.46	0.46	0.46	0.46	0.46
1250	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.37	0.37	0.37	0.37	0.38	0.38	0.38	0.38
1300	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
1400	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
1440	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

EXHIBIT 4C. RAINFALL INTENSITIES - K ZONE- 25-YR

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
200	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
400	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
600	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
900	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
1000	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
1050	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
1100	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
1110	0.68	0.68	0.68	0.68	0.68	0.68	0.67	0.67	0.66	0.66	0.66	0.66	0.66	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.64	0.64	0.64	0.64	0.64	0.64
1120	0.70	0.70	0.70	0.70	0.70	0.70	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.68	0.68	0.68	0.68	0.67	0.67	0.67	0.67	0.67	0.67
1130	0.85	0.85	0.85	0.85	0.85	0.85	0.83	0.82	0.81	0.80	0.80	0.79	0.78	0.78	0.78	0.77	0.77	0.76	0.76	0.76	0.75	0.75	0.75	0.74	0.74	0.74
1131	0.87	0.86	0.86	0.86	0.86	0.86	0.86	0.84	0.83	0.82	0.81	0.81	0.80	0.79	0.79	0.78	0.78	0.78	0.77	0.77	0.76	0.76	0.76	0.76	0.75	0.75
1132	0.89	0.88	0.88	0.88	0.87	0.87	0.87	0.86	0.85	0.84	0.83	0.82	0.82	0.81	0.80	0.80	0.79	0.79	0.78	0.78	0.78	0.77	0.77	0.76	0.76	0.76
1133	0.91	0.90	0.90	0.89	0.88	0.88	0.88	0.88	0.87	0.86	0.85	0.84	0.83	0.82	0.82	0.81	0.80	0.80	0.80	0.79	0.79	0.78	0.78	0.78	0.77	0.77
1134	0.94	0.92	0.91	0.90	0.90	0.89	0.89	0.88	0.88	0.88	0.87	0.86	0.85	0.84	0.83	0.82	0.82	0.81	0.81	0.80	0.80	0.79	0.79	0.78	0.78	0.78
1135	0.96	0.94	0.93	0.92	0.91	0.90	0.90	0.89	0.89	0.89	0.88	0.87	0.86	0.85	0.84	0.84	0.83	0.82	0.82	0.81	0.81	0.80	0.80	0.80	0.79	0.79
1136	0.98	0.98	0.96	0.95	0.94	0.93	0.92	0.91	0.91	0.90	0.90	0.90	0.88	0.87	0.86	0.86	0.85	0.84	0.84	0.83	0.82	0.82	0.81	0.81	0.80	0.80
1137	1.01	1.00	0.99	0.98	0.96	0.95	0.94	0.93	0.93	0.92	0.92	0.91	0.91	0.90	0.88	0.88	0.87	0.86	0.85	0.85	0.84	0.83	0.83	0.82	0.82	0.81
1138	1.03	1.02	1.01	1.00	0.99	0.97	0.96	0.95	0.94	0.94	0.93	0.93	0.92	0.92	0.90	0.90	0.88	0.88	0.87	0.86	0.86	0.85	0.84	0.84	0.83	0.83
1139	1.06	1.04	1.03	1.02	1.01	1.00	0.98	0.97	0.96	0.95	0.95	0.94	0.94	0.93	0.92	0.91	0.90	0.89	0.88	0.88	0.87	0.86	0.86	0.85	0.85	0.84
1140	1.08	1.06	1.05	1.04	1.03	1.02	1.00	0.99	0.98	0.97	0.96	0.96	0.95	0.94	0.94	0.93	0.92	0.91	0.90	0.89	0.89	0.88	0.87	0.86	0.86	0.85
1141	1.10	1.10	1.08	1.06	1.05	1.04	1.03	1.02	1.00	0.99	0.98	0.98	0.97	0.96	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.90	0.89	0.88	0.88	0.87
1142	1.12	1.11	1.11	1.09	1.08	1.06	1.05	1.05	1.03	1.02	1.01	1.00	0.99	0.98	0.97	0.97	0.96	0.96	0.94	0.93	0.92	0.92	0.91	0.90	0.89	0.89
1143	1.14	1.13	1.12	1.12	1.10	1.08	1.07	1.06	1.06	1.04	1.03	1.02	1.01	1.00	0.99	0.98	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.92	0.91	0.90
1144	1.16	1.14	1.14	1.13	1.12	1.11	1.09	1.08	1.07	1.06	1.05	1.04	1.03	1.02	1.01	1.00	0.99	0.98	0.98	0.97	0.96	0.95	0.94	0.93	0.93	0.92
1145	1.18	1.16	1.15	1.14	1.13	1.13	1.11	1.10	1.09	1.08	1.07	1.06	1.04	1.03	1.02	1.02	1.01	1.00	0.99	0.99	0.98	0.97	0.96	0.95	0.94	0.93

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1146	1.21	1.20	1.19	1.17	1.16	1.16	1.15	1.13	1.12	1.11	1.10	1.09	1.08	1.06	1.05	1.04	1.03	1.02	1.02	1.01	1.00	1.00	0.98	0.97	0.96	0.96
1147	1.25	1.23	1.23	1.21	1.19	1.18	1.17	1.16	1.15	1.14	1.12	1.11	1.10	1.09	1.08	1.07	1.06	1.05	1.04	1.03	1.02	1.02	1.01	1.00	0.99	0.98
1148	1.29	1.27	1.26	1.24	1.23	1.21	1.20	1.19	1.18	1.17	1.15	1.14	1.13	1.12	1.11	1.09	1.08	1.07	1.06	1.05	1.04	1.04	1.03	1.02	1.01	1.00
1149	1.90	1.78	1.70	1.63	1.58	1.53	1.49	1.46	1.43	1.40	1.37	1.35	1.32	1.30	1.28	1.26	1.24	1.22	1.21	1.19	1.18	1.17	1.16	1.14	1.13	1.12
1150	2.52	2.30	2.14	2.02	1.92	1.85	1.78	1.72	1.67	1.63	1.59	1.55	1.52	1.49	1.46	1.43	1.41	1.38	1.36	1.34	1.32	1.30	1.28	1.27	1.25	1.24
1151	3.10	2.81	2.58	2.40	2.26	2.16	2.07	1.98	1.92	1.86	1.80	1.76	1.71	1.67	1.63	1.60	1.57	1.54	1.51	1.48	1.45	1.43	1.41	1.39	1.37	1.35
1152	3.68	3.30	3.02	2.79	2.61	2.46	2.35	2.25	2.16	2.08	2.02	1.96	1.91	1.85	1.81	1.76	1.73	1.69	1.65	1.62	1.59	1.56	1.53	1.51	1.49	1.47
1153	4.27	3.79	3.44	3.18	2.96	2.78	2.63	2.51	2.41	2.31	2.23	2.16	2.10	2.04	1.98	1.93	1.89	1.84	1.80	1.76	1.73	1.70	1.66	1.63	1.61	1.58
1154	3.71	3.80	3.45	3.19	2.99	2.81	2.66	2.53	2.43	2.34	2.26	2.18	2.12	2.06	2.01	1.96	1.91	1.86	1.83	1.79	1.75	1.72	1.68	1.66	1.63	1.60
1155	3.06	3.26	3.40	3.15	2.95	2.79	2.64	2.52	2.42	2.33	2.25	2.18	2.11	2.06	2.00	1.96	1.91	1.87	1.83	1.79	1.76	1.72	1.69	1.66	1.63	1.61
1156	2.39	2.70	2.92	3.09	2.90	2.74	2.62	2.50	2.40	2.31	2.23	2.17	2.10	2.05	2.00	1.95	1.91	1.86	1.83	1.79	1.76	1.73	1.69	1.66	1.64	1.61
1157	1.71	2.14	2.44	2.67	2.84	2.70	2.58	2.47	2.37	2.29	2.21	2.15	2.09	2.04	1.98	1.94	1.90	1.86	1.82	1.79	1.75	1.72	1.70	1.66	1.64	1.61
1158	1.02	1.57	1.96	2.24	2.47	2.65	2.53	2.43	2.35	2.27	2.19	2.13	2.08	2.02	1.98	1.93	1.89	1.85	1.82	1.78	1.75	1.72	1.69	1.67	1.64	1.61
1159	0.91	1.00	1.48	1.82	2.10	2.31	2.49	2.40	2.32	2.25	2.18	2.11	2.06	2.01	1.96	1.92	1.88	1.84	1.81	1.78	1.75	1.72	1.69	1.66	1.64	1.61
1160	0.89	0.91	0.99	1.40	1.72	1.97	2.18	2.36	2.28	2.21	2.16	2.10	2.04	1.99	1.95	1.91	1.87	1.84	1.80	1.77	1.74	1.72	1.69	1.66	1.64	1.61
1161	0.84	0.85	0.88	0.95	1.32	1.62	1.86	2.06	2.22	2.16	2.11	2.06	2.01	1.96	1.92	1.88	1.85	1.82	1.78	1.76	1.73	1.70	1.68	1.65	1.63	1.60
1162	0.80	0.81	0.83	0.85	0.92	1.26	1.53	1.76	1.95	2.11	2.06	2.02	1.98	1.94	1.90	1.86	1.83	1.80	1.77	1.74	1.71	1.69	1.66	1.64	1.62	1.59
1163	0.76	0.78	0.79	0.80	0.83	0.89	1.20	1.46	1.67	1.86	2.02	1.98	1.94	1.91	1.87	1.84	1.80	1.78	1.75	1.72	1.70	1.67	1.65	1.63	1.61	1.58
1164	0.71	0.74	0.76	0.78	0.79	0.81	0.87	1.16	1.40	1.60	1.78	1.93	1.90	1.87	1.84	1.81	1.78	1.75	1.73	1.70	1.68	1.66	1.63	1.61	1.60	1.58
1165	0.67	0.70	0.73	0.75	0.76	0.78	0.80	0.85	1.12	1.34	1.54	1.71	1.86	1.83	1.81	1.78	1.76	1.73	1.70	1.68	1.66	1.64	1.62	1.60	1.58	1.56
1166	0.67	0.67	0.70	0.72	0.74	0.76	0.77	0.79	0.84	1.09	1.30	1.48	1.65	1.79	1.77	1.75	1.73	1.70	1.68	1.66	1.64	1.62	1.60	1.58	1.57	1.55
1167	0.67	0.67	0.67	0.69	0.72	0.73	0.75	0.76	0.78	0.83	1.06	1.26	1.44	1.59	1.73	1.72	1.70	1.68	1.66	1.64	1.62	1.60	1.59	1.57	1.55	1.54
1168	0.67	0.67	0.67	0.67	0.69	0.71	0.73	0.74	0.75	0.77	0.82	1.03	1.22	1.39	1.54	1.68	1.66	1.65	1.64	1.62	1.60	1.58	1.57	1.56	1.54	1.52
1169	0.67	0.67	0.67	0.67	0.67	0.69	0.71	0.72	0.73	0.74	0.76	0.81	1.01	1.19	1.35	1.50	1.63	1.62	1.61	1.60	1.58	1.56	1.55	1.54	1.52	1.51
1170	0.67	0.67	0.67	0.67	0.67	0.67	0.69	0.70	0.72	0.73	0.74	0.76	0.80	0.99	1.16	1.32	1.46	1.59	1.58	1.57	1.56	1.54	1.53	1.52	1.51	1.50
1171	0.64	0.65	0.65	0.65	0.65	0.66	0.66	0.68	0.69	0.70	0.72	0.73	0.74	0.78	0.97	1.14	1.28	1.42	1.54	1.54	1.53	1.52	1.51	1.50	1.49	1.48
1172	0.62	0.63	0.63	0.64	0.64	0.64	0.64	0.65	0.67	0.68	0.70	0.71	0.72	0.74	0.77	0.95	1.11	1.25	1.38	1.50	1.50	1.49	1.48	1.47	1.46	1.45
1173	0.60	0.61	0.62	0.62	0.63	0.63	0.64	0.64	0.64	0.66	0.67	0.69	0.70	0.71	0.72	0.76	0.93	1.08	1.22	1.35	1.46	1.46	1.46	1.45	1.44	1.43

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1174	0.58	0.59	0.60	0.61	0.62	0.62	0.62	0.63	0.63	0.63	0.65	0.66	0.68	0.69	0.70	0.72	0.75	0.91	1.06	1.19	1.32	1.43	1.43	1.42	1.42	1.41
1175	0.55	0.57	0.58	0.60	0.60	0.61	0.61	0.62	0.62	0.62	0.63	0.64	0.66	0.67	0.68	0.69	0.71	0.74	0.90	1.04	1.17	1.28	1.40	1.40	1.39	1.39
1176	0.55	0.55	0.57	0.58	0.59	0.60	0.60	0.61	0.61	0.62	0.62	0.62	0.64	0.65	0.66	0.68	0.69	0.70	0.73	0.88	1.02	1.14	1.26	1.36	1.37	1.36
1177	0.55	0.55	0.55	0.57	0.58	0.59	0.59	0.60	0.60	0.61	0.61	0.62	0.62	0.63	0.65	0.66	0.67	0.68	0.70	0.73	0.87	1.00	1.12	1.23	1.34	1.34
1178	0.55	0.55	0.55	0.55	0.56	0.58	0.58	0.59	0.60	0.60	0.60	0.61	0.61	0.62	0.63	0.64	0.65	0.66	0.68	0.69	0.72	0.86	0.98	1.10	1.21	1.31
1179	0.55	0.55	0.55	0.55	0.55	0.56	0.57	0.58	0.59	0.59	0.60	0.60	0.61	0.61	0.61	0.63	0.64	0.65	0.66	0.67	0.68	0.71	0.85	0.97	1.08	1.19
1180	0.55	0.55	0.55	0.55	0.55	0.55	0.56	0.57	0.58	0.58	0.59	0.60	0.60	0.60	0.61	0.61	0.62	0.63	0.64	0.66	0.66	0.68	0.71	0.84	0.95	1.06
1185	0.47	0.48	0.49	0.50	0.50	0.51	0.51	0.52	0.52	0.52	0.52	0.53	0.54	0.55	0.55	0.56	0.56	0.57	0.57	0.58	0.58	0.59	0.60	0.61	0.62	0.63
1190	0.47	0.47	0.47	0.47	0.47	0.47	0.48	0.48	0.49	0.49	0.50	0.50	0.50	0.50	0.51	0.51	0.52	0.52	0.53	0.54	0.54	0.55	0.55	0.56	0.56	0.56
1195	0.39	0.40	0.41	0.42	0.42	0.43	0.43	0.44	0.44	0.44	0.44	0.45	0.46	0.46	0.46	0.47	0.47	0.48	0.48	0.48	0.49	0.49	0.50	0.50	0.51	0.52
1200	0.39	0.39	0.39	0.39	0.39	0.39	0.40	0.40	0.41	0.41	0.42	0.42	0.42	0.42	0.43	0.43	0.44	0.44	0.44	0.45	0.45	0.46	0.46	0.46	0.47	0.47
1225	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.34	0.34	0.34	0.34	0.35	0.35	0.35	0.35	0.36	0.36	0.36	0.36	0.36
1250	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.29	0.29	0.29	0.29	0.29	0.29
1300	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
1400	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
1440	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07

EXHIBIT 4D. RAINFALL INTENSITIES - K ZONE- 10-YR

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
200	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
400	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
600	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
900	0.28	0.28	0.28	0.28	0.28	0.20	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
1000	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
1050	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
1100	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47
1110	0.59	0.59	0.59	0.59	0.59	0.59	0.58	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.51	0.51
1120	0.65	0.65	0.65	0.65	0.65	0.65	0.64	0.64	0.64	0.63	0.63	0.63	0.63	0.62	0.62	0.62	0.61	0.61	0.60	0.60	0.59	0.59	0.58	0.58	0.58	0.57
1130	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.65	0.65	0.65	0.65	0.65	0.64	0.64	0.64	0.64	0.64	0.64	0.63
1131	0.70	0.69	0.69	0.68	0.68	0.68	0.68	0.67	0.67	0.67	0.67	0.67	0.67	0.66	0.66	0.66	0.66	0.66	0.66	0.65	0.65	0.65	0.65	0.65	0.64	0.64
1132	0.73	0.72	0.71	0.70	0.70	0.70	0.69	0.69	0.69	0.68	0.68	0.68	0.68	0.68	0.68	0.67	0.67	0.67	0.67	0.66	0.66	0.66	0.66	0.65	0.65	0.65
1133	0.77	0.75	0.74	0.73	0.72	0.71	0.71	0.70	0.70	0.70	0.69	0.69	0.69	0.69	0.68	0.68	0.68	0.68	0.68	0.68	0.67	0.67	0.67	0.66	0.66	0.66
1134	0.80	0.78	0.70	0.75	0.74	0.73	0.72	0.72	0.72	0.71	0.71	0.70	0.70	0.70	0.70	0.69	0.69	0.69	0.69	0.68	0.68	0.68	0.68	0.67	0.67	0.67
1135	0.84	0.81	0.79	0.77	0.76	0.75	0.74	0.74	0.73	0.72	0.72	0.72	0.71	0.71	0.70	0.70	0.70	0.70	0.70	0.69	0.69	0.69	0.68	0.68	0.68	0.68
1136	0.86	0.86	0.83	0.81	0.79	0.78	0.77	0.76	0.75	0.75	0.74	0.74	0.73	0.72	0.72	0.72	0.71	0.71	0.71	0.71	0.70	0.70	0.70	0.69	0.69	0.69
1137	0.89	0.88	0.87	0.85	0.83	0.81	0.80	0.78	0.78	0.77	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.72	0.72	0.71	0.71	0.71	0.70	0.70
1138	0.91	0.90	0.89	0.88	0.86	0.84	0.82	0.81	0.80	0.79	0.78	0.77	0.77	0.76	0.75	0.75	0.74	0.74	0.74	0.73	0.73	0.73	0.72	0.72	0.72	0.71
1139	0.94	0.92	0.91	0.90	0.89	0.87	0.85	0.84	0.82	0.81	0.80	0.79	0.78	0.78	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.74	0.73	0.73	0.73	0.72
1140	0.96	0.94	0.90	0.92	0.91	0.90	0.88	0.86	0.84	0.83	0.82	0.81	0.80	0.79	0.79	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.75	0.74	0.74	0.74
1141	0.99	0.99	0.96	0.95	0.94	0.93	0.92	0.90	0.88	0.86	0.85	0.84	0.83	0.82	0.81	0.80	0.80	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.76	0.75
1142	1.02	1.01	1.00	0.96	0.97	0.96	0.94	0.94	0.92	0.90	0.88	0.87	0.86	0.84	0.83	0.83	0.82	0.81	0.80	0.80	0.79	0.79	0.78	0.78	0.77	0.77
1143	1.05	1.04	1.03	1.02	1.00	0.96	0.97	0.96	0.95	0.93	0.91	0.90	0.88	0.87	0.86	0.85	0.84	0.83	0.82	0.82	0.81	0.80	0.80	0.79	0.79	0.78
1144	1.08	1.06	1.05	1.04	1.03	1.01	1.00	0.98	0.97	0.96	0.94	0.92	0.91	0.90	0.88	0.87	0.86	0.85	0.84	0.84	0.83	0.82	0.82	0.81	0.80	0.80
1145	1.12	1.09	1.07	1.06	1.05	1.04	1.02	1.00	0.99	0.98	0.97	0.95	0.94	0.92	0.91	0.89	0.88	0.87	0.86	0.86	0.85	0.84	0.83	0.83	0.82	0.81

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1146	1.14	1.14	1.11	1.10	1.08	1.07	1.06	1.04	1.02	1.01	1.00	0.99	0.97	0.95	0.94	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.86	0.85	0.84	0.83
1147	1.17	1.16	1.16	1.13	1.11	1.10	1.08	1.08	1.06	1.04	1.03	1.02	1.01	0.99	0.97	0.95	0.94	0.93	0.92	0.90	0.90	0.89	0.88	0.87	0.86	0.86
1148	1.31	1.28	1.26	1.24	1.21	1.18	1.16	1.14	1.13	1.11	1.09	1.08	1.06	1.05	1.03	1.01	0.99	0.98	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.89
1149	1.51	1.44	1.40	1.36	1.33	1.30	1.26	1.24	1.22	1.20	1.18	1.16	1.14	1.12	1.10	1.08	1.06	1.04	1.03	1.01	1.00	0.98	0.97	0.96	0.95	0.94
1150	1.76	1.66	1.56	1.52	1.48	1.44	1.40	1.36	1.33	1.30	1.28	1.25	1.23	1.21	1.19	1.17	1.15	1.12	1.10	1.08	1.07	1.05	1.04	1.02	1.01	1.00
1151	2.35	2.17	2.02	1.91	1.82	1.75	1.69	1.63	1.58	1.53	1.50	1.46	1.43	1.39	1.36	1.34	1.31	1.28	1.26	1.23	1.21	1.19	1.17	1.15	1.13	1.12
1152	3.30	2.96	2.72	2.52	2.36	2.24	2.14	2.05	1.97	1.89	1.83	1.78	1.73	1.68	1.64	1.60	1.56	1.53	1.49	1.46	1.42	1.39	1.37	1.34	1.32	1.30
1153	3.72	3.40	3.09	2.86	2.67	2.52	2.39	2.28	2.19	2.10	2.03	1.96	1.90	1.85	1.80	1.75	1.71	1.67	1.63	1.59	1.55	1.52	1.49	1.46	1.43	1.40
1154	3.54	3.30	3.09	2.86	2.68	2.52	2.40	2.29	2.20	2.12	2.04	1.98	1.92	1.86	1.82	1.77	1.72	1.68	1.65	1.62	1.57	1.54	1.51	1.48	1.45	1.42
1155	3.24	3.10	2.96	2.81	2.64	2.50	2.38	2.27	2.18	2.11	2.04	1.97	1.91	1.86	1.81	1.77	1.73	1.68	1.65	1.62	1.58	1.55	1.52	1.48	1.46	1.43
1156	2.57	2.84	2.78	2.69	2.59	2.46	2.35	2.25	2.16	2.09	2.02	1.96	1.91	1.85	1.81	1.76	1.73	1.68	1.65	1.62	1.58	1.56	1.52	1.49	1.46	1.44
1157	1.54	2.28	2.55	2.54	2.49	2.42	2.31	2.22	2.14	2.07	2.00	1.95	1.90	1.85	1.80	1.76	1.72	1.68	1.65	1.62	1.58	1.56	1.53	1.50	1.47	1.44
1158	0.92	1.42	2.07	2.34	2.35	2.32	2.28	2.19	2.12	2.05	1.98	1.93	1.88	1.84	1.79	1.75	1.71	1.68	1.65	1.62	1.58	1.56	1.53	1.50	1.48	1.45
1159	0.85	0.91	1.34	1.92	2.17	2.20	2.19	2.16	2.09	2.03	1.97	1.91	1.87	1.82	1.79	1.75	1.71	1.68	1.64	1.62	1.58	1.56	1.53	1.50	1.48	1.45
1160	0.84	0.85	0.90	1.28	1.80	2.04	2.07	2.08	2.05	2.00	1.95	1.90	1.85	1.81	1.77	1.74	1.70	1.67	1.64	1.61	1.58	1.56	1.53	1.50	1.48	1.46
1161	0.79	0.80	0.81	0.86	1.20	1.68	1.91	1.95	1.96	1.95	1.90	1.86	1.82	1.78	1.74	1.71	1.68	1.65	1.62	1.59	1.57	1.54	1.52	1.50	1.47	1.45
1162	0.73	0.75	0.76	0.76	0.83	1.13	1.58	1.80	1.84	1.86	1.86	1.82	1.79	1.75	1.72	1.68	1.66	1.63	1.60	1.58	1.55	1.53	1.51	1.48	1.46	1.44
1163	0.68	0.70	0.72	0.74	0.76	0.80	1.08	1.49	1.70	1.75	1.77	1.78	1.74	1.72	1.69	1.66	1.63	1.61	1.59	1.56	1.54	1.52	1.49	1.48	1.45	1.43
1164	0.62	0.66	0.69	0.70	0.72	0.74	0.78	1.04	1.42	1.62	1.67	1.70	1.70	1.68	1.66	1.63	1.61	1.58	1.56	1.54	1.52	1.50	1.48	1.46	1.44	1.42
1165	0.57	0.62	0.65	0.67	0.69	0.70	0.72	0.76	1.00	1.36	1.55	1.60	1.63	1.64	1.62	1.60	1.58	1.56	1.54	1.52	1.51	1.48	1.47	1.45	1.43	1.42
1166	0.57	0.57	0.61	0.64	0.66	0.68	0.69	0.71	0.75	0.97	1.31	1.49	1.54	1.57	1.58	1.57	1.55	1.53	1.52	1.50	1.48	1.47	1.45	1.43	1.42	1.40
1167	0.57	0.57	0.57	0.60	0.63	0.65	0.67	0.68	0.70	0.74	0.95	1.26	1.44	1.49	1.52	1.53	1.52	1.51	1.49	1.48	1.46	1.45	1.44	1.42	1.40	1.39
1168	0.57	0.57	0.57	0.57	0.60	0.62	0.64	0.66	0.67	0.69	0.72	0.92	1.22	1.39	1.44	1.47	1.49	1.48	1.47	1.45	1.44	1.43	1.42	1.41	1.39	1.38
1169	0.57	0.57	0.57	0.57	0.57	0.60	0.62	0.64	0.65	0.67	0.68	0.71	0.90	1.18	1.34	1.40	1.43	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.38	1.36
1170	0.57	0.57	0.57	0.57	0.57	0.57	0.60	0.62	0.63	0.65	0.66	0.68	0.71	0.88	1.15	1.30	1.36	1.39	1.41	1.40	1.40	1.39	1.38	1.37	1.36	1.35
1171	0.54	0.55	0.55	0.55	0.56	0.56	0.56	0.58	0.60	0.62	0.63	0.65	0.66	0.69	0.86	1.12	1.26	1.32	1.35	1.37	1.36	1.36	1.35	1.34	1.34	1.33
1172	0.52	0.53	0.53	0.54	0.54	0.54	0.55	0.55	0.57	0.59	0.61	0.62	0.63	0.65	0.68	0.84	1.08	1.23	1.28	1.31	1.33	1.33	1.33	1.32	1.31	1.30
1173	0.49	0.50	0.51	0.52	0.53	0.53	0.53	0.54	0.54	0.56	0.58	0.60	0.61	0.62	0.64	0.67	0.82	1.06	1.19	1.24	1.28	1.30	1.30	1.29	1.29	1.28

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1174	0.46	0.48	0.50	0.50	0.51	0.52	0.52	0.53	0.53	0.53	0.55	0.57	0.59	0.60	0.61	0.63	0.66	0.80	1.03	1.16	1.21	1.24	1.26	1.26	1.26	1.26
1175	0.44	0.46	0.48	0.49	0.50	0.50	0.51	0.52	0.52	0.52	0.53	0.55	0.56	0.58	0.59	0.60	0.62	0.64	0.79	1.00	1.13	1.18	1.21	1.24	1.24	1.24
1176	0.44	0.44	0.46	0.47	0.48	0.49	0.50	0.50	0.51	0.51	0.52	0.52	0.54	0.56	0.57	0.58	0.60	0.61	0.64	0.77	0.98	1.10	1.15	1.19	1.21	1.21
1177	0.44	0.44	0.44	0.46	0.47	0.48	0.49	0.49	0.50	0.50	0.51	0.51	0.52	0.53	0.55	0.56	0.58	0.59	0.60	0.63	0.76	0.96	1.08	1.13	1.16	1.18
1178	0.44	0.44	0.44	0.44	0.45	0.46	0.47	0.48	0.49	0.50	0.50	0.50	0.51	0.51	0.53	0.54	0.56	0.57	0.58	0.60	0.62	0.75	0.94	1.06	1.10	1.14
1179	0.44	0.44	0.44	0.44	0.44	0.45	0.46	0.47	0.48	0.48	0.49	0.50	0.50	0.50	0.51	0.52	0.54	0.55	0.56	0.58	0.59	0.61	0.74	0.92	1.04	1.08
1180	0.44	0.44	0.44	0.44	0.44	0.44	0.45	0.46	0.47	0.48	0.48	0.49	0.49	0.50	0.50	0.50	0.52	0.54	0.55	0.56	0.57	0.58	0.61	0.72	0.91	1.02
1185	0.41	0.41	0.42	0.42	0.42	0.42	0.42	0.43	0.43	0.43	0.43	0.44	0.44	0.45	0.46	0.46	0.47	0.47	0.48	0.48	0.48	0.50	0.51	0.52	0.53	0.54
1190	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.43	0.44	0.44	0.45	0.45	0.46	0.46	0.46	0.47	0.47
1195	0.39	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.41	0.41	0.41	0.41	0.41	0.41	0.42	0.42	0.42	0.42	0.43	0.43	0.44	0.44
1200	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.41	0.41	0.41	0.41	0.41	0.41	0.41
1225	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.31	0.31	0.32	0.32	0.32	0.33	0.33	0.33	0.34	0.34	0.34	0.34	0.34	0.34
1250	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.25	0.25	0.25	0.25
1300	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
1400	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
1440	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06

EXHIBIT 5A. RAINFALL INTENSITIES - L ZONE- 100-YR

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
200	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47
400	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
600	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
900	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
1000	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
1050	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
1100	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
1110	1.02	1.02	1.02	1.02	1.02	1.02	1.01	1.00	1.00	0.99	0.99	0.98	0.98	0.98	0.98	0.97	0.97	0.97	0.97	0.96	0.96	0.96	0.96	0.96	0.96	0.96
1120	1.03	1.03	1.03	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.01	1.01	1.01	1.00	1.00	1.00	1.00	0.99	0.99
1130	1.21	1.21	1.21	1.21	1.21	1.21	1.20	1.18	1.17	1.16	1.15	1.14	1.14	1.13	1.12	1.12	1.11	1.11	1.11	1.10	1.10	1.10	1.09	1.09	1.09	1.09
1131	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.20	1.18	1.17	1.16	1.15	1.15	1.14	1.13	1.13	1.12	1.12	1.11	1.11	1.11	1.10	1.10	1.10	1.09	1.09
1132	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.20	1.18	1.17	1.16	1.16	1.15	1.14	1.14	1.13	1.13	1.12	1.12	1.11	1.11	1.11	1.10	1.10	1.10
1133	1.26	1.26	1.25	1.24	1.24	1.24	1.24	1.23	1.23	1.22	1.20	1.19	1.18	1.18	1.17	1.16	1.15	1.15	1.14	1.14	1.13	1.13	1.12	1.12	1.12	1.11
1134	1.31	1.29	1.28	1.27	1.27	1.26	1.26	1.25	1.25	1.25	1.23	1.22	1.21	1.20	1.19	1.18	1.17	1.17	1.16	1.16	1.15	1.14	1.14	1.14	1.13	1.13
1135	1.37	1.34	1.32	1.31	1.30	1.29	1.28	1.28	1.27	1.27	1.26	1.25	1.24	1.22	1.21	1.20	1.20	1.19	1.18	1.18	1.17	1.16	1.16	1.15	1.15	1.14
1136	1.43	1.39	1.36	1.35	1.33	1.32	1.31	1.30	1.29	1.29	1.28	1.28	1.26	1.25	1.24	1.23	1.22	1.21	1.20	1.20	1.19	1.18	1.18	1.17	1.16	1.16
1137	1.44	1.43	1.40	1.37	1.36	1.34	1.33	1.32	1.31	1.30	1.30	1.29	1.29	1.27	1.26	1.25	1.24	1.23	1.22	1.21	1.20	1.20	1.19	1.18	1.18	1.17
1138	1.46	1.45	1.42	1.40	1.38	1.36	1.34	1.33	1.32	1.32	1.31	1.30	1.30	1.29	1.28	1.27	1.26	1.24	1.24	1.23	1.22	1.21	1.20	1.20	1.19	1.19
1139	1.48	1.46	1.45	1.42	1.39	1.38	1.36	1.35	1.34	1.33	1.32	1.31	1.31	1.30	1.30	1.28	1.27	1.26	1.25	1.24	1.23	1.22	1.22	1.21	1.20	1.20
1140	1.50	1.48	1.46	1.45	1.42	1.40	1.38	1.37	1.36	1.34	1.34	1.33	1.32	1.32	1.31	1.30	1.29	1.28	1.27	1.26	1.25	1.24	1.23	1.22	1.22	1.21
1141	1.52	1.52	1.52	1.51	1.51	1.48	1.45	1.43	1.41	1.40	1.39	1.38	1.37	1.36	1.35	1.34	1.34	1.32	1.31	1.30	1.29	1.28	1.27	1.26	1.25	1.24
1142	1.63	1.63	1.59	1.58	1.56	1.55	1.52	1.50	1.47	1.46	1.44	1.42	1.41	1.40	1.39	1.38	1.37	1.37	1.35	1.34	1.33	1.31	1.30	1.29	1.28	1.28
1143	1.74	1.68	1.65	1.63	1.61	1.60	1.59	1.56	1.53	1.50	1.49	1.47	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.38	1.36	1.35	1.34	1.32	1.32	1.30
1144	1.86	1.78	1.72	1.69	1.67	1.65	1.63	1.62	1.59	1.56	1.54	1.52	1.50	1.48	1.47	1.46	1.44	1.43	1.42	1.42	1.40	1.38	1.37	1.36	1.35	1.34
1145	1.98	1.89	1.82	1.76	1.73	1.70	1.68	1.66	1.65	1.62	1.59	1.57	1.55	1.53	1.51	1.50	1.48	1.47	1.46	1.45	1.44	1.42	1.41	1.40	1.38	1.37

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1146	1.99	1.99	1.91	1.84	1.79	1.76	1.74	1.72	1.69	1.68	1.65	1.62	1.60	1.58	1.56	1.54	1.52	1.51	1.50	1.48	1.47	1.46	1.45	1.43	1.42	1.40
1147	2.00	2.00	2.00	1.93	1.87	1.82	1.78	1.76	1.74	1.72	1.70	1.67	1.64	1.62	1.60	1.58	1.56	1.55	1.53	1.52	1.51	1.50	1.48	1.47	1.45	1.44
1148	2.03	2.01	2.01	2.00	1.94	1.88	1.84	1.80	1.78	1.76	1.74	1.72	1.69	1.67	1.64	1.62	1.60	1.58	1.57	1.55	1.54	1.53	1.52	1.50	1.49	1.47
1149	2.86	2.71	2.60	2.52	2.46	2.36	2.27	2.20	2.14	2.09	2.05	2.01	1.98	1.94	1.90	1.87	1.84	1.81	1.78	1.76	1.74	1.72	1.70	1.68	1.66	1.64
1150	3.66	3.39	3.19	3.03	2.91	2.82	2.70	2.58	2.49	2.42	2.36	2.30	2.25	2.21	2.16	2.11	2.07	2.03	1.99	1.96	1.93	1.90	1.88	1.85	1.83	1.81
1151	4.48	4.07	3.78	3.56	3.37	3.23	3.12	2.98	2.86	2.75	2.66	2.59	2.53	2.47	2.42	2.36	2.30	2.25	2.20	2.16	2.13	2.09	2.06	2.03	2.00	1.97
1152	5.29	4.75	4.36	4.07	3.84	3.65	3.50	3.37	3.22	3.09	2.98	2.88	2.80	2.73	2.66	2.60	2.53	2.47	2.42	2.37	2.32	2.28	2.24	2.20	2.17	2.14
1153	6.11	5.43	4.95	4.58	4.30	4.07	3.87	3.72	3.58	3.43	3.29	3.17	3.07	2.98	2.90	2.83	2.77	2.70	2.63	2.57	2.52	2.47	2.42	2.38	2.34	2.30
1154	5.29	5.43	4.95	4.58	4.30	4.07	3.88	3.72	3.59	3.47	3.34	3.21	3.11	3.01	2.93	2.86	2.79	2.74	2.67	2.61	2.55	2.50	2.45	2.41	2.37	2.33
1155	4.46	4.73	4.93	4.57	4.29	4.06	3.88	3.72	3.58	3.47	3.37	3.25	3.14	3.04	2.96	2.88	2.82	2.76	2.70	2.64	2.58	2.53	2.48	2.43	2.39	2.35
1156	3.53	3.96	4.26	4.49	4.22	4.00	3.82	3.68	3.54	3.43	3.33	3.25	3.14	3.04	2.96	2.88	2.81	2.76	2.70	2.65	2.59	2.54	2.49	2.44	2.40	2.36
1157	2.60	3.19	3.61	3.92	4.16	3.95	3.78	3.63	3.51	3.40	3.30	3.22	3.14	3.05	2.96	2.88	2.81	2.76	2.70	2.65	2.60	2.55	2.50	2.45	2.41	2.37
1158	1.67	2.41	2.94	3.34	3.64	3.89	3.72	3.58	3.46	3.36	3.27	3.18	3.11	3.05	2.96	2.87	2.81	2.75	2.70	2.65	2.60	2.56	2.51	2.46	2.42	2.38
1159	1.49	1.58	2.23	2.72	3.09	3.39	3.64	3.50	3.39	3.30	3.21	3.14	3.06	3.00	2.95	2.87	2.80	2.74	2.68	2.63	2.59	2.54	2.50	2.46	2.41	2.37
1160	1.31	1.41	1.50	2.08	2.53	2.89	3.18	3.42	3.31	3.22	3.14	3.08	3.01	2.95	2.90	2.85	2.79	2.72	2.66	2.61	2.57	2.53	2.49	2.45	2.41	2.37
1161	1.25	1.28	1.37	1.46	1.97	2.39	2.73	3.00	3.24	3.16	3.08	3.02	2.96	2.91	2.86	2.81	2.77	2.71	2.65	2.60	2.55	2.51	2.48	2.44	2.41	2.37
1162	1.15	1.21	1.24	1.33	1.41	1.88	2.26	2.58	2.85	3.09	3.02	2.96	2.90	2.85	2.81	2.76	2.73	2.69	2.64	2.58	2.54	2.50	2.46	2.42	2.39	2.36
1163	1.07	1.13	1.18	1.22	1.29	1.37	1.80	2.16	2.46	2.72	2.95	2.89	2.84	2.80	2.76	2.72	2.68	2.65	2.62	2.57	2.52	2.48	2.44	2.41	2.38	2.34
1164	1.06	1.07	1.12	1.17	1.20	1.27	1.34	1.74	2.08	2.37	2.61	2.83	2.78	2.74	2.71	2.67	2.64	2.61	2.58	2.56	2.51	2.47	2.43	2.39	2.36	2.33
1165	1.04	1.04	1.05	1.10	1.15	1.18	1.24	1.31	1.68	2.00	2.27	2.51	2.72	2.68	2.65	2.62	2.60	2.56	2.54	2.51	2.49	2.45	2.41	2.37	2.34	2.31
1166	1.01	1.03	1.03	1.04	1.09	1.13	1.16	1.22	1.28	1.63	1.93	2.19	2.42	2.62	2.59	2.57	2.54	2.52	2.49	2.47	2.45	2.43	2.40	2.36	2.33	2.30
1167	1.00	1.00	1.02	1.02	1.03	1.07	1.11	1.14	1.20	1.26	1.58	1.87	2.19	2.34	2.54	2.51	2.49	2.47	2.45	2.43	2.41	2.39	2.38	2.34	2.31	2.28
1168	1.00	1.00	1.00	1.02	1.02	1.03	1.07	1.10	1.13	1.19	1.24	1.55	1.82	2.06	2.27	2.46	2.44	2.42	2.40	2.39	2.37	2.36	2.34	2.33	2.30	2.27
1169	0.96	0.98	0.99	0.99	1.01	1.01	1.02	1.06	1.09	1.11	1.17	1.22	1.51	1.77	2.00	2.20	2.39	2.37	2.36	2.34	2.33	2.32	2.30	2.29	2.28	2.25
1170	0.96	0.96	0.98	0.98	0.99	1.00	1.00	1.02	1.05	1.08	1.10	1.16	1.21	1.48	1.72	1.94	2.14	2.32	2.31	2.30	2.29	2.28	2.27	2.25	2.24	2.24
1171	0.96	0.96	0.96	0.98	0.98	0.98	1.00	1.00	1.01	1.04	1.07	1.10	1.14	1.19	1.45	1.69	1.90	2.09	2.26	2.25	2.24	2.24	2.23	2.22	2.21	2.20
1172	0.97	0.97	0.97	0.97	0.98	0.98	0.99	1.00	1.00	1.01	1.04	1.07	1.09	1.14	1.18	1.43	1.65	1.86	2.04	2.21	2.20	2.20	2.19	2.19	2.18	2.17
1173	0.95	0.96	0.96	0.96	0.96	0.97	0.98	0.98	0.99	0.99	1.00	1.03	1.06	1.08	1.12	1.17	1.41	1.62	1.82	1.99	2.16	2.15	2.15	2.14	2.14	2.14

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1174	0.94	0.93	0.94	0.94	0.95	0.95	0.96	0.96	0.97	0.98	0.98	0.99	1.02	1.05	1.07	1.11	1.15	1.38	1.59	1.78	1.95	2.11	2.10	2.10	2.10	2.10
1175	0.92	0.93	0.93	0.94	0.94	0.94	0.94	0.96	0.96	0.96	0.97	0.98	0.99	1.01	1.04	1.06	1.10	1.14	1.36	1.56	1.74	1.91	2.06	2.06	2.06	2.06
1176	0.91	0.92	0.93	0.93	0.93	0.94	0.94	0.94	0.95	0.96	0.96	0.97	0.97	0.98	1.01	1.03	1.05	1.09	1.13	1.34	1.53	1.71	1.87	2.02	2.02	2.02
1177	0.88	0.90	0.91	0.92	0.91	0.92	0.93	0.93	0.93	0.94	0.95	0.95	0.96	0.97	0.98	1.00	1.02	1.04	1.08	1.12	1.32	1.50	1.68	1.83	1.98	1.98
1178	0.85	0.86	0.88	0.89	0.90	0.90	0.91	0.92	0.92	0.92	0.93	0.94	0.94	0.95	0.96	0.97	0.99	1.01	1.03	1.07	1.11	1.30	1.48	1.64	1.80	1.94
1179	0.84	0.84	0.85	0.87	0.88	0.89	0.89	0.90	0.90	0.91	0.91	0.92	0.93	0.93	0.94	0.95	0.96	0.98	1.00	1.02	1.06	1.09	1.28	1.45	1.61	1.76
1180	0.82	0.82	0.82	0.83	0.85	0.86	0.87	0.88	0.89	0.89	0.90	0.90	0.91	0.92	0.92	0.93	0.94	0.95	0.97	0.99	1.01	1.04	1.08	1.26	1.43	1.58
1185	0.81	0.81	0.82	0.82	0.82	0.83	0.84	0.84	0.85	0.86	0.86	0.87	0.87	0.88	0.88	0.88	0.89	0.90	0.90	0.91	0.92	0.92	0.93	0.95	0.97	0.98
1190	0.80	0.80	0.80	0.80	0.80	0.82	0.83	0.83	0.84	0.85	0.86	0.87	0.87	0.88	0.88	0.89	0.89	0.89	0.90	0.90	0.90	0.90	0.91	0.92	0.92	0.93
1195	0.79	0.79	0.79	0.79	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.87	0.87	0.87	0.88	0.88	0.88
1200	0.79	0.79	0.79	0.79	0.79	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
1225	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
1250	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.72
1300	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
1400	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
1440	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30

EXHIBIT 5B. RAINFALL INTENSITIES - L ZONE- 50-YR

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
200	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
400	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
600	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
900	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
1000	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
1050	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
1100	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
1110	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
1120	0.98	0.98	0.98	0.98	0.98	0.98	0.97	0.96	0.96	0.96	0.95	0.95	0.95	0.94	0.94	0.94	0.93	0.93	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.92
1130	1.08	1.08	1.08	1.08	1.08	1.08	1.07	1.06	1.06	1.05	1.05	1.04	1.04	1.04	1.03	1.03	1.02	1.02	1.01	1.01	1.00	1.00	1.00	0.99	0.99	0.99
1131	1.11	1.11	1.10	1.10	1.10	1.10	1.09	1.08	1.08	1.07	1.06	1.06	1.05	1.05	1.04	1.04	1.04	1.03	1.03	1.02	1.02	1.01	1.01	1.00	1.00	1.00
1132	1.14	1.13	1.12	1.12	1.12	1.11	1.11	1.11	1.10	1.09	1.08	1.07	1.07	1.06	1.06	1.06	1.05	1.05	1.04	1.04	1.03	1.02	1.02	1.02	1.01	1.01
1133	1.17	1.16	1.15	1.14	1.13	1.13	1.12	1.12	1.12	1.11	1.10	1.09	1.08	1.08	1.07	1.07	1.06	1.06	1.06	1.05	1.04	1.04	1.03	1.03	1.02	1.02
1134	1.20	1.18	1.17	1.16	1.15	1.14	1.14	1.13	1.13	1.12	1.12	1.11	1.10	1.09	1.09	1.08	1.08	1.07	1.07	1.06	1.06	1.05	1.04	1.04	1.04	1.03
1135	1.24	1.21	1.19	1.18	1.17	1.16	1.15	1.14	1.14	1.14	1.13	1.12	1.11	1.11	1.10	1.09	1.09	1.08	1.08	1.07	1.07	1.06	1.06	1.05	1.05	1.04
1136	1.27	1.26	1.24	1.22	1.20	1.19	1.18	1.17	1.16	1.16	1.15	1.15	1.14	1.13	1.12	1.12	1.11	1.10	1.10	1.09	1.09	1.08	1.08	1.07	1.06	1.06
1137	1.30	1.29	1.28	1.26	1.24	1.22	1.21	1.20	1.19	1.18	1.18	1.17	1.16	1.15	1.14	1.14	1.13	1.12	1.12	1.11	1.10	1.10	1.10	1.09	1.08	1.08
1138	1.34	1.32	1.31	1.30	1.28	1.26	1.24	1.23	1.22	1.20	1.20	1.19	1.18	1.18	1.17	1.16	1.15	1.14	1.13	1.13	1.12	1.12	1.11	1.11	1.10	1.09
1139	1.37	1.35	1.33	1.32	1.31	1.29	1.27	1.25	1.24	1.23	1.22	1.21	1.20	1.20	1.19	1.18	1.17	1.16	1.15	1.14	1.14	1.13	1.13	1.12	1.12	1.11
1140	1.40	1.38	1.36	1.34	1.33	1.32	1.30	1.28	1.26	1.25	1.24	1.23	1.22	1.21	1.21	1.20	1.19	1.18	1.17	1.16	1.16	1.15	1.14	1.14	1.13	1.13
1141	1.44	1.43	1.40	1.38	1.36	1.35	1.34	1.32	1.30	1.29	1.27	1.26	1.25	1.24	1.23	1.22	1.22	1.21	1.20	1.19	1.18	1.17	1.16	1.16	1.15	1.14
1142	1.47	1.46	1.45	1.42	1.40	1.38	1.37	1.36	1.34	1.32	1.30	1.29	1.28	1.27	1.26	1.25	1.24	1.23	1.22	1.21	1.20	1.19	1.19	1.18	1.17	1.16
1143	1.50	1.48	1.47	1.46	1.44	1.42	1.40	1.39	1.38	1.35	1.34	1.32	1.31	1.29	1.28	1.27	1.26	1.26	1.25	1.24	1.22	1.22	1.21	1.20	1.19	1.18
1144	1.53	1.51	1.49	1.48	1.47	1.45	1.43	1.41	1.40	1.39	1.37	1.35	1.33	1.32	1.31	1.30	1.29	1.28	1.27	1.26	1.25	1.24	1.23	1.22	1.21	1.20
1145	1.56	1.53	1.52	1.50	1.49	1.48	1.46	1.44	1.42	1.41	1.40	1.38	1.36	1.35	1.33	1.32	1.31	1.30	1.29	1.28	1.27	1.26	1.25	1.24	1.23	1.22

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1146	1.61	1.60	1.57	1.55	1.54	1.52	1.51	1.49	1.47	1.45	1.44	1.42	1.40	1.39	1.37	1.36	1.34	1.33	1.32	1.31	1.30	1.29	1.28	1.27	1.26	1.25
1147	1.66	1.64	1.63	1.60	1.58	1.56	1.55	1.54	1.51	1.49	1.48	1.46	1.45	1.43	1.41	1.39	1.38	1.36	1.35	1.34	1.33	1.32	1.31	1.30	1.29	1.28
1148	1.76	1.73	1.71	1.69	1.66	1.63	1.61	1.59	1.58	1.55	1.53	1.51	1.50	1.48	1.46	1.44	1.43	1.41	1.40	1.38	1.37	1.36	1.35	1.34	1.33	1.32
1149	2.11	2.02	1.95	1.90	1.87	1.82	1.78	1.75	1.72	1.70	1.67	1.64	1.62	1.60	1.58	1.55	1.53	1.51	1.49	1.48	1.46	1.44	1.43	1.42	1.41	1.39
1150	2.58	2.41	2.29	2.20	2.13	2.07	2.01	1.96	1.92	1.88	1.85	1.81	1.78	1.75	1.72	1.70	1.67	1.64	1.62	1.59	1.57	1.55	1.54	1.52	1.50	1.49
1151	3.48	3.20	2.97	2.79	2.65	2.54	2.46	2.37	2.29	2.23	2.17	2.13	2.07	2.03	1.99	1.95	1.91	1.88	1.84	1.81	1.78	1.75	1.73	1.71	1.68	1.66
1152	5.10	4.55	4.16	3.83	3.58	3.38	3.21	3.08	2.95	2.84	2.74	2.66	2.58	2.51	2.44	2.38	2.33	2.28	2.22	2.18	2.13	2.09	2.06	2.02	1.99	1.96
1153	5.58	5.00	4.54	4.20	3.91	3.67	3.48	3.32	3.18	3.06	2.95	2.85	2.77	2.69	2.61	2.54	2.48	2.43	2.37	2.32	2.27	2.22	2.18	2.14	2.11	2.07
1154	5.40	5.05	4.63	4.28	4.00	3.76	3.56	3.39	3.25	3.13	3.01	2.91	2.82	2.74	2.68	2.60	2.54	2.48	2.42	2.38	2.32	2.28	2.23	2.19	2.15	2.12
1155	4.92	4.75	4.54	4.24	3.97	3.75	3.55	3.38	3.24	3.12	3.02	2.92	2.83	2.75	2.68	2.62	2.55	2.49	2.44	2.39	2.34	2.29	2.25	2.20	2.17	2.13
1156	3.88	4.28	4.23	4.11	3.89	3.68	3.51	3.35	3.21	3.09	2.99	2.90	2.81	2.73	2.66	2.60	2.54	2.48	2.43	2.38	2.33	2.29	2.25	2.20	2.17	2.13
1157	2.12	3.41	3.83	3.84	3.78	3.61	3.44	3.31	3.17	3.06	2.96	2.87	2.79	2.72	2.65	2.58	2.53	2.48	2.42	2.37	2.33	2.29	2.25	2.21	2.17	2.13
1158	1.44	1.95	3.08	3.48	3.53	3.51	3.38	3.25	3.14	3.02	2.93	2.84	2.77	2.70	2.63	2.57	2.51	2.46	2.42	2.37	2.32	2.28	2.24	2.21	2.17	2.13
1159	1.17	1.38	1.82	2.83	3.22	3.29	3.29	3.19	3.08	2.99	2.90	2.81	2.74	2.67	2.61	2.55	2.50	2.45	2.40	2.36	2.32	2.28	2.24	2.20	2.17	2.13
1160	1.09	1.16	1.34	1.73	2.64	3.01	3.09	3.10	3.03	2.94	2.86	2.78	2.71	2.65	2.59	2.54	2.48	2.44	2.39	2.35	2.31	2.27	2.23	2.20	2.16	2.13
1161	1.07	1.07	1.13	1.29	1.65	2.47	2.82	2.91	2.94	2.88	2.81	2.75	2.68	2.61	2.56	2.51	2.46	2.42	2.37	2.33	2.29	2.26	2.22	2.19	2.15	2.12
1162	1.04	1.05	1.06	1.11	1.26	1.58	2.34	2.67	2.76	2.80	2.75	2.69	2.64	2.58	2.53	2.48	2.44	2.40	2.35	2.31	2.28	2.24	2.21	2.18	2.14	2.11
1163	1.02	1.03	1.04	1.05	1.10	1.23	1.52	2.22	2.54	2.63	2.68	2.64	2.59	2.55	2.50	2.45	2.41	2.37	2.33	2.30	2.26	2.23	2.20	2.17	2.14	2.11
1164	1.00	1.01	1.02	1.03	1.04	1.08	1.20	1.48	2.13	2.42	2.52	2.57	2.54	2.50	2.47	2.42	2.38	2.34	2.31	2.28	2.24	2.21	2.18	2.15	2.13	2.10
1165	0.98	0.99	1.01	1.02	1.02	1.03	1.08	1.18	1.44	2.04	2.33	2.43	2.48	2.46	2.42	2.39	2.35	2.32	2.28	2.25	2.22	2.19	2.16	2.14	2.11	2.09
1166	0.97	0.97	0.99	1.00	1.01	1.02	1.03	1.07	1.17	1.41	1.97	2.24	2.34	2.39	2.38	2.35	2.32	2.29	2.26	2.23	2.20	2.18	2.15	2.12	2.10	2.07
1167	0.97	0.97	0.97	0.99	1.00	1.01	1.02	1.02	1.06	1.16	1.38	1.91	2.17	2.26	2.32	2.31	2.28	2.26	2.23	2.20	2.18	2.15	2.13	2.11	2.08	2.06
1168	0.97	0.97	0.97	0.97	0.98	1.00	1.00	1.01	1.02	1.05	1.14	1.35	1.86	2.10	2.20	2.25	2.24	2.22	2.21	2.18	2.15	2.13	2.11	2.09	2.07	2.04
1169	0.97	0.97	0.97	0.97	0.97	0.98	0.99	1.00	1.01	1.02	1.05	1.13	1.33	1.81	2.04	2.14	2.19	2.19	2.17	2.15	2.13	2.11	2.09	2.07	2.05	2.03
1170	0.97	0.97	0.97	0.97	0.97	0.97	0.98	0.99	1.00	1.01	1.01	1.04	1.12	1.31	1.76	1.99	2.08	2.14	2.13	2.12	2.11	2.09	2.07	2.05	2.03	2.02
1171	0.94	0.95	0.95	0.95	0.96	0.96	0.96	0.97	0.98	0.99	0.99	1.00	1.03	1.10	1.28	1.72	1.93	2.02	2.08	2.08	2.07	2.06	2.04	2.02	2.01	1.99
1172	0.91	0.92	0.93	0.93	0.94	0.94	0.94	0.95	0.96	0.97	0.98	0.98	0.99	1.02	1.09	1.26	1.67	1.88	1.97	2.03	2.03	2.02	2.01	2.00	1.98	1.97
1173	0.88	0.89	0.90	0.91	0.92	0.92	0.93	0.93	0.94	0.95	0.96	0.96	0.97	0.98	1.01	1.08	1.24	1.63	1.84	1.92	1.98	1.98	1.98	1.97	1.96	1.94

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1174	0.85	0.87	0.88	0.89	0.90	0.91	0.92	0.92	0.92	0.93	0.94	0.95	0.96	0.96	0.97	1.00	1.06	1.22	1.60	1.79	1.88	1.93	1.94	1.93	1.93	1.92
1175	0.82	0.84	0.86	0.88	0.88	0.89	0.90	0.91	0.91	0.92	0.92	0.93	0.94	0.95	0.96	0.96	0.99	1.05	1.20	1.56	1.75	1.84	1.89	1.90	1.90	1.89
1176	0.82	0.82	0.84	0.86	0.87	0.88	0.89	0.89	0.90	0.90	0.91	0.91	0.92	0.93	0.94	0.95	0.96	0.98	1.04	1.19	1.54	1.72	1.80	1.85	1.86	1.86
1177	0.82	0.82	0.82	0.84	0.85	0.86	0.87	0.88	0.89	0.89	0.90	0.90	0.91	0.92	0.93	0.94	0.94	0.95	0.97	1.03	1.17	1.51	1.68	1.76	1.82	1.83
1178	0.82	0.82	0.82	0.82	0.83	0.85	0.86	0.87	0.88	0.88	0.89	0.89	0.90	0.90	0.91	0.92	0.93	0.94	0.94	0.97	1.02	1.16	1.48	1.65	1.73	1.78
1179	0.82	0.82	0.82	0.82	0.82	0.83	0.84	0.86	0.86	0.87	0.88	0.88	0.89	0.89	0.90	0.91	0.92	0.92	0.93	0.94	0.96	1.02	1.14	1.46	1.62	1.70
1180	0.82	0.82	0.82	0.82	0.82	0.82	0.83	0.84	0.85	0.86	0.87	0.88	0.88	0.88	0.89	0.89	0.90	0.91	0.92	0.93	0.93	0.96	1.01	1.13	1.44	1.60
1185	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.82	0.83	0.84	0.85	0.85	0.86	0.86	0.87	0.87	0.88	0.88	0.89	0.90	0.91	0.91
1190	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.82	0.82	0.83	0.84	0.84	0.85	0.85	0.86	0.86	0.86
1195	0.73	0.74	0.75	0.76	0.76	0.76	0.77	0.77	0.77	0.78	0.78	0.78	0.78	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.80	0.81	0.81	0.82	0.82
1200	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.74	0.74	0.75	0.75	0.76	0.76	0.76	0.76	0.76	0.77	0.77	0.77	0.77	0.78	0.78	0.78	0.78	0.78	0.78
1225	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.64	0.64	0.65	0.65	0.65	0.66	0.66	0.66	0.67	0.67	0.67	0.67	0.68	0.68	0.68
1250	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.59	0.59	0.59	0.59	0.59	0.59	0.60	0.60
1300	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
1400	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
1440	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

EXHIBIT 5C. RAINFALL INTENSITIES - L ZONE- 25-YR

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
200	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
400	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
600	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
900	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
1000	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
1050	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
1100	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74
1110	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.77	0.77	0.77	0.77	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.75	0.75	0.75	0.75	0.75
1120	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.85	0.84	0.84	0.84	0.83	0.83	0.83	0.82	0.82	0.82	0.81	0.81	0.81	0.80	0.80	0.80	0.80	0.80	0.79
1130	1.07	1.07	1.07	1.07	1.07	1.07	1.05	1.03	1.02	1.01	1.00	0.99	0.98	0.98	0.97	0.97	0.96	0.95	0.94	0.94	0.93	0.92	0.92	0.91	0.91	0.90
1131	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.05	1.04	1.02	1.01	1.00	1.00	0.99	0.98	0.98	0.97	0.96	0.96	0.95	0.94	0.94	0.93	0.92	0.92	0.91
1132	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.05	1.04	1.03	1.02	1.01	1.00	0.99	0.99	0.98	0.98	0.97	0.96	0.95	0.95	0.94	0.93	0.93	0.92
1133	1.08	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.06	1.04	1.03	1.02	1.01	1.00	1.00	0.99	0.99	0.98	0.97	0.96	0.96	0.95	0.94	0.94	0.93
1134	1.08	1.08	1.08	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.06	1.05	1.04	1.02	1.02	1.01	1.00	1.00	0.99	0.98	0.98	0.97	0.96	0.96	0.95	0.94
1135	1.08	1.08	1.08	1.08	1.08	1.07	1.07	1.07	1.07	1.07	1.07	1.06	1.05	1.04	1.03	1.02	1.01	1.01	1.00	0.99	0.99	0.98	0.97	0.97	0.96	0.95
1136	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.07	1.07	1.07	1.07	1.06	1.05	1.04	1.03	1.02	1.02	1.01	1.00	1.00	0.99	0.98	0.98	0.97	0.96
1137	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.07	1.06	1.05	1.04	1.03	1.03	1.02	1.01	1.01	1.00	1.00	0.99	0.98	0.98
1138	1.09	1.09	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.06	1.05	1.04	1.04	1.03	1.02	1.02	1.01	1.00	1.00	0.99	0.98
1139	1.09	1.09	1.09	1.09	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.07	1.06	1.05	1.04	1.03	1.02	1.02	1.01	1.01	1.00	1.00
1140	1.09	1.09	1.09	1.09	1.09	1.09	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.07	1.06	1.05	1.04	1.03	1.03	1.02	1.02	1.01	1.01
1141	1.14	1.14	1.13	1.12	1.12	1.11	1.11	1.11	1.10	1.10	1.10	1.10	1.10	1.09	1.09	1.09	1.09	1.08	1.07	1.06	1.05	1.05	1.04	1.03	1.03	1.02
1142	1.20	1.18	1.17	1.16	1.15	1.14	1.14	1.13	1.13	1.12	1.12	1.12	1.11	1.11	1.11	1.11	1.10	1.10	1.09	1.08	1.07	1.07	1.06	1.05	1.04	1.04
1143	1.25	1.22	1.20	1.19	1.18	1.17	1.16	1.15	1.15	1.14	1.14	1.13	1.13	1.13	1.12	1.12	1.12	1.12	1.11	1.10	1.09	1.08	1.08	1.07	1.06	1.06
1144	1.30	1.27	1.24	1.22	1.21	1.20	1.19	1.18	1.17	1.16	1.16	1.15	1.15	1.14	1.14	1.14	1.13	1.13	1.13	1.12	1.11	1.10	1.10	1.09	1.08	1.07
1145	1.36	1.31	1.28	1.26	1.24	1.22	1.21	1.20	1.19	1.18	1.18	1.17	1.16	1.16	1.15	1.15	1.14	1.14	1.14	1.14	1.13	1.12	1.11	1.10	1.10	1.09

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1146	1.40	1.40	1.35	1.32	1.29	1.27	1.26	1.24	1.23	1.22	1.21	1.20	1.19	1.19	1.18	1.18	1.17	1.16	1.16	1.16	1.15	1.15	1.14	1.13	1.12	1.11
1147	1.45	1.43	1.42	1.38	1.35	1.32	1.30	1.28	1.27	1.26	1.24	1.23	1.22	1.22	1.21	1.20	1.20	1.19	1.18	1.18	1.18	1.17	1.17	1.16	1.15	1.14
1148	1.50	1.48	1.46	1.45	1.41	1.38	1.35	1.33	1.31	1.29	1.28	1.27	1.26	1.25	1.24	1.23	1.22	1.21	1.21	1.20	1.20	1.19	1.19	1.18	1.17	1.16
1149	2.20	2.06	1.96	1.89	1.83	1.75	1.69	1.64	1.60	1.56	1.53	1.50	1.48	1.46	1.44	1.42	1.40	1.39	1.37	1.36	1.35	1.34	1.33	1.32	1.31	1.30
1150	2.90	2.65	2.46	2.32	2.22	2.13	2.04	1.96	1.89	1.83	1.78	1.74	1.70	1.67	1.64	1.61	1.58	1.56	1.54	1.52	1.50	1.48	1.47	1.45	1.44	1.43
1151	3.57	3.24	2.97	2.77	2.61	2.49	2.38	2.28	2.18	2.11	2.04	1.98	1.93	1.88	1.84	1.80	1.77	1.73	1.70	1.68	1.65	1.63	1.61	1.59	1.57	1.56
1152	4.25	3.80	3.49	3.22	3.02	2.85	2.71	2.60	2.48	2.38	2.30	2.22	2.16	2.10	2.04	2.00	1.95	1.91	1.88	1.84	1.81	1.78	1.76	1.73	1.71	1.69
1153	4.94	4.39	3.99	3.69	3.43	3.22	3.05	2.91	2.79	2.67	2.57	2.47	2.39	2.32	2.26	2.20	2.14	2.10	2.05	2.01	1.97	1.94	1.90	1.88	1.85	1.82
1154	4.27	4.37	3.98	3.68	3.45	3.24	3.07	2.92	2.80	2.70	2.59	2.50	2.42	2.34	2.28	2.22	2.16	2.11	2.07	2.03	1.99	1.95	1.92	1.89	1.86	1.84
1155	3.53	3.75	3.91	3.62	3.40	3.22	3.05	2.91	2.79	2.68	2.60	2.50	2.42	2.34	2.28	2.22	2.17	2.12	2.07	2.03	1.99	1.96	1.92	1.89	1.86	1.84
1156	2.76	3.12	3.37	3.56	3.34	3.16	3.02	2.88	2.77	2.66	2.58	2.50	2.42	2.34	2.28	2.22	2.17	2.12	2.07	2.03	1.99	1.96	1.92	1.89	1.86	1.84
1157	1.98	2.48	2.83	3.08	3.28	3.11	2.98	2.86	2.74	2.64	2.56	2.48	2.42	2.34	2.28	2.22	2.16	2.12	2.07	2.03	1.99	1.96	1.92	1.89	1.86	1.84
1158	1.18	1.83	2.28	2.61	2.86	3.06	2.93	2.82	2.72	2.62	2.54	2.47	2.40	2.34	2.28	2.22	2.16	2.12	2.07	2.03	1.99	1.96	1.92	1.89	1.87	1.84
1159	1.09	1.16	1.72	2.13	2.44	2.68	2.88	2.78	2.68	2.61	2.52	2.45	2.38	2.33	2.28	2.22	2.16	2.12	2.07	2.03	1.99	1.96	1.92	1.89	1.87	1.84
1160	1.08	1.09	1.15	1.64	2.01	2.30	2.54	2.73	2.64	2.57	2.50	2.43	2.37	2.31	2.26	2.22	2.16	2.12	2.07	2.03	1.99	1.96	1.92	1.89	1.87	1.84
1161	1.03	1.04	1.06	1.11	1.55	1.90	2.17	2.40	2.58	2.52	2.45	2.40	2.34	2.28	2.24	2.19	2.15	2.10	2.06	2.02	1.98	1.95	1.92	1.89	1.86	1.83
1162	0.99	1.00	1.01	1.03	1.08	1.48	1.80	2.06	2.28	2.46	2.40	2.35	2.31	2.26	2.21	2.17	2.13	2.09	2.05	2.01	1.97	1.94	1.91	1.88	1.85	1.82
1163	0.94	0.96	0.98	0.99	1.01	1.06	1.42	1.72	1.97	2.17	2.35	2.31	2.26	2.23	2.18	2.14	2.10	2.07	2.04	2.00	1.96	1.93	1.90	1.87	1.84	1.82
1164	0.89	0.92	0.95	0.96	0.98	0.99	1.04	1.38	1.65	1.89	2.09	2.26	2.22	2.19	2.16	2.12	2.08	2.05	2.02	1.99	1.95	1.92	1.89	1.86	1.83	1.81
1165	0.85	0.88	0.91	0.93	0.95	0.96	0.98	1.02	1.34	1.60	1.82	2.01	2.18	2.14	2.12	2.09	2.06	2.02	1.99	1.97	1.94	1.91	1.88	1.85	1.82	1.80
1166	0.85	0.85	0.88	0.90	0.92	0.94	0.95	0.97	1.01	1.30	1.55	1.76	1.94	2.10	2.08	2.05	2.03	2.00	1.97	1.95	1.92	1.90	1.87	1.84	1.82	1.79
1167	0.85	0.85	0.85	0.88	0.90	0.92	0.93	0.94	0.96	1.00	1.27	1.50	1.70	1.88	2.04	2.02	2.00	1.98	1.95	1.92	1.90	1.88	1.86	1.83	1.81	1.78
1168	0.85	0.85	0.85	0.85	0.87	0.89	0.91	0.92	0.94	0.95	0.99	1.24	1.46	1.66	1.82	1.98	1.96	1.94	1.93	1.90	1.88	1.86	1.84	1.82	1.80	1.78
1169	0.85	0.85	0.85	0.85	0.85	0.87	0.89	0.90	0.92	0.93	0.94	0.98	1.22	1.43	1.61	1.78	1.92	1.91	1.90	1.88	1.86	1.84	1.82	1.81	1.79	1.77
1170	0.85	0.85	0.85	0.85	0.85	0.85	0.87	0.88	0.90	0.91	0.92	0.94	0.97	1.20	1.40	1.58	1.73	1.87	1.86	1.85	1.84	1.82	1.80	1.79	1.77	1.76
1171	0.82	0.82	0.83	0.83	0.83	0.83	0.84	0.86	0.87	0.89	0.90	0.91	0.92	0.96	1.18	1.36	1.53	1.68	1.82	1.82	1.81	1.80	1.78	1.77	1.75	1.74
1172	0.80	0.80	0.81	0.82	0.82	0.82	0.82	0.82	0.84	0.86	0.88	0.89	0.90	0.91	0.94	1.15	1.33	1.50	1.64	1.78	1.77	1.76	1.76	1.74	1.73	1.72
1173	0.77	0.78	0.79	0.80	0.80	0.81	0.81	0.82	0.82	0.84	0.85	0.87	0.88	0.89	0.90	0.93	1.13	1.31	1.46	1.60	1.74	1.73	1.73	1.72	1.71	1.70

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1174	0.74	0.76	0.77	0.78	0.79	0.80	0.80	0.80	0.81	0.81	0.83	0.84	0.86	0.87	0.88	0.89	0.92	1.11	1.28	1.43	1.57	1.70	1.69	1.69	1.69	1.68
1175	0.72	0.74	0.76	0.77	0.78	0.78	0.79	0.79	0.80	0.80	0.80	0.82	0.84	0.85	0.86	0.87	0.89	0.91	1.10	1.26	1.40	1.54	1.66	1.66	1.66	1.65
1176	0.72	0.72	0.74	0.75	0.76	0.77	0.78	0.78	0.79	0.79	0.80	0.80	0.82	0.83	0.84	0.86	0.87	0.88	0.90	1.08	1.24	1.38	1.51	1.63	1.63	1.62
1177	0.72	0.72	0.72	0.74	0.75	0.76	0.77	0.77	0.78	0.78	0.79	0.79	0.79	0.81	0.82	0.84	0.85	0.86	0.87	0.90	1.07	1.22	1.35	1.48	1.60	1.60
1178	0.72	0.72	0.72	0.72	0.73	0.74	0.75	0.76	0.77	0.77	0.78	0.78	0.79	0.79	0.80	0.82	0.83	0.84	0.85	0.86	0.89	1.05	1.20	1.33	1.45	1.57
1179	0.72	0.72	0.72	0.72	0.72	0.73	0.74	0.75	0.76	0.76	0.77	0.78	0.78	0.78	0.79	0.80	0.81	0.83	0.84	0.85	0.86	0.88	1.04	1.18	1.31	1.43
1180	0.72	0.72	0.72	0.72	0.72	0.72	0.73	0.74	0.75	0.76	0.76	0.77	0.77	0.78	0.78	0.78	0.80	0.81	0.82	0.83	0.84	0.85	0.88	1.03	1.16	1.29
1185	0.65	0.66	0.67	0.68	0.68	0.69	0.69	0.69	0.70	0.70	0.70	0.71	0.72	0.72	0.73	0.74	0.74	0.74	0.75	0.75	0.76	0.77	0.78	0.79	0.80	0.81
1190	0.65	0.65	0.65	0.65	0.65	0.65	0.66	0.66	0.67	0.67	0.68	0.68	0.68	0.68	0.68	0.69	0.70	0.70	0.71	0.71	0.72	0.72	0.73	0.73	0.74	0.74
1195	0.50	0.53	0.54	0.56	0.57	0.58	0.58	0.59	0.60	0.60	0.60	0.61	0.62	0.62	0.63	0.63	0.64	0.64	0.64	0.65	0.65	0.66	0.66	0.67	0.68	0.68
1200	0.50	0.50	0.50	0.50	0.50	0.50	0.52	0.53	0.54	0.54	0.55	0.56	0.56	0.57	0.57	0.58	0.58	0.59	0.60	0.60	0.61	0.61	0.61	0.62	0.62	0.62
1225	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
1250	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.48	0.46	0.46	0.46	0.46	0.46	0.46	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47
1300	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
1400	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
1440	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

EXHIBIT 5D. RAINFALL INTENSITIES - L ZONE- 10-YR

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
200	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
400	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
600	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
900	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
1000	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
1050	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
1100	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
1110	0.74	0.74	0.74	0.74	0.74	0.74	0.73	0.72	0.72	0.71	0.71	0.70	0.70	0.70	0.69	0.69	0.69	0.69	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
1120	0.86	0.86	0.86	0.86	0.86	0.86	0.85	0.84	0.84	0.83	0.82	0.82	0.81	0.81	0.80	0.80	0.79	0.79	0.78	0.78	0.77	0.76	0.76	0.76	0.75	0.75
1130	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.89	0.89	0.89	0.89	0.89	0.88	0.88	0.88	0.88	0.88	0.87	0.86	0.86	0.85	0.85	0.84	0.84	0.84	0.83
1131	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.89	0.89	0.89	0.89	0.89	0.88	0.87	0.87	0.86	0.86	0.85	0.85	0.85	0.84
1132	0.94	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.89	0.89	0.89	0.88	0.87	0.87	0.86	0.86	0.86	0.85
1133	0.96	0.95	0.94	0.94	0.93	0.93	0.93	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.89	0.88	0.88	0.87	0.87	0.86	0.86
1134	0.98	0.96	0.96	0.95	0.94	0.94	0.94	0.93	0.93	0.93	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.90	0.90	0.90	0.89	0.89	0.88	0.88	0.87	0.87
1135	1.00	0.98	0.97	0.96	0.95	0.95	0.94	0.94	0.94	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.90	0.90	0.89	0.89	0.88	0.88
1136	1.00	1.00	0.98	0.97	0.96	0.96	0.95	0.95	0.94	0.94	0.94	0.94	0.93	0.93	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.90	0.90	0.89	0.89
1137	1.00	1.00	1.00	0.98	0.98	0.97	0.96	0.96	0.95	0.95	0.94	0.94	0.94	0.94	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.90	0.90	0.89
1138	1.00	1.00	1.00	1.00	0.98	0.98	0.97	0.96	0.96	0.96	0.95	0.95	0.94	0.94	0.94	0.94	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.91	0.90
1139	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.97	0.97	0.96	0.96	0.95	0.95	0.95	0.94	0.94	0.94	0.93	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.91
1140	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.97	0.97	0.96	0.96	0.96	0.95	0.95	0.95	0.94	0.94	0.94	0.93	0.93	0.93	0.93	0.92	0.92	0.92
1141	1.01	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.98	0.97	0.97	0.96	0.96	0.96	0.96	0.95	0.95	0.94	0.94	0.94	0.94	0.93	0.93	0.93	0.93
1142	1.02	1.01	1.01	1.01	1.01	1.01	1.00	1.00	1.00	0.99	0.98	0.98	0.97	0.97	0.97	0.96	0.96	0.96	0.95	0.95	0.95	0.94	0.94	0.94	0.93	0.93
1143	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.00	0.99	0.99	0.98	0.98	0.97	0.97	0.97	0.96	0.96	0.96	0.95	0.95	0.95	0.94	0.94	0.94
1144	1.03	1.03	1.02	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.00	1.00	0.99	0.98	0.98	0.98	0.97	0.97	0.97	0.96	0.96	0.96	0.95	0.95	0.95	0.94
1145	1.04	1.04	1.03	1.03	1.02	1.02	1.02	1.02	1.01	1.01	1.01	1.00	1.00	0.99	0.99	0.98	0.98	0.98	0.97	0.97	0.97	0.96	0.96	0.96	0.95	0.95

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1146	1.14	1.12	1.10	1.09	1.08	1.07	1.06	1.06	1.05	1.05	1.05	1.04	1.03	1.03	1.02	1.01	1.01	1.00	1.00	1.00	0.99	0.99	0.98	0.98	0.98	0.97
1147	1.23	1.20	1.17	1.15	1.14	1.12	1.11	1.10	1.09	1.08	1.08	1.07	1.07	1.06	1.05	1.04	1.04	1.03	1.02	1.02	1.02	1.01	1.01	1.00	1.00	0.99
1148	1.39	1.33	1.29	1.26	1.23	1.21	1.19	1.17	1.16	1.15	1.14	1.13	1.12	1.11	1.10	1.09	1.08	1.08	1.07	1.06	1.05	1.05	1.04	1.04	1.03	1.03
1149	1.67	1.57	1.49	1.44	1.39	1.35	1.32	1.29	1.27	1.25	1.23	1.22	1.21	1.20	1.18	1.17	1.16	1.14	1.14	1.12	1.12	1.11	1.10	1.09	1.09	1.08
1150	2.28	2.07	1.93	1.82	1.73	1.66	1.60	1.55	1.51	1.47	1.44	1.41	1.39	1.37	1.35	1.33	1.31	1.29	1.27	1.26	1.24	1.23	1.22	1.21	1.20	1.19
1151	2.94	2.70	2.46	2.29	2.15	2.04	1.95	1.87	1.80	1.74	1.69	1.65	1.61	1.58	1.55	1.52	1.49	1.47	1.44	1.42	1.40	1.38	1.36	1.35	1.33	1.32
1152	4.20	3.75	3.43	3.13	2.90	2.71	2.56	2.44	2.32	2.23	2.15	2.08	2.01	1.96	1.90	1.86	1.82	1.78	1.74	1.71	1.68	1.64	1.62	1.59	1.57	1.55
1153	4.31	3.90	3.56	3.30	3.05	2.85	2.68	2.55	2.43	2.33	2.24	2.16	2.09	2.03	1.98	1.93	1.88	1.84	1.81	1.77	1.74	1.70	1.67	1.65	1.62	1.60
1154	4.06	3.79	3.51	3.26	3.07	2.86	2.70	2.56	2.44	2.34	2.25	2.18	2.11	2.04	1.99	1.94	1.90	1.85	1.82	1.78	1.75	1.72	1.68	1.66	1.63	1.61
1155	3.42	3.53	3.38	3.19	3.00	2.85	2.69	2.55	2.43	2.33	2.25	2.17	2.10	2.04	1.98	1.94	1.89	1.85	1.81	1.78	1.75	1.72	1.68	1.66	1.63	1.61
1156	2.61	2.97	3.13	3.05	2.92	2.77	2.66	2.52	2.41	2.31	2.23	2.15	2.09	2.02	1.97	1.92	1.88	1.84	1.80	1.77	1.74	1.71	1.68	1.65	1.62	1.60
1157	1.20	2.30	2.66	2.83	2.79	2.70	2.59	2.50	2.39	2.29	2.21	2.14	2.07	2.01	1.96	1.91	1.87	1.83	1.79	1.76	1.73	1.70	1.67	1.64	1.62	1.60
1158	0.87	1.12	2.08	2.42	2.60	2.59	2.52	2.44	2.36	2.27	2.19	2.12	2.05	2.00	1.94	1.90	1.85	1.82	1.78	1.75	1.72	1.69	1.66	1.64	1.61	1.59
1159	0.78	0.85	1.07	1.91	2.23	2.42	2.42	2.37	2.31	2.25	2.17	2.10	2.04	1.98	1.93	1.88	1.84	1.80	1.77	1.74	1.71	1.68	1.65	1.63	1.61	1.58
1160	0.74	0.77	0.83	1.03	1.78	2.08	2.26	2.28	2.25	2.19	2.15	2.08	2.02	1.96	1.92	1.87	1.83	1.79	1.76	1.73	1.70	1.67	1.64	1.62	1.60	1.58
1161	0.74	0.74	0.76	0.82	0.99	1.67	1.96	2.13	2.16	2.14	2.10	2.06	2.00	1.94	1.90	1.86	1.82	1.78	1.74	1.71	1.68	1.66	1.63	1.61	1.59	1.57
1162	0.73	0.73	0.73	0.75	0.80	0.96	1.58	1.85	2.02	2.06	2.04	2.01	1.98	1.93	1.88	1.84	1.80	1.77	1.73	1.70	1.67	1.65	1.62	1.60	1.58	1.56
1163	0.72	0.73	0.73	0.73	0.75	0.79	0.94	1.51	1.76	1.93	1.97	1.96	1.93	1.91	1.86	1.82	1.78	1.75	1.72	1.69	1.66	1.64	1.61	1.59	1.57	1.55
1164	0.72	0.72	0.72	0.73	0.73	0.74	0.79	0.92	1.45	1.69	1.85	1.89	1.88	1.86	1.84	1.80	1.77	1.74	1.71	1.68	1.65	1.63	1.60	1.58	1.56	1.54
1165	0.71	0.71	0.72	0.72	0.72	0.73	0.74	0.78	0.90	1.40	1.62	1.78	1.82	1.82	1.80	1.79	1.75	1.72	1.69	1.66	1.64	1.61	1.59	1.57	1.55	1.53
1166	0.71	0.71	0.71	0.72	0.72	0.72	0.72	0.74	0.77	0.89	1.35	1.57	1.72	1.76	1.76	1.75	1.74	1.70	1.68	1.65	1.63	1.60	1.58	1.56	1.54	1.52
1167	0.71	0.71	0.71	0.71	0.72	0.72	0.72	0.72	0.74	0.77	0.88	1.31	1.52	1.66	1.70	1.71	1.70	1.69	1.66	1.64	1.61	1.59	1.57	1.55	1.53	1.51
1168	0.71	0.71	0.71	0.71	0.71	0.72	0.72	0.72	0.72	0.74	0.77	0.87	1.28	1.47	1.61	1.65	1.66	1.65	1.65	1.62	1.60	1.58	1.56	1.54	1.52	1.50
1169	0.71	0.71	0.71	0.71	0.71	0.71	0.72	0.72	0.72	0.72	0.73	0.76	0.86	1.24	1.43	1.56	1.61	1.62	1.61	1.61	1.58	1.56	1.54	1.53	1.51	1.49
1170	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.72	0.72	0.72	0.73	0.76	0.85	1.22	1.40	1.52	1.56	1.58	1.58	1.57	1.55	1.53	1.52	1.50	1.48
1171	0.69	0.69	0.69	0.70	0.70	0.70	0.70	0.70	0.70	0.71	0.71	0.71	0.72	0.75	0.84	1.18	1.36	1.48	1.52	1.54	1.54	1.54	1.52	1.50	1.48	1.47
1172	0.66	0.67	0.68	0.68	0.68	0.69	0.69	0.69	0.69	0.70	0.70	0.70	0.71	0.72	0.74	0.82	1.16	1.32	1.44	1.48	1.50	1.50	1.50	1.48	1.47	1.45
1173	0.64	0.65	0.66	0.67	0.67	0.68	0.68	0.68	0.68	0.69	0.69	0.70	0.70	0.70	0.71	0.74	0.81	1.13	1.29	1.41	1.45	1.46	1.47	1.47	1.45	1.44

	Time of Concentration (Minutes)																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1174	0.62	0.64	0.65	0.65	0.66	0.66	0.67	0.67	0.68	0.68	0.68	0.69	0.69	0.69	0.70	0.70	0.73	0.80	1.11	1.26	1.38	1.42	1.43	1.44	1.44	1.42
1175	0.60	0.62	0.63	0.64	0.65	0.65	0.66	0.66	0.67	0.67	0.67	0.68	0.68	0.68	0.69	0.69	0.70	0.72	0.80	1.09	1.24	1.34	1.39	1.40	1.41	1.41
1176	0.60	0.60	0.62	0.63	0.64	0.64	0.65	0.65	0.66	0.66	0.66	0.67	0.67	0.68	0.68	0.68	0.69	0.70	0.72	0.79	1.07	1.21	1.32	1.36	1.38	1.38
1177	0.60	0.60	0.60	0.61	0.62	0.63	0.64	0.64	0.65	0.65	0.66	0.66	0.66	0.67	0.67	0.68	0.68	0.68	0.69	0.71	0.78	1.05	1.19	1.29	1.33	1.35
1178	0.60	0.60	0.60	0.60	0.61	0.62	0.63	0.64	0.64	0.65	0.65	0.65	0.66	0.66	0.66	0.67	0.67	0.68	0.68	0.69	0.71	0.77	1.03	1.17	1.27	1.31
1179	0.60	0.60	0.60	0.60	0.60	0.61	0.62	0.63	0.63	0.64	0.64	0.65	0.65	0.65	0.66	0.66	0.66	0.67	0.67	0.68	0.68	0.70	0.77	1.02	1.15	1.25
1180	0.60	0.60	0.60	0.60	0.60	0.60	0.61	0.62	0.62	0.63	0.64	0.64	0.64	0.65	0.65	0.65	0.66	0.66	0.67	0.67	0.67	0.68	0.70	0.76	1.00	1.13
1185	0.58	0.58	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.60	0.61	0.61	0.62	0.62	0.63	0.63	0.63	0.64	0.64	0.64	0.65	0.65	0.65	0.66
1190	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.60	0.60	0.61	0.61	0.61	0.62	0.62	0.62	0.63	0.63
1195	0.51	0.52	0.53	0.54	0.54	0.55	0.55	0.55	0.55	0.56	0.56	0.56	0.56	0.56	0.57	0.57	0.57	0.57	0.57	0.57	0.58	0.58	0.58	0.59	0.59	0.60
1200	0.51	0.51	0.51	0.51	0.51	0.51	0.52	0.52	0.53	0.53	0.53	0.54	0.54	0.54	0.54	0.55	0.55	0.55	0.55	0.56	0.56	0.56	0.56	0.56	0.56	0.56
1225	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.40	0.40	0.41	0.42	0.42	0.42	0.43	0.43	0.44	0.44	0.44	0.44	0.45	0.45	0.45
1250	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
1300	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
1400	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
1440	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

EXHIBIT 6A. RUNOFF COEFFICIENT CURVE- SOIL NUMBER 1 (NRCS TYPE D)

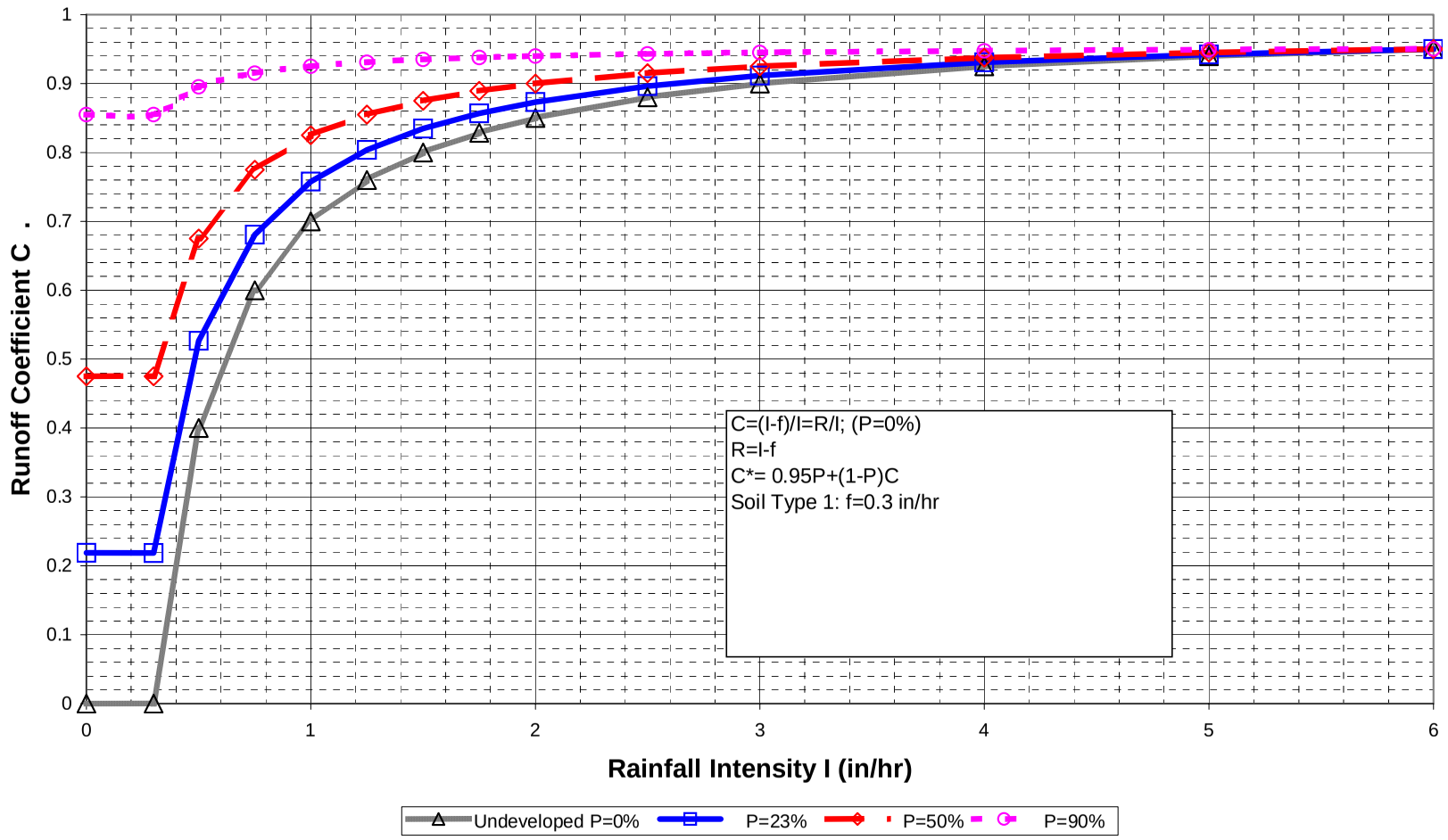


EXHIBIT 6B. RUNOFF COEFFICIENT CURVE- SOIL NUMBER 2 (NRCS TYPE C)

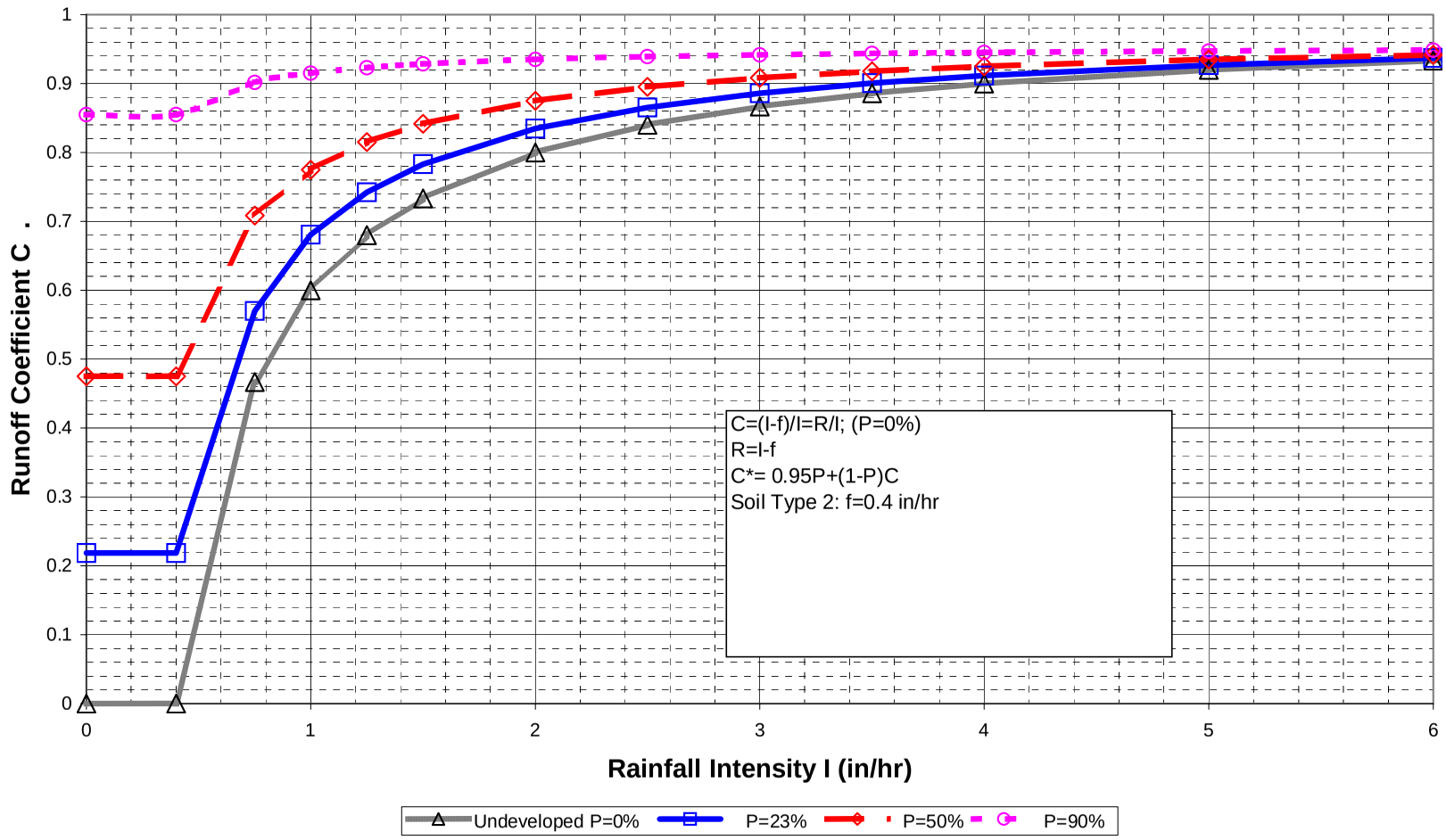


EXHIBIT 6C. RUNOFF COEFFICIENT CURVE- SOIL NUMBER 3 (NRCS TYPE C)

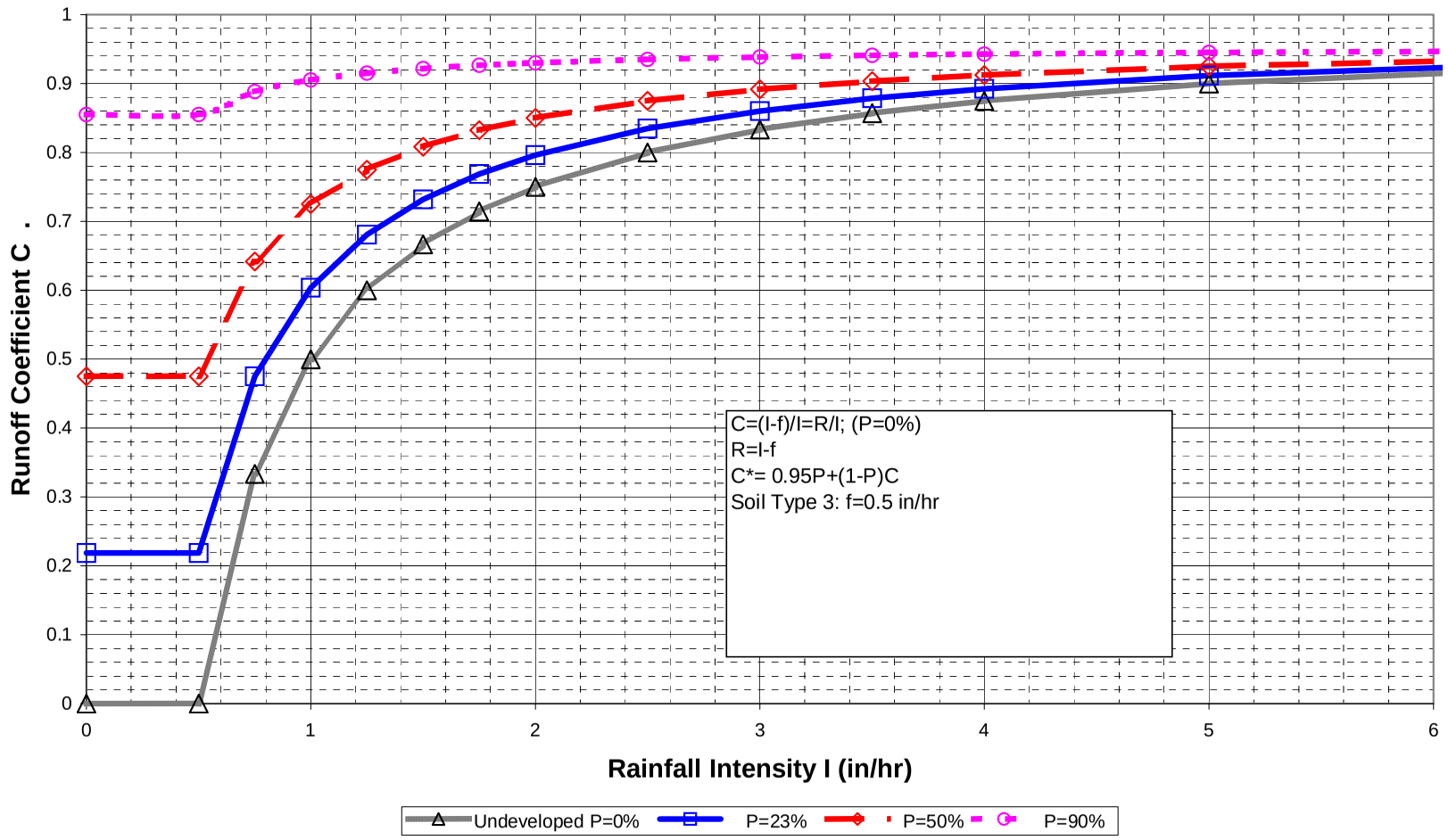


EXHIBIT 6D. RUNOFF COEFFICIENT CURVE- SOIL NUMBER 4 (NRCS TYPE B)

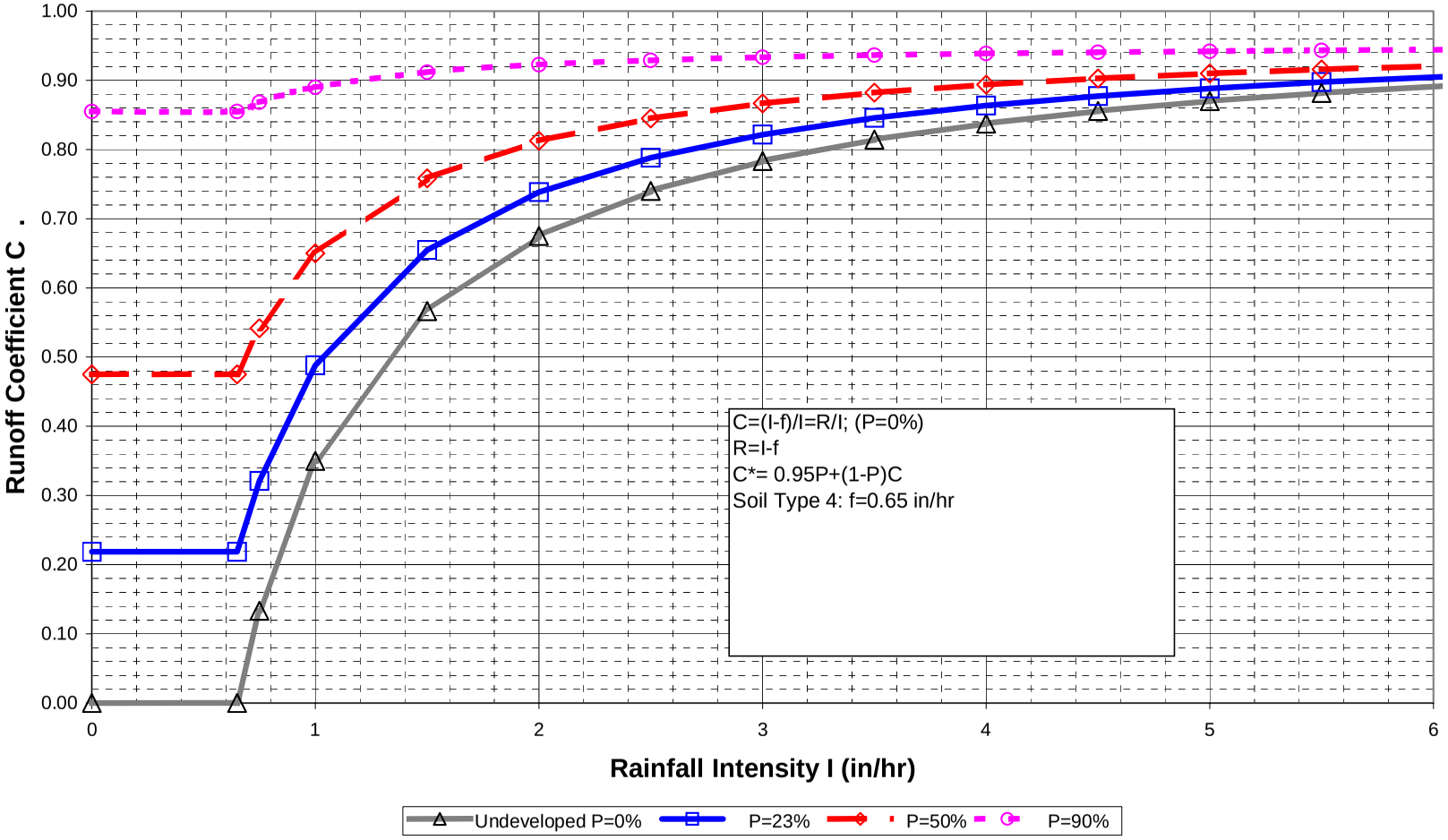


EXHIBIT 6E. RUNOFF COEFFICIENT CURVE- SOIL NUMBER 5 (NRCS TYPE B)

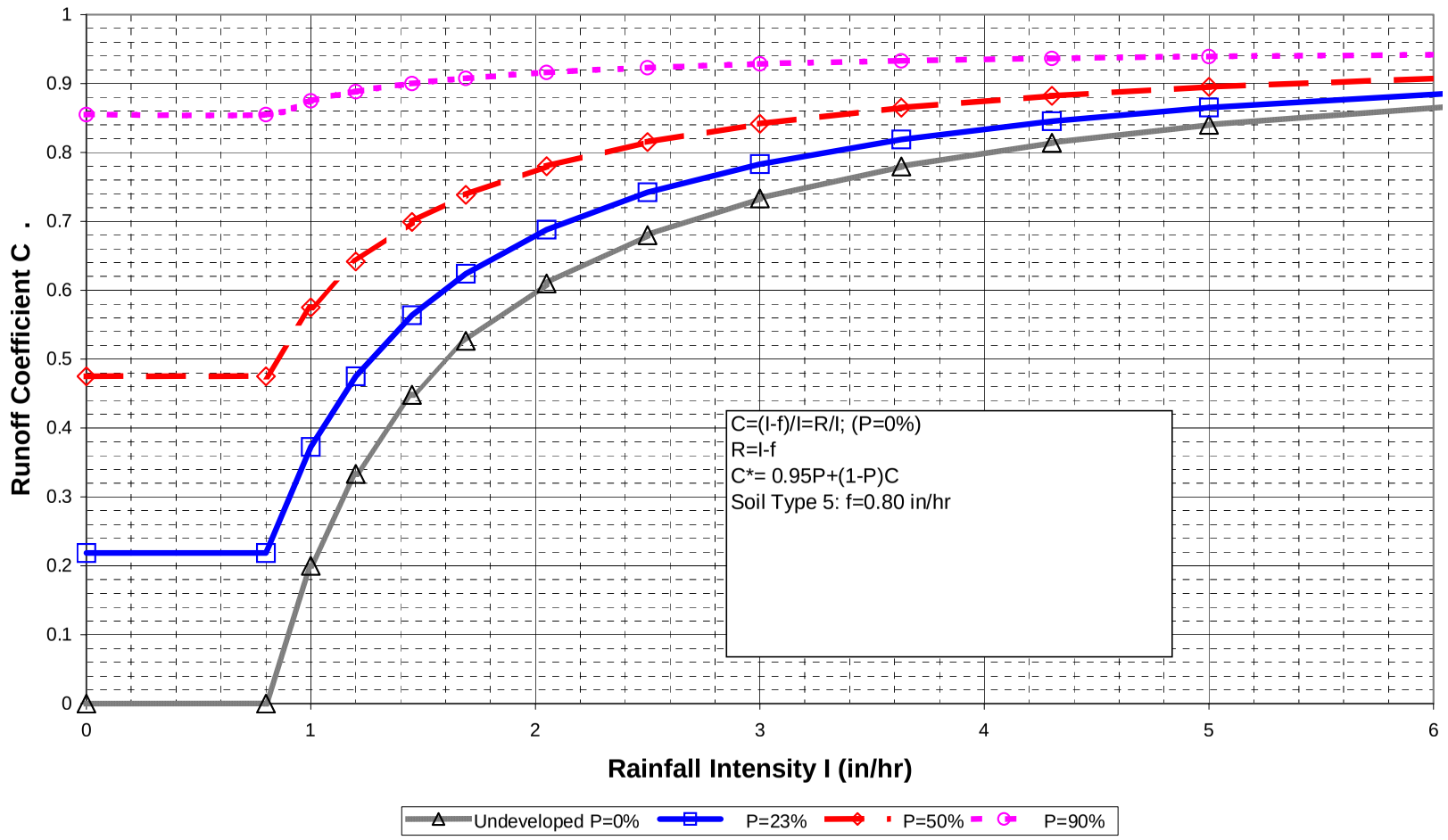


EXHIBIT 6F. RUNOFF COEFFICIENT CURVE- SOIL NUMBER 6 (NRCS TYPE A)

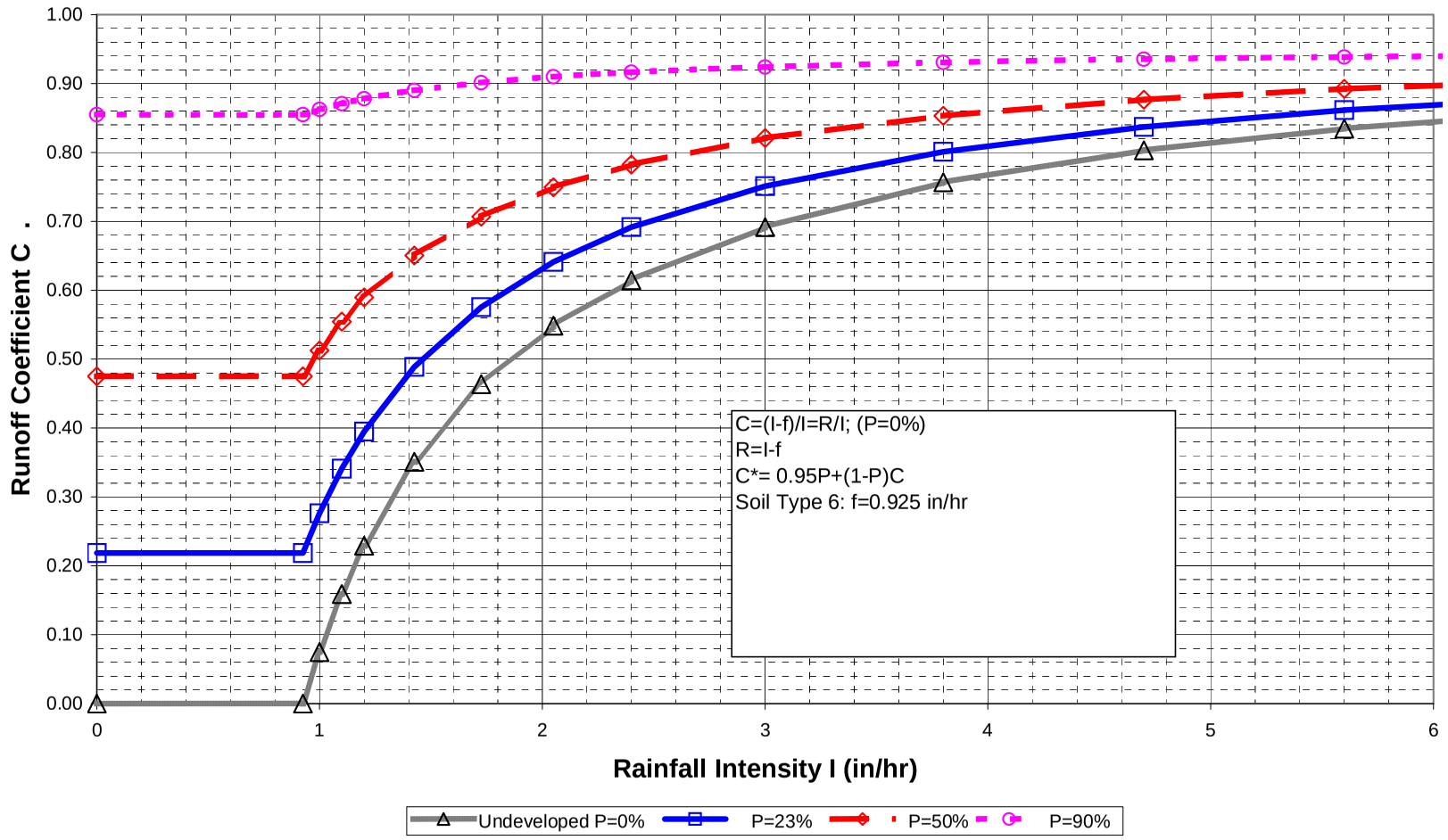


EXHIBIT 6G. RUNOFF COEFFICIENT CURVE- SOIL NUMBER 7 (NRCS TYPE A)

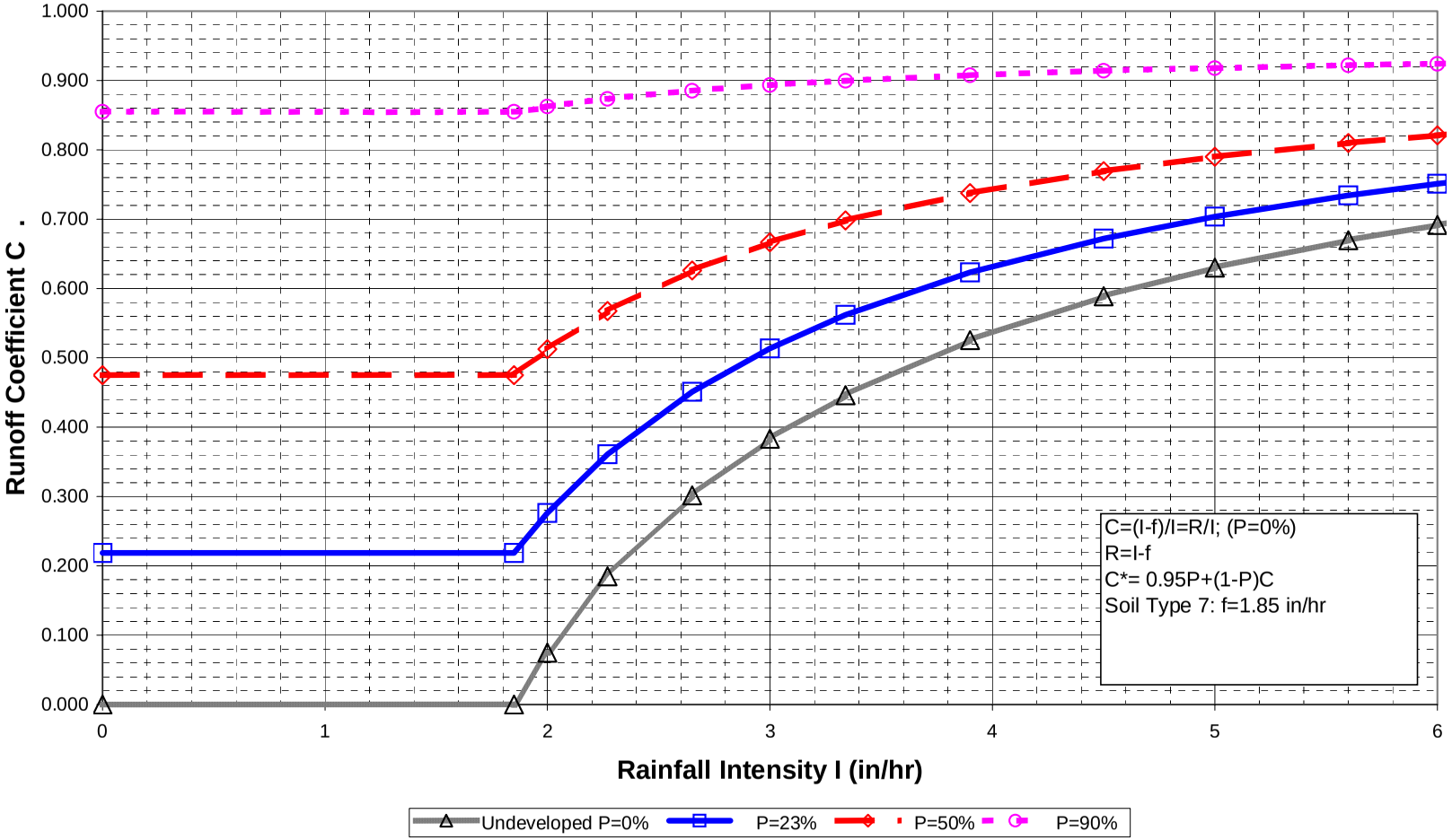


EXHIBIT 7. SLOPE CORRECTION CURVE FOR MOUNTAIN CHANNEL SCOUR VELOCITY CHECK

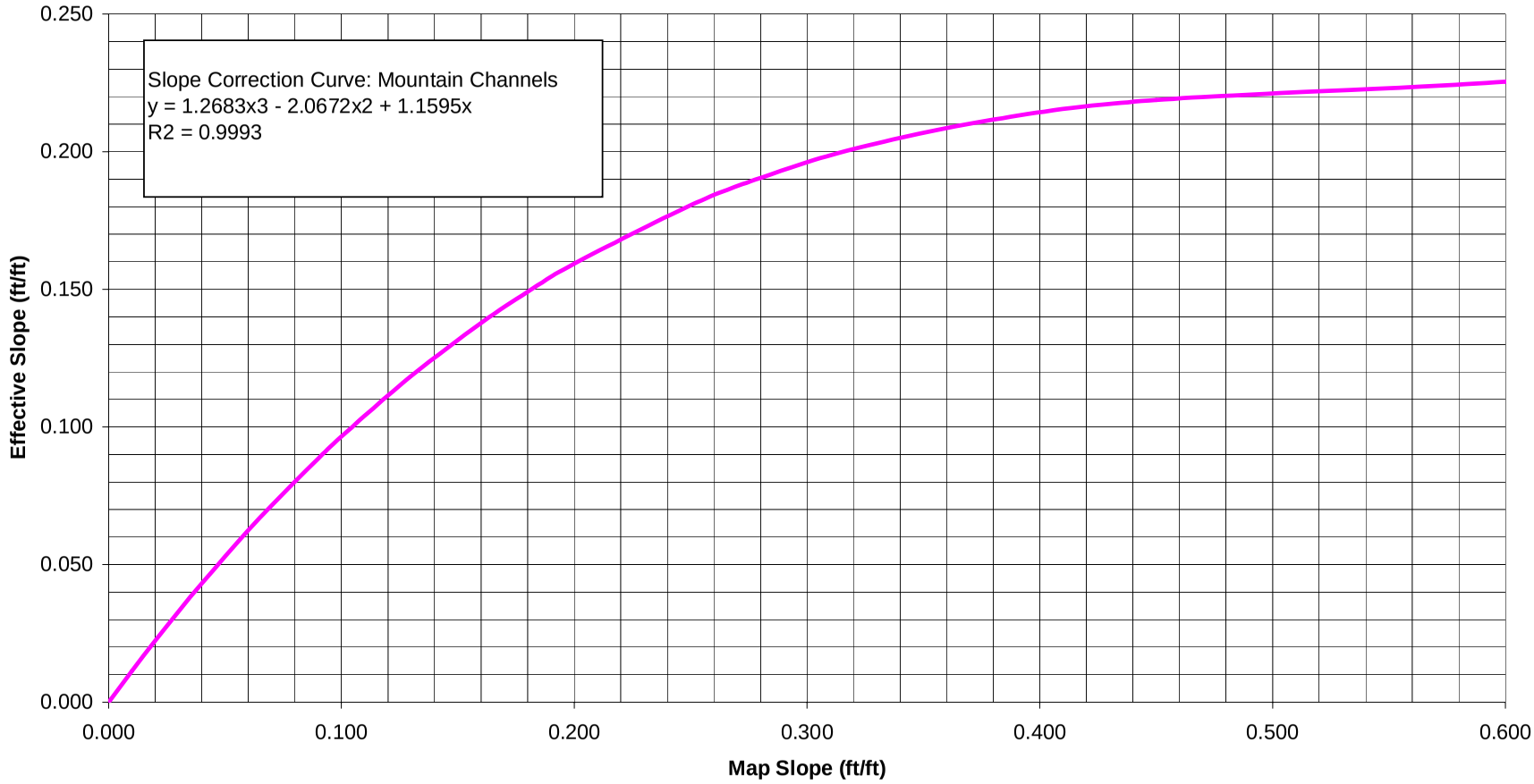
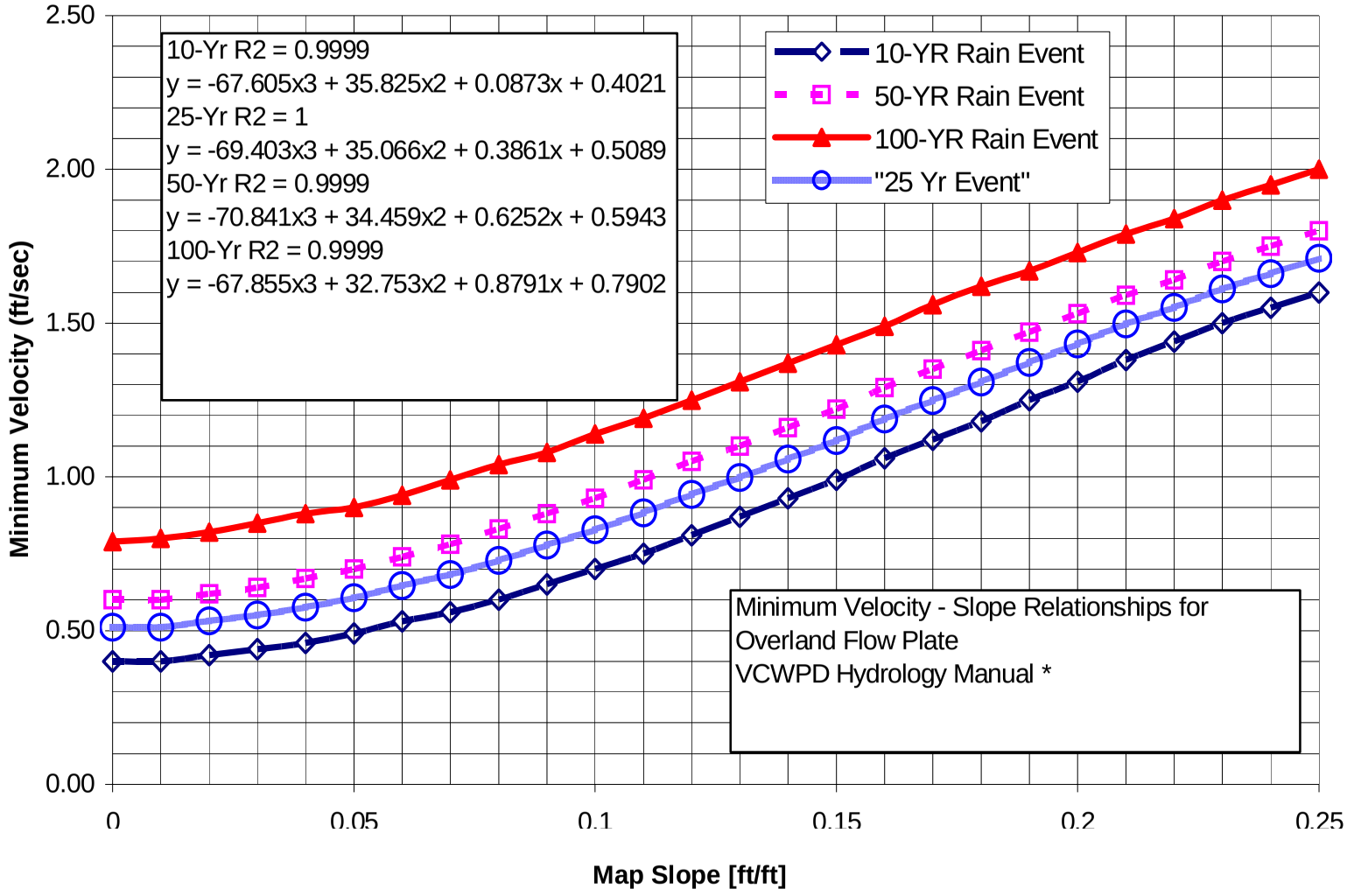


EXHIBIT 8. MINIMUM VELOCITY-SLOPE RELATIONSHIPS, OVERLAND FLOW



Note: Commercial and Industrial Areas: For 100- and 50-Yr storms, minimum velocity is 1.0 fps; for 25- and 10-Yr storms, minimum velocity is 0.5 fps.

EXHIBIT 9. VELOCITY- DISCHARGE- SLOPE RELATIONSHIPS, NATURAL MOUNTAIN CHANNELS

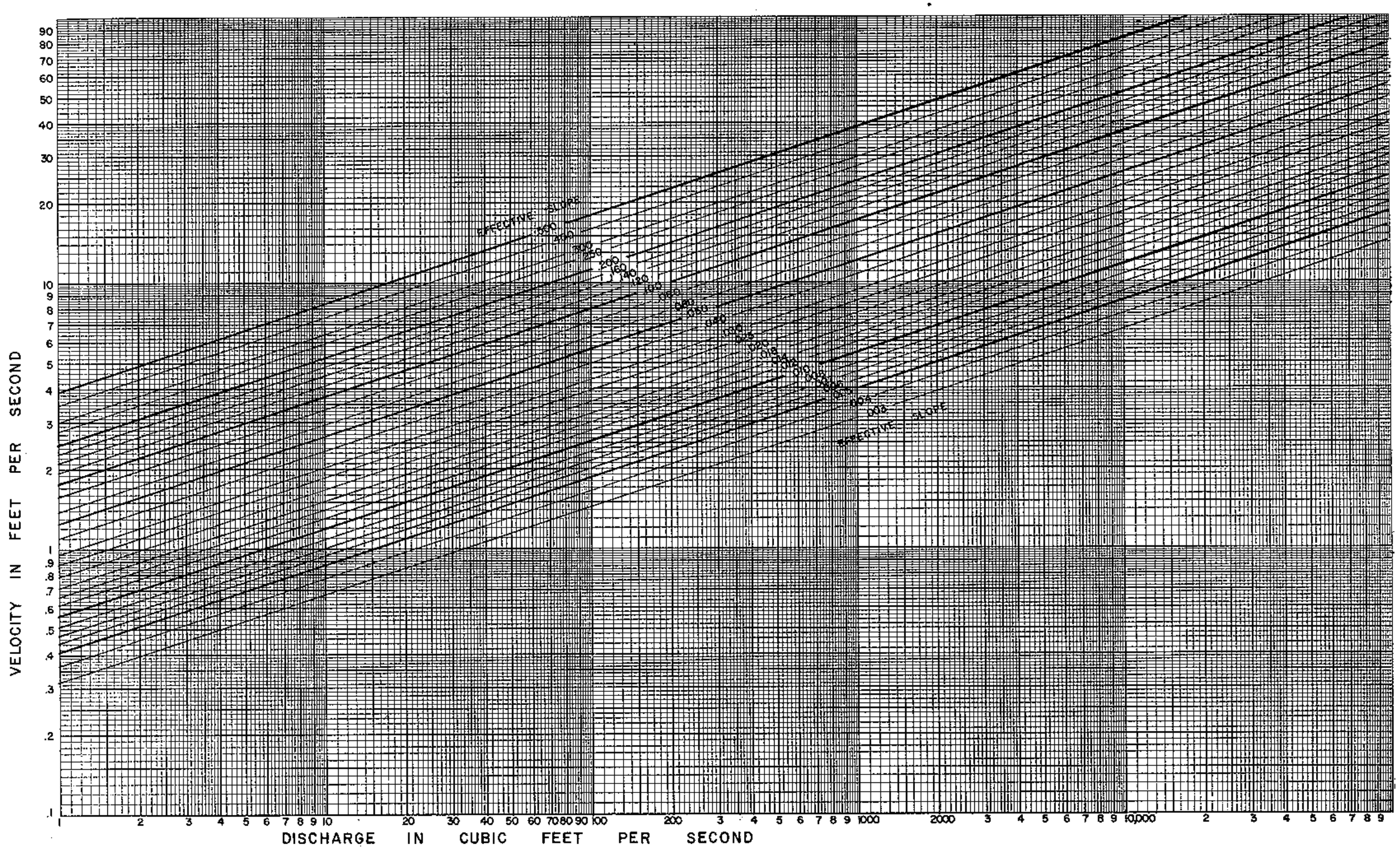


EXHIBIT 10. VELOCITY- DISCHARGE- SLOPE RELATIONSHIPS, NATURAL VALLEY CHANNELS

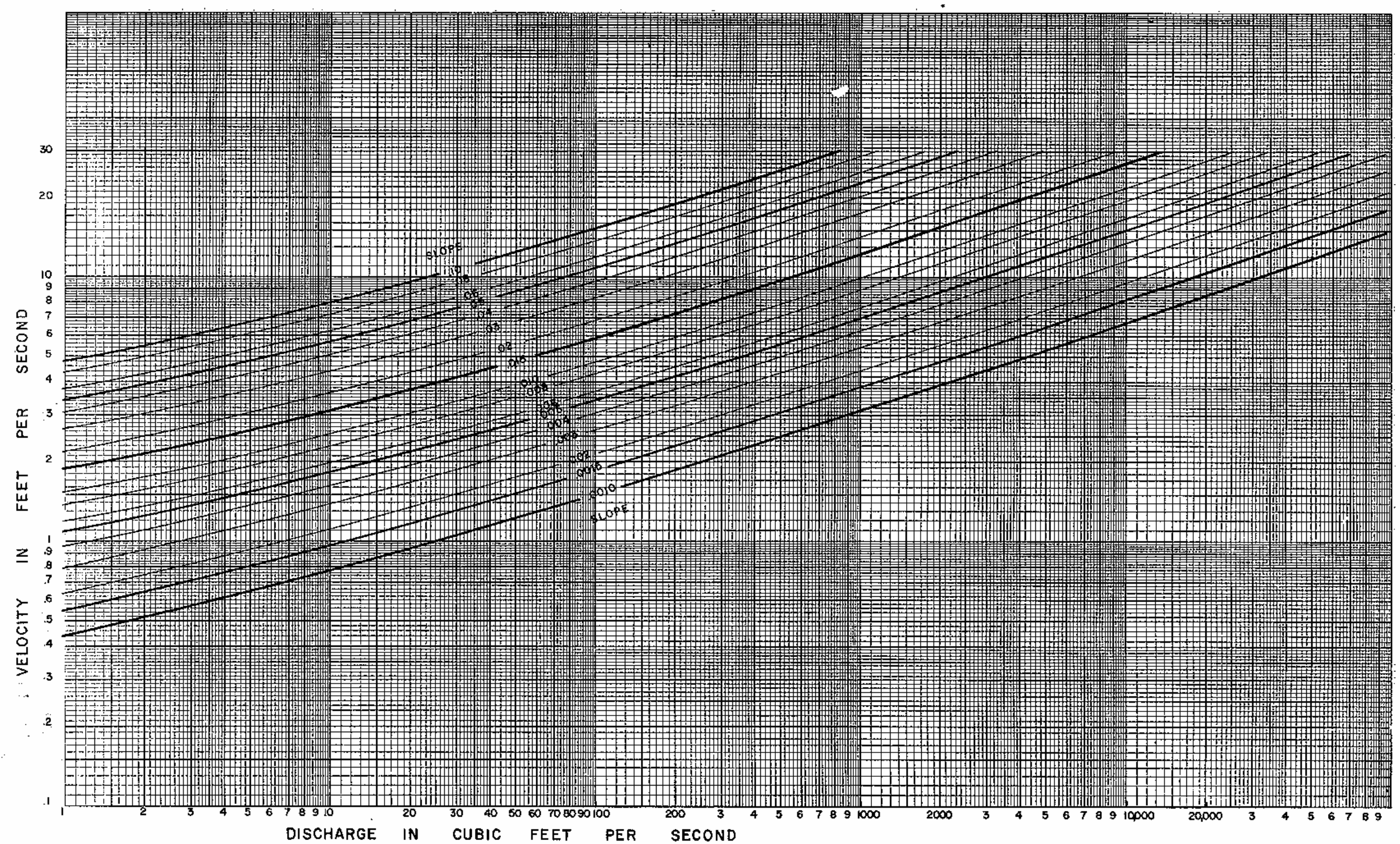


EXHIBIT 11A. VELOCITY- DISCHARGE- SLOPE RELATIONSHIPS, 32' ROAD WIDTH – 6" CURB

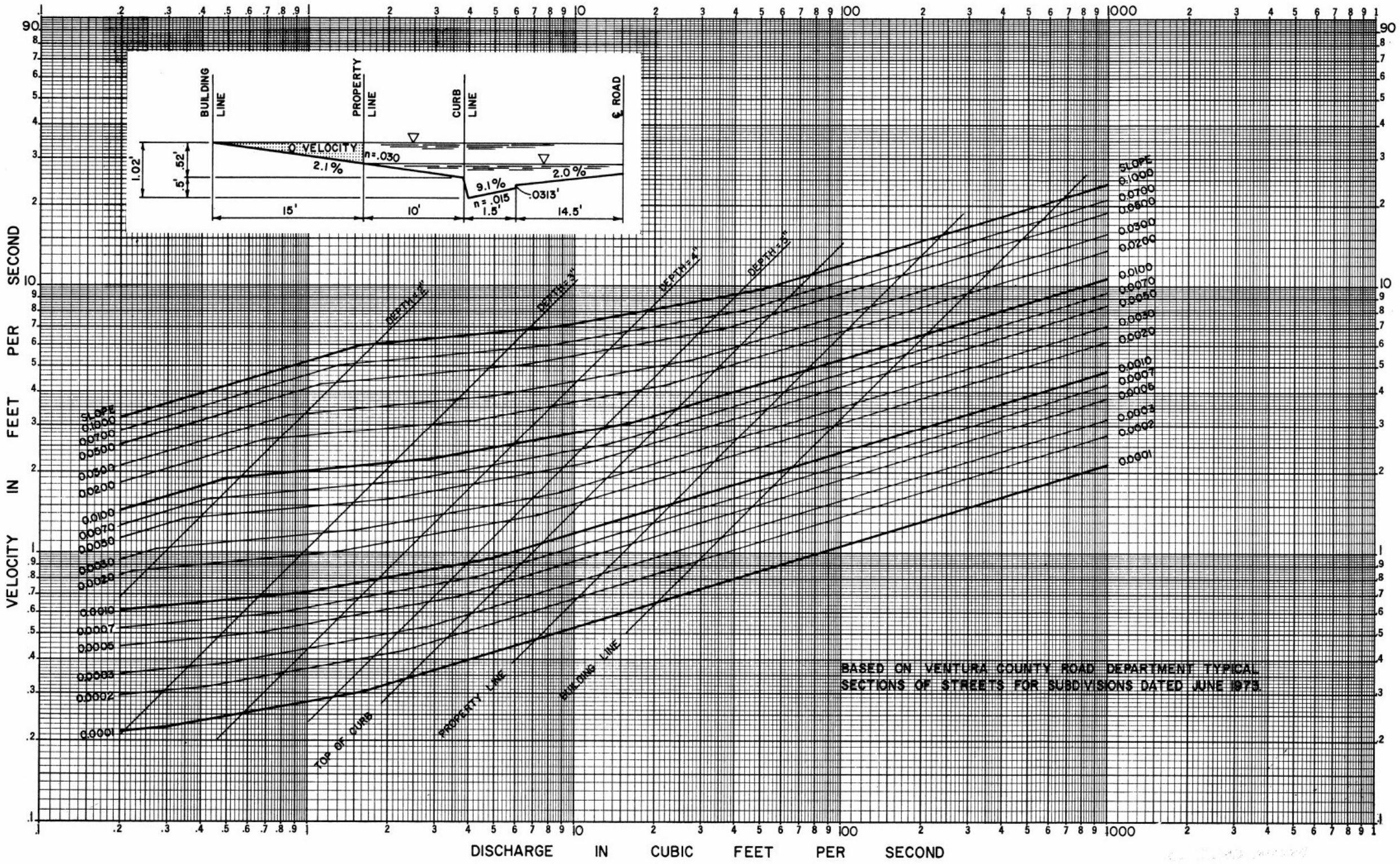


EXHIBIT 11B. VELOCITY- DISCHARGE- SLOPE RELATIONSHIPS, 32' ROAD WIDTH – 8" CURB

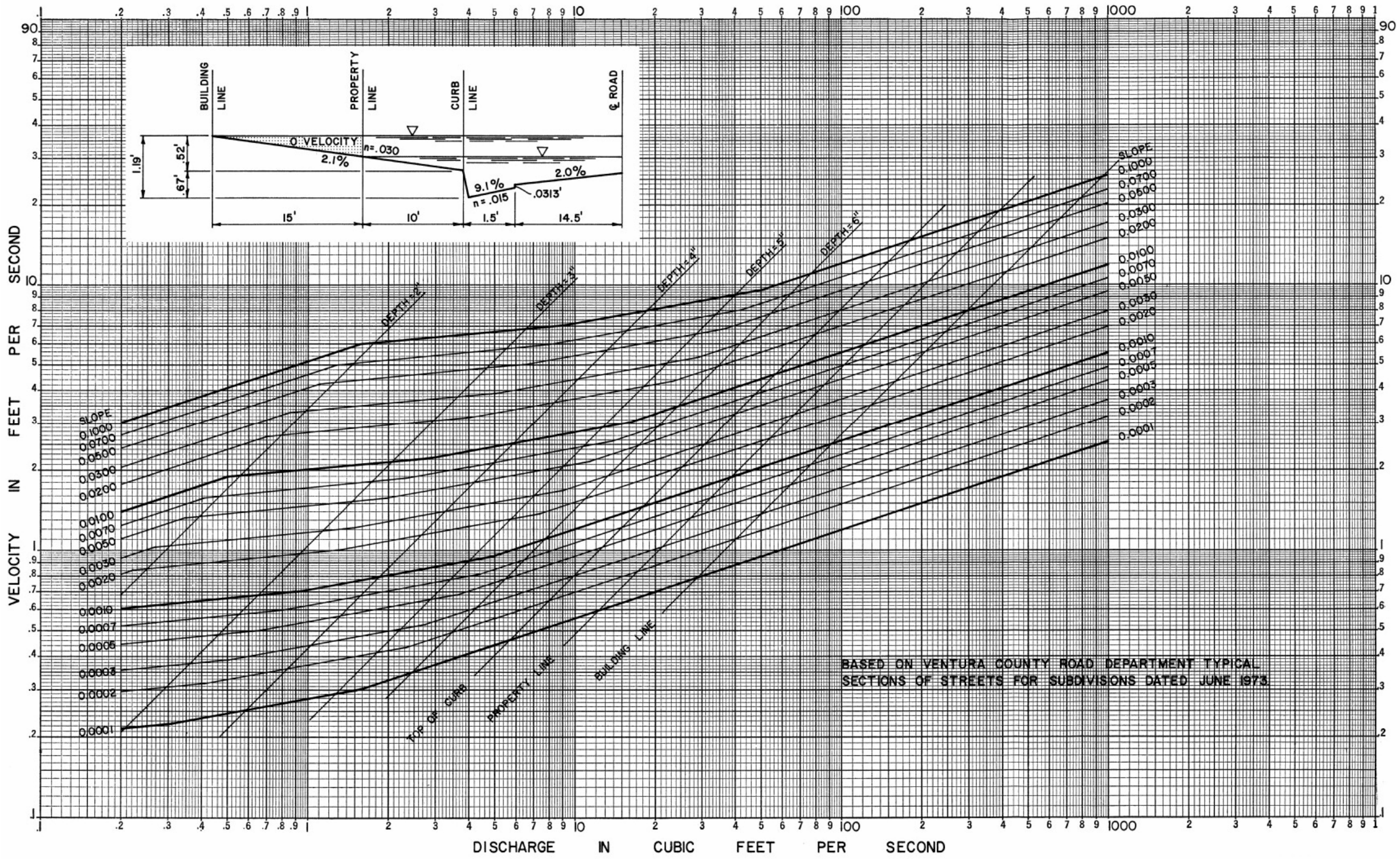


EXHIBIT 11C. VELOCITY- DISCHARGE- SLOPE RELATIONSHIPS, 40' ROAD WIDTH – 6" CURB

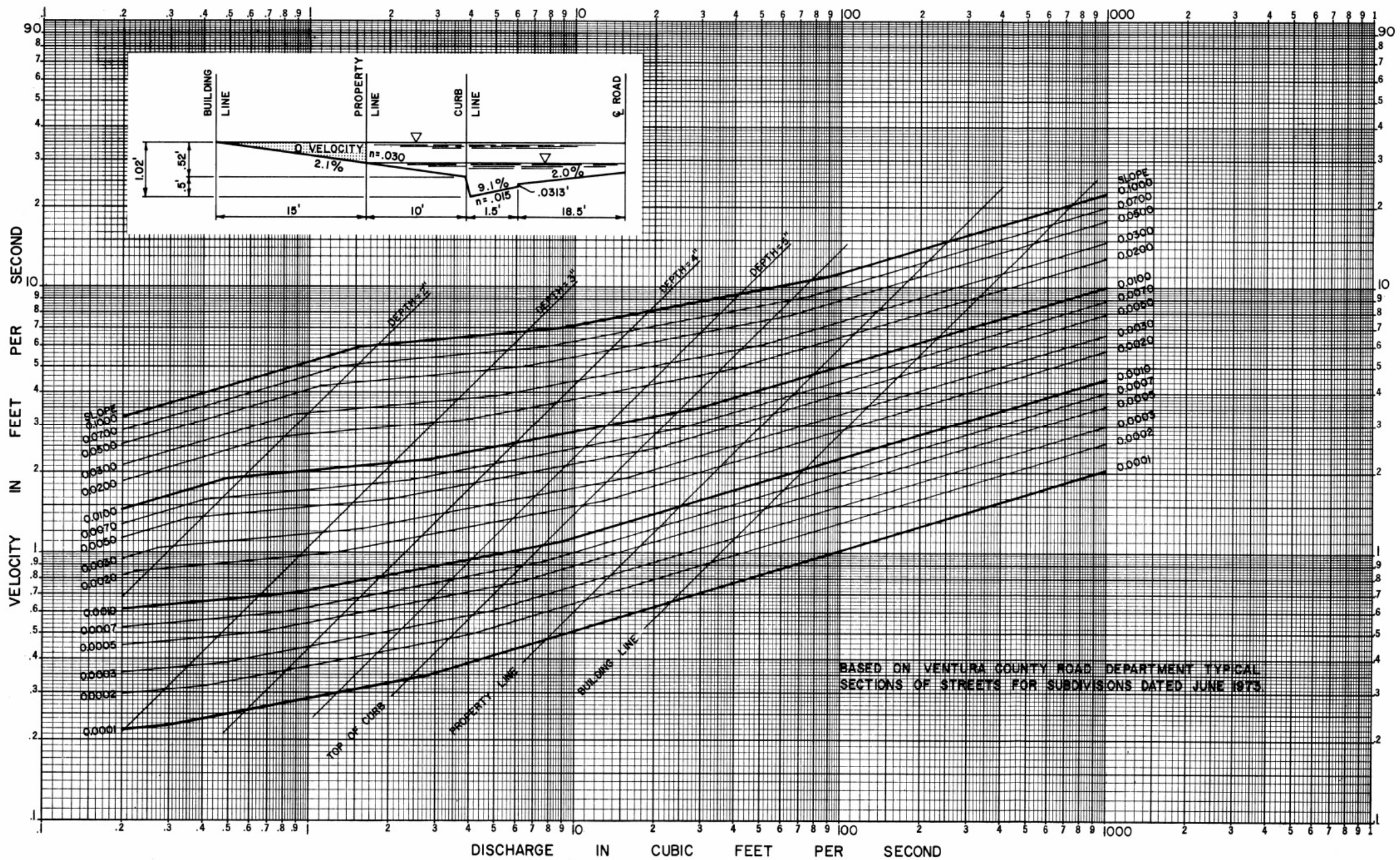


EXHIBIT 11D. VELOCITY- DISCHARGE- SLOPE RELATIONSHIPS, 40' ROAD WIDTH – 8" CURB

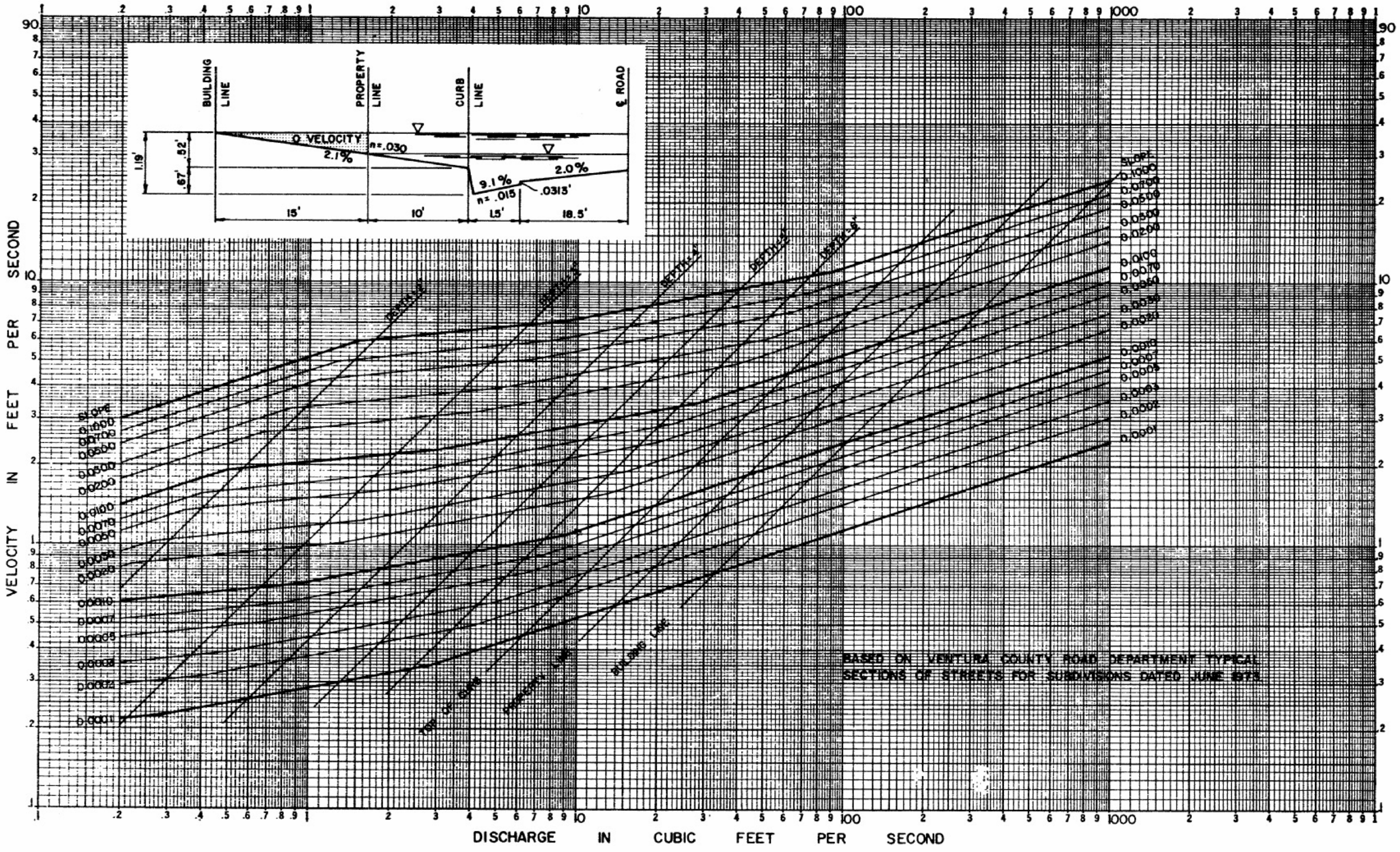


EXHIBIT 12A. WAVE VELOCITY- RECTANGULAR CHANNEL

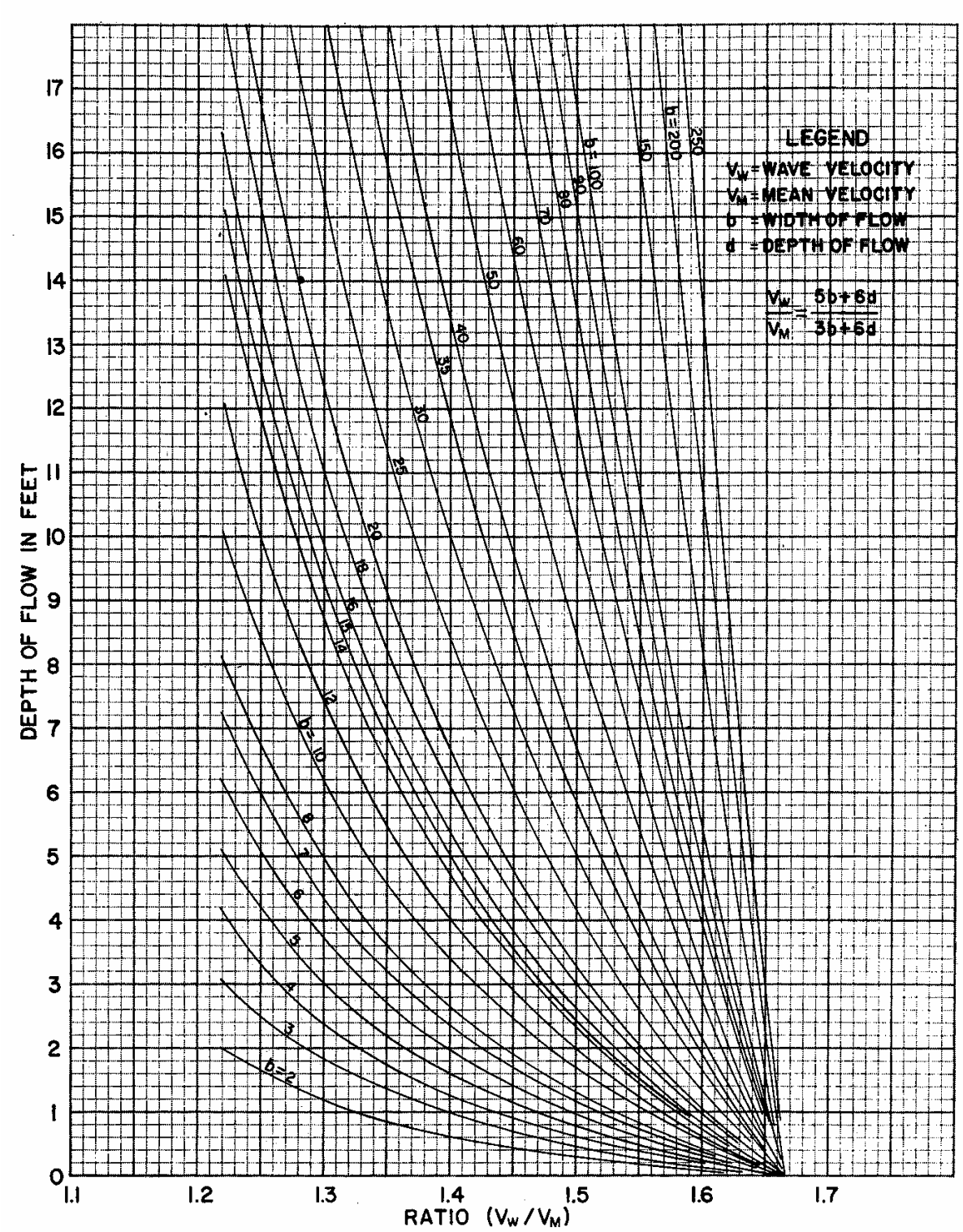
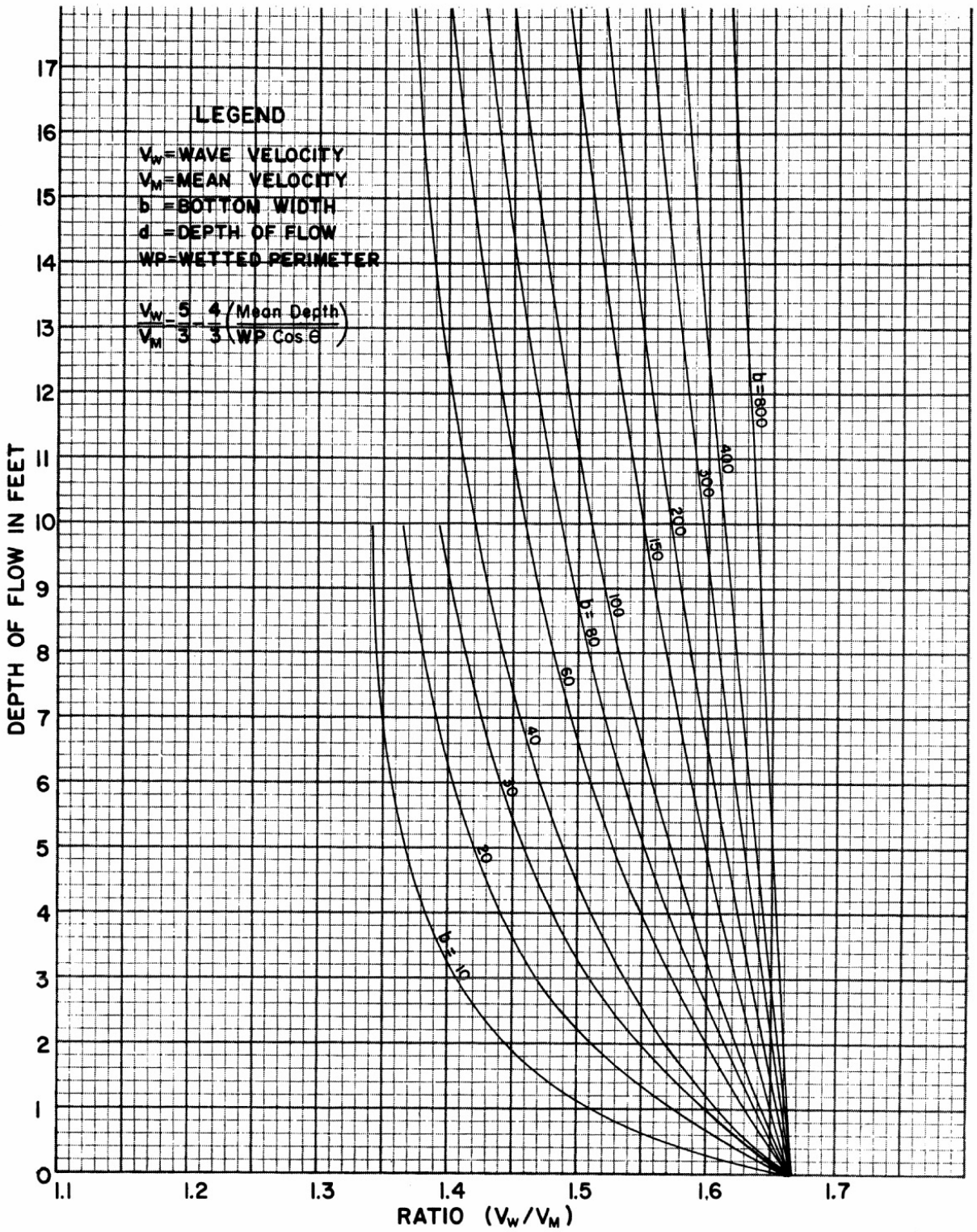


EXHIBIT 12B. WAVE VELOCITY- TRAPEZOIDAL CHANNEL 1.5:1 SIDESLOPE



%Q	%V	%Vw	%Q	%V	%Vw	%Q	%V	%Vw	%Q	%V	%Vw	%Q	%V	%Vw
0	0	--												
1	30	43	21	78	110	41	95	129	61	105	137	81	111	137
2	37	53	22	79	111	42	96	130	62	105	137	82	112	137
3	42	61	23	81	112	43	96	130	63	106	137	83	112	137
4	46	66	24	82	113	44	97	131	64	106	137	84	112	137
5	50	70	25	83	115	45	97	131	65	106	137	85	112	137
6	53	74	26	84	116	46	98	132	66	107	137	86	112	137
7	55	78	27	85	117	47	98	132	67	107	137	87	113	137
8	57	81	28	86	118	48	99	133	68	107	137	88	113	137
9	59	84	29	86	119	49	100	133	69	108	137	89	113	137
10	62	88	30	87	120	50	100	133	70	108	137	90	113	137
11	64	91	31	88	121	51	101	134	71	108	137	91	113	137
12	66	93	32	89	122	52	101	134	72	109	137	92	113	137
13	68	95	33	90	123	53	101	135	73	109	137	93	113	137
14	69	97	34	90	124	54	102	135	74	109	137	94	114	137
15	71	99	35	91	125	55	102	136	75	110	137	95	114	137
16	72	101	36	92	126	56	103	136	76	110	137	96	114	137
17	74	103	37	93	126	57	103	136	77	110	137	97	114	137
18	75	105	38	93	127	58	104	136	78	111	137	98	114	137
19	76	107	39	94	128	59	104	136	79	111	137	99	114	137
20	77	108	40	95	128	60	105	137	80	111	137	100	114	137

Note:

1. In %Q column find %Q based on pipe-full Q
2. On same line as %Q, find %V and %VW; These are percentages of mean velocity in pipe flowing full
3. Because pipe-full Q is not maximum Q due to boundary resistance, appears table only goes up to depth/diameter = 0.82

EXHIBIT 12C. WAVE VELOCITY- CIRCULAR PIPE

EXHIBIT 13. DIRECT RUNOFF FOR VARIOUS CURVE NUMBERS- NRCS

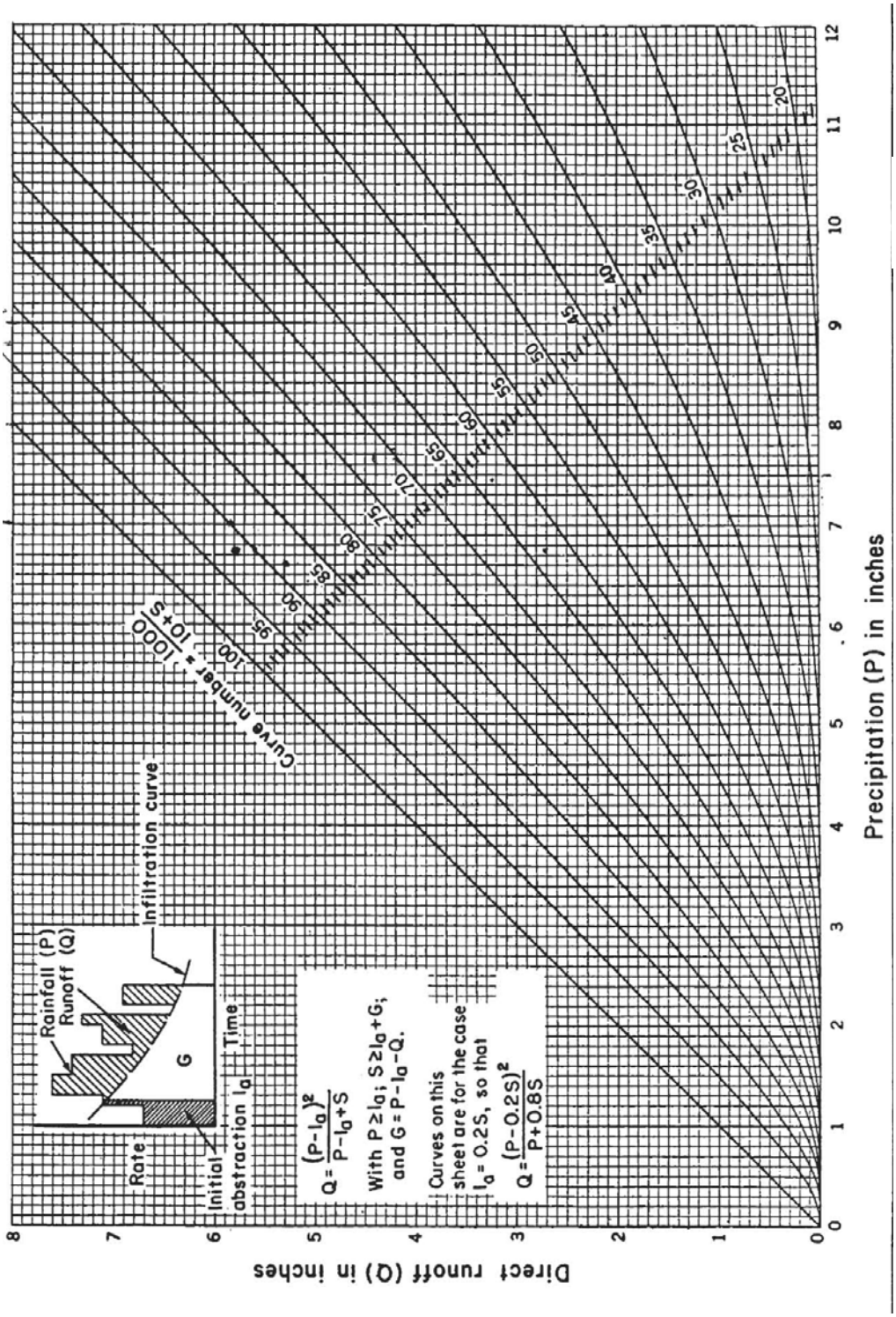


EXHIBIT 14A. CURVE NUMBERS FOR UNDEVELOPED LAND USES- NRCS

UNDEVELOPED LAND USE DESCRIPTION	POOR: Less than 50% Cover FAIR: From 50% to 75% Cover GOOD: More Than 75% Cover	EFFEC. IMPERV %	AVE. IMPERV %	HYDROLOGIC SOIL GROUP A 7	A 6	B 5	B 4	C 3	C 2	D 1
GRASSLAND (ANNUAL GRASS)	POOR	0	0	46	54	61	63	68	72	76
"	FAIR	0	0	27	31	51	53	61	65	70
"	GOOD	0	0			43	45	56	60	64
OPEN BRUSH (SAGEBRUSH, FLATOP BUCKWHEAT)	POOR	0	0	37	43	56	58	66	70	75
"	FAIR	0	0	19	23	45	47	56	60	61
"	GOOD	0	0	4	4	35	37	48	50	56
BIG BRUSH (SCRUB OAK, MANZANITA, CEANOTHIS)	FAIR	0	0	13	15	41	43	51	55	59
"	GOOD	0	0	2	2	30	32	44	46	51
CHAMISE (NARROW LEAF CHAPPARAL)	FAIR	0	0	(1)	(1)	52	54	62	66	75
"	GOOD	0	0	12	14	45	47	56	60	64
OAK SAVANNA (SPARSE OAKS & ANNUAL GRASS)	POOR	0	0	40	46	57	59	68	72	
"	FAIR	0	0	22	26	47	49	57	61	
ORCHARD	POOR	0	0	45	53	58	60	64	68	71
WOODLAND	FAIR	0	0			36	38	44	46	
PINON & JUNIPER	FAIR	0	0	(1)	(1)	44	46	54	58	62
FOREST	FAIR	0	0	19	23	46	48	56	60	64

NOTE: MODIFIED RATIONAL METHOD USES SOIL TYPES 1-7 AND EFFECTIVE IMPERVIOUS PERCENTAGE

Note (1) Curve numbers for soil types 1 and 3 have only been developed for desert shrub.

EXHIBIT 14B. CURVE NUMBERS FOR DEVELOPED LAND USES- NRCS

DEVELOPED LAND USE DESCRIPTION	EFFECTIVE IMPERV %	AVERAGE IMPERV %	HYDROLOGIC SOIL GROUP						
			A		B		C		D
			7	6	5	4	3	2	1
OPEN SPACES, LAWNS, PARKS, GOLF COURSES, CEMETERIES, ETC., GRASS COVER ON 75% OR MORE	0	0	37	41	60	62	73	75	80
OPEN SPACES…ETC., GRASS COVER ON 50-75%	0	0	48	50	70	71	78	80	84
RESIDENTIAL 1 ACRE LOT	10	20	50	52	67	69	78	80	84
RESIDENTIAL 1/2 ACRE LOT	13	25	53	55	69	71	79	81	85
RESIDENTIAL 1/3 ACRE LOT	15	30	56	58	71	73	80	82	86
RESIDENTIAL 1/4 ACRE LOT	19	38	60	62	74	76	82	84	87
RESIDENTIAL 1/5 ACRE LOT	23	47	65	67	77	79	84	86	89
RESIDENTIAL 1/6 ACRE LOT	28	56	71	73	81	83	87	89	90
RESIDENTIAL 1/8 ACRE LOT	32	65	76	78	84	86	89	91	92
RESIDENTIAL - CONDOMINIUMS	37	69	78	80	86	88	89	92	93
INDUSTRIAL - UNPAVED YARDS, ETC.	36	72	80	82	87	89	90	92	93
COMMERCIAL & BUSINESS	50	85	88	90	91	93	93	95	95
INDUSTRIAL PARKS PAVED PARKING, ETC.	70	93	93	94	95	96	96	97	97
PARKING LOTS, ROOFS, DRIVEWAYS, PAVED STREETS WITH CURBS & DRAINS	90	100	98	98	98	98	98	98	98

NOTE: MODIFIED RATIONAL METHOD USES SOIL TYPES 1-7

Note: Percent effective impervious values apply only to SCS Unit Hydrograph Method

EXHIBIT 15. ZONE FOURTH DAY STORM TOTALS AND MASS CURVE IDS

Rainfall Zone	100-Year Storm	50-Year Storm	25-Year Storm	10-Year Storm
J	7.00	5.0	3.91	3.17
J' (J prime)	6.66	6.0	5.28	4.38
K	10.60	8.0	6.41	5.53
L	15.00	11.0	8.81	7.21
	VCRat 2.5 Model Mass Curve IDs			
J	D96 (Note 1)	I50	I25	I10
J' (J prime)	A97	J50	J25	J10
K	B98	K50	K25	K10
L	C99	L50	L25	L10

Note 1: For VCRat 2.2, the J and J prime distributions use the same mass curve Ids of A97, J50, J25, and J10 in the VCRain.dat file and the modeler is required to insert the correct mass curve data required for the run in the appropriate location.

EXHIBIT 16. VCRATP.FOR AREAL REDUCTION DATA FROM FORTRAN PROGRAM

Area (ac)	Area (sq mi)	Factor	Area (ac)	Area (sq mi)	Factor
0	0	1.0000	19200	30	0.7850
800	1.25	0.9450	22400	35	0.7730
1600	2.5	0.9250	25600	40	0.7625
3200	5	0.8950	28800	45	0.7520
6400	10	0.8600	32000	50	0.7420
9600	15	0.8350	48000	75	0.7020
12800	20	0.8150	64000	100	0.6700
16000	25	0.8000			

EXHIBIT 17 100-YR HYDROGRAPH DISCRETIZATION

Time Period Minutes	Point Spacing Minutes	Number of Points
0 - 1000	100	11
1000 - 1100	50	2
1100 - 1130	10	3
1130 - 1300	1	170
1300 - 1400	10	10
1400 - 1460	20	3
1460 - 1500	40	1
		Total 200

EXHIBIT 18.VCRAIN.DAT FILE FOR VCRAT 2.2

C coefficients and mass curves for J'10, 50, 100, J25, K10, 25, 50, 100, L10, 25, 50, and 100. For VCRat 2.2, the J and J prime distributions use the same mass curve Ids of A97, J50, J25, and J10 in the VCRain.dat file and the modeler is required to insert the correct mass curve data required for the run in the appropriate location.

```
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EXHIBIT 19.VCRAIN.DAT FILE FOR VCRAT 2.5

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VCRAIN.DAT v2.5
VERSION 200604
SOILCRV 010
INTENSI 1 0.000 0.300 0.500 0.750 1.000 1.250 1.500 1.750 2.000 2.500 3.000 4.000 5.000 6.000
RUNOFF  1 0.000 0.001 0.400 0.600 0.700 0.765 0.800 0.828 0.850 0.880 0.900 0.925 0.940 0.950
SOILCRV 020
INTENSI 1 0.000 0.400 0.750 1.000 1.250 1.500 2.000 2.500 3.000 3.500 4.000 5.000 6.000 7.000
RUNOFF  1 0.000 0.000 0.450 0.591 0.663 0.709 0.762 0.800 0.829 0.850 0.868 0.890 0.903 0.910
SOILCRV 030
INTENSI 1 0.000 0.500 0.750 1.000 1.250 1.500 1.750 2.000 2.500 3.000 3.500 4.000 5.000 7.000
RUNOFF  1 0.000 0.000 0.332 0.502 0.590 0.645 0.677 0.704 0.746 0.777 0.800 0.816 0.840 0.856
SOILCRV 040
INTENSI 1 0.000 0.650 0.750 1.000 1.500 2.000 2.500 3.000 3.500 4.000 4.500 5.000 5.500 6.500
RUNOFF  1 0.000 0.000 0.140 0.360 0.570 0.647 0.692 0.727 0.752 0.770 0.785 0.795 0.802 0.809
SOILCRV 050
INTENSI 1 0.000 0.800 1.000 1.200 1.450 1.690 2.050 2.500 3.000 3.630 4.300 5.000 6.000 7.000
RUNOFF  1 0.000 0.000 0.270 0.400 0.500 0.550 0.600 0.630 0.672 0.700 0.720 0.732 0.744 0.750
SOILCRV 060
INTENSI 1 0.000 0.925 1.000 1.100 1.200 1.425 1.725 2.050 2.400 3.000 3.800 4.700 5.600 7.000
RUNOFF  1 0.000 0.001 0.170 0.250 0.310 0.370 0.420 0.460 0.490 0.530 0.570 0.600 0.620 0.643
SOILCRV 070
INTENSI 1 0.000 1.850 2.000 2.270 2.650 3.000 3.340 3.900 4.500 5.000 5.600 6.000 6.600 7.000
RUNOFF  1 0.000 0.001 0.090 0.200 0.300 0.360 0.400 0.450 0.490 0.515 0.540 0.560 0.580 0.593
MASSCRV J 10 I10 3.17
TIME    1     0   100   200   300   400   500   600   700   800   900  1000  1050  1100  1110
RAIN    1     0 0.017 0.069 0.156 0.278 0.433 0.632 0.848 1.105 1.398 1.726 1.903 2.089 2.127
TIME   15  1120  1130  1135  1140  1145  1147  1148  1149  1150  1151  1152  1153  1154  1155
RAIN   15 2.168 2.216 2.246 2.286 2.340 2.370 2.392 2.428 2.464 2.500 2.536 2.572 2.584 2.594
TIME   29  1160  1170  1180  1190  1210  1230  1260  1300  1340  1400  1440  1500
RAIN   29 2.632 2.684 2.719 2.753 2.817 2.876 2.954 3.039 3.103 3.159 3.170 3.170
MASSCRV J 25 I25 3.91
TIME    1     0   100   200   300   400   500   600   700   800   900  1000  1050  1100  1110
RAIN    1 0.000 0.022 0.085 0.192 0.340 0.532 0.765 1.042 1.360 1.722 2.125 2.343 2.572 2.620
TIME   15  1120  1130  1135  1140  1145  1147  1148  1149  1150  1151  1152  1153  1154  1155
RAIN   15 2.677 2.745 2.786 2.833 2.887 2.920 2.952 2.996 3.040 3.084 3.128 3.172 3.186 3.198
TIME   29  1160  1170  1180  1190  1210  1230  1260  1300  1340  1400  1440  1500
RAIN   29 3.241 3.300 3.347 3.389 3.469 3.542 3.640 3.747 3.827 3.897 3.910 3.910
MASSCRV J 50 I50 5.00
TIME    1     0   100   200   300   400   500   600   700   800   900  1000  1050  1100  1110
RAIN    1     0 0.028 0.111 0.251 0.446 0.698 1.005 1.368 1.786 2.261 2.791 3.077 3.377 3.439
TIME   15  1120  1130  1135  1140  1145  1147  1148  1149  1150  1151  1152  1153  1154  1155
RAIN   15 3.508 3.585 3.628 3.676 3.735 3.769 3.804 3.853 3.902 3.951 4.000 4.049 4.066 4.081
TIME   29  1160  1170  1180  1190  1210  1230  1260  1300  1340  1400  1440  1500
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RAIN   29 4.133 4.199 4.257 4.313 4.419 4.516 4.645 4.786 4.891 4.983 5.000 5.000
MASSCRV J 100 D96 7.00
TIME    1     0   100   200   300   400   500   600   700   800   900  1000  1050  1100  1110
RAIN    1 0.000 0.210 0.420 0.641 0.883 1.167 1.482 1.841 2.302 2.859 3.542 3.952 4.463 4.593
TIME   15  1120  1130  1131  1132  1133  1134  1135  1136  1137  1138  1139  1140  1141  1142
RAIN   15 4.751 4.887 4.908 4.929 4.949 4.970 4.991 5.012 5.033 5.053 5.074 5.095 5.122 5.148
TIME   29  1143  1144  1145  1146  1147  1148  1149  1150  1151  1152  1153  1154  1155  1156
RAIN   29 5.174 5.202 5.236 5.270 5.305 5.339 5.350 5.360 5.424 5.592 5.655 5.689 5.716 5.733
TIME   43  1157  1158  1159  1160  1161  1162  1163  1164  1165  1166  1167  1168  1169  1170
RAIN   43 5.751 5.772 5.785 5.802 5.817 5.833 5.846 5.861 5.874 5.886 5.896 5.908 5.910 5.932
TIME   57  1171  1172  1173  1174  1175  1176  1177  1178  1179  1180  1181  1182  1183  1184
RAIN   57 5.943 5.952 5.962 5.972 5.982 5.991 6.000 6.011 6.018 6.028 6.035 6.041 6.049 6.056
TIME   71  1185  1186  1187  1188  1189  1190  1191  1192  1193  1194  1195  1196  1197  1198
RAIN   71 6.062 6.070 6.076 6.083 6.092 6.099 6.108 6.116 6.123 6.132 6.140 6.148 6.156 6.164
TIME   85  1199  1200  1201  1202  1203  1204  1205  1206  1207  1208  1209  1210  1211  1212
RAIN   85 6.172 6.180 6.190 6.199 6.209 6.218 6.227 6.237 6.246 6.256 6.265 6.275 6.281 6.287
TIME   99  1213  1214  1215  1216  1217  1218  1219  1220  1221  1222  1223  1224  1225  1226
RAIN   99 6.294 6.300 6.306 6.313 6.319 6.325 6.332 6.338 6.344 6.350 6.357 6.363 6.369 6.376
TIME  113  1227  1228  1229  1230  1231  1232  1233  1234  1235  1236  1237  1238  1239  1240
RAIN  113 6.382 6.388 6.395 6.401 6.407 6.414 6.420 6.426 6.432 6.439 6.445 6.451 6.458 6.464
TIME  127  1241  1242  1243  1244  1245  1246  1247  1248  1249  1250  1251  1252  1253  1254
RAIN  127 6.469 6.474 6.480 6.485 6.490 6.495 6.501 6.506 6.511 6.517 6.522 6.527 6.532 6.538
TIME  141  1255  1256  1257  1258  1259  1260  1261  1262  1263  1264  1265  1266  1267  1268
RAIN  141 6.543 6.548 6.553 6.559 6.564 6.569 6.574 6.580 6.585 6.590 6.595 6.601 6.606 6.611
TIME  155  1269  1270  1271  1272  1273  1274  1275  1276  1277  1278  1279  1280  1281  1282
RAIN  155 6.616 6.622 6.626 6.630 6.634 6.638 6.643 6.647 6.651 6.655 6.659 6.664 6.668 6.672
TIME  169  1283  1284  1285  1286  1287  1288  1289  1290  1291  1292  1293  1294  1295  1296
RAIN  169 6.676 6.680 6.685 6.689 6.693 6.697 6.702 6.706 6.710 6.714 6.718 6.723 6.727 6.731
TIME  183  1297  1298  1299  1300  1310  1320  1330  1340  1350  1360  1370  1380  1390  1400
RAIN  183 6.735 6.739 6.744 6.748 6.779 6.811 6.832 6.853 6.884 6.905 6.926 6.947 6.968 6.979
TIME  197  1420  1440  1460  1500
RAIN  197 6.989 6.998 6.999 7.000
MASSCRV J' 10 J10 4.38
TIME    1     0   276   512   768   926  1072  1084  1088  1092  1104  1108  1112  1116  1120
RAIN    1 0.000 0.140 0.340 1.160 1.760 2.584 2.677 2.718 2.754 2.856 2.888 2.931 2.970 3.003
TIME   15  1128  1136  1140  1144  1148  1152  1153  1154  1156  1158  1160  1163  1165  1167
RAIN   15 3.072 3.160 3.208 3.277 3.360 3.504 3.540 3.561 3.590 3.612 3.621 3.658 3.676 3.692
TIME   29  1170  1180  1200  1215  1236  1254  1276  1305  1340  1375  1430  1500
RAIN   29 3.714 3.784 3.896 3.940 4.020 4.080 4.140 4.200 4.260 4.340 4.360 4.380
MASSCRV J' 25 J25 5.28
TIME    1     0   100   200   300   400   500   600   700   800   900  1000  1050  1100  1110
RAIN    1 0.000 0.044 0.088 0.176 0.290 0.502 0.836 1.250 1.707 2.200 2.746 3.080 3.476 3.546
TIME   15  1120  1130  1135  1140  1145  1147  1148  1149  1150  1151  1152  1153  1154  1155
RAIN   15 3.628 3.727 3.784 3.856 3.934 4.004 4.007 4.022 4.050 4.066 4.224 4.278 4.300 4.316
TIME   29  1160  1170  1180  1190  1210  1230  1260  1300  1340  1400  1440  1500
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RAIN   29 4.373 4.443 4.532 4.594 4.726 4.840 4.998 5.166 5.192 5.271 5.280 5.280
MASSCRV J' 50 J50 6.00
TIME    1     0   100   200   300   400   500   600   700   800   900  1000  1050  1100  1110
RAIN    1 0.000 0.050 0.100 0.200 0.330 0.570 0.950 1.420 1.940 2.500 3.120 3.500 3.950 4.030
TIME   15  1120  1130  1135  1140  1145  1147  1148  1149  1150  1151  1152  1153  1154  1155
RAIN   15 4.123 4.235 4.300 4.382 4.470 4.550 4.553 4.570 4.602 4.620 4.800 4.861 4.886 4.904
TIME   29  1160  1170  1180  1190  1210  1230  1260  1300  1340  1400  1440  1500
RAIN   29 4.969 5.049 5.150 5.220 5.370 5.500 5.680 5.870 5.900 5.990 6.000 6.000
MASSCRV J' 100 A97 6.66
TIME    1     0   100   200   300   400   500   600   700   800   900  1000  1050  1100  1110
RAIN    1 0.000 0.200 0.400 0.610 0.840 1.110 1.410 1.752 2.190 2.720 3.370 3.760 4.246 4.370
TIME   15  1120  1130  1131  1132  1133  1134  1135  1136  1137  1138  1139  1140  1141  1142
RAIN   15 4.520 4.650 4.670 4.690 4.709 4.729 4.749 4.769 4.789 4.808 4.828 4.848 4.873 4.898
TIME   29  1143  1144  1145  1146  1147  1148  1149  1150  1151  1152  1153  1154  1155  1156
RAIN   29 4.923 4.949 4.982 5.014 5.047 5.080 5.090 5.100 5.161 5.320 5.380 5.413 5.438 5.455
TIME   43  1157  1158  1159  1160  1161  1162  1163  1164  1165  1166  1167  1168  1169  1170
RAIN   43 5.472 5.492 5.504 5.520 5.534 5.550 5.562 5.576 5.589 5.600 5.610 5.621 5.623 5.644
TIME   57  1171  1172  1173  1174  1175  1176  1177  1178  1179  1180  1181  1182  1183  1184
RAIN   57 5.654 5.663 5.672 5.682 5.691 5.700 5.709 5.719 5.726 5.735 5.742 5.748 5.755 5.762
TIME   71  1185  1186  1187  1188  1189  1190  1191  1192  1193  1194  1195  1196  1197  1198
RAIN   71 5.768 5.775 5.781 5.788 5.796 5.803 5.811 5.819 5.826 5.834 5.842 5.849 5.857 5.865
TIME   85  1199  1200  1201  1202  1203  1204  1205  1206  1207  1208  1209  1210  1211  1212
RAIN   85 5.872 5.880 5.889 5.898 5.907 5.916 5.925 5.934 5.943 5.952 5.961 5.970 5.976 5.982
TIME   99  1213  1214  1215  1216  1217  1218  1219  1220  1221  1222  1223  1224  1225  1226
RAIN   99 5.988 5.994 6.000 6.006 6.012 6.018 6.024 6.030 6.036 6.042 6.048 6.054 6.060 6.066
TIME  113  1227  1228  1229  1230  1231  1232  1233  1234  1235  1236  1237  1238  1239  1240
RAIN  113 6.072 6.078 6.084 6.090 6.096 6.102 6.108 6.114 6.120 6.126 6.132 6.138 6.144 6.150
TIME  127  1241  1242  1243  1244  1245  1246  1247  1248  1249  1250  1251  1252  1253  1254
RAIN  127 6.155 6.160 6.165 6.170 6.175 6.180 6.185 6.190 6.195 6.200 6.205 6.210 6.215 6.220
TIME  141  1255  1256  1257  1258  1259  1260  1261  1262  1263  1264  1265  1266  1267  1268
RAIN  141 6.225 6.230 6.235 6.240 6.245 6.250 6.255 6.260 6.265 6.270 6.275 6.280 6.285 6.290
TIME  155  1269  1270  1271  1272  1273  1274  1275  1276  1277  1278  1279  1280  1281  1282
RAIN  155 6.295 6.300 6.304 6.308 6.312 6.316 6.320 6.324 6.328 6.332 6.336 6.340 6.344 6.348
TIME  169  1283  1284  1285  1286  1287  1288  1289  1290  1291  1292  1293  1294  1295  1296
RAIN  169 6.352 6.356 6.360 6.364 6.368 6.372 6.376 6.380 6.384 6.388 6.392 6.396 6.400 6.404
TIME  183  1297  1298  1299  1300  1310  1320  1330  1340  1350  1360  1370  1380  1390  1400
RAIN  183 6.408 6.412 6.416 6.420 6.450 6.480 6.500 6.520 6.550 6.570 6.590 6.610 6.630 6.640
TIME  197  1420  1440  1460  1500
RAIN  197 6.650 6.658 6.659 6.660
MASSCRV K 10 K10 5.53
TIME    1     0   100   200   300   400   500   600   700   800   900  1000  1050  1100  1110
RAIN    1 0.000 0.100 0.210 0.350 0.520 0.735 0.980 1.290 1.670 2.140 2.792 3.154 3.547 3.646
TIME   15  1120  1130  1135  1140  1145  1147  1148  1149  1150  1151  1152  1153  1154  1155
RAIN   15 3.754 3.864 3.934 4.014 4.107 4.149 4.179 4.214 4.254 4.324 4.424 4.489 4.509 4.524
TIME   29  1160  1170  1180  1190  1210  1230  1260  1300  1340  1400  1440  1500
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RAIN   29 4.594 4.689 4.762 4.830 4.961 5.060 5.175 5.305 5.400 5.490 5.530 5.530
MASSCRV K 25 K25 6.408
TIME    1     0   100   200   300   400   500   600   700   800   900  1000  1050  1100  1110
RAIN    1 0.000 0.100 0.235 0.407 0.623 0.893 1.215 1.605 2.061 2.523 3.198 3.619 4.138 4.251
TIME   15  1120  1130  1135  1140  1145  1147  1148  1149  1150  1151  1152  1153  1154  1155
RAIN   15 4.367 4.508 4.588 4.678 4.776 4.821 4.844 4.915 4.986 5.057 5.128 5.200 5.224 5.241
TIME   29  1160  1170  1180  1190  1210  1230  1260  1300  1340  1400  1440  1500
RAIN   29 5.315 5.426 5.518 5.596 5.726 5.835 5.973 6.135 6.253 6.364 6.408 6.408
MASSCRV K 50 K50 8.000
TIME    1     0   100   200   300   400   500   600   700   800   900  1000  1050  1100  1110
RAIN    1 0.000 0.100 0.280 0.510 0.810 1.180 1.640 2.175 2.770 3.470 4.340 4.784 5.311 5.426
TIME   15  1120  1130  1135  1140  1145  1147  1148  1149  1150  1151  1152  1153  1154  1155
RAIN   15 5.560 5.701 5.776 5.886 6.020 6.080 6.111 6.146 6.195 6.290 6.400 6.490 6.520 6.540
TIME   29  1160  1170  1180  1190  1210  1230  1260  1300  1340  1400  1440  1500
RAIN   29 6.620 6.730 6.830 6.930 7.100 7.240 7.420 7.640 7.800 7.950 8.000 8.000
MASSCRV K 100 B98 10.600
TIME    1     0   100   200   300   400   500   600   700   800   900  1000  1050  1100  1110
RAIN    1 0.000 0.450 0.940 1.500 2.060 2.650 3.270 3.920 4.600 5.350 6.220 6.730 7.267 7.407
TIME   15  1120  1130  1131  1132  1133  1134  1135  1136  1137  1138  1139  1140  1141  1142
RAIN   15 7.536 7.706 7.723 7.740 7.760 7.781 7.801 7.816 7.838 7.859 7.880 7.902 7.928 7.953
TIME   29  1143  1144  1145  1146  1147  1148  1149  1150  1151  1152  1153  1154  1155  1156
RAIN   29 7.978 8.004 8.038 8.072 8.106 8.140 8.225 8.310 8.327 8.480 8.565 8.599 8.624 8.646
TIME   43  1157  1158  1159  1160  1161  1162  1163  1164  1165  1166  1167  1168  1169  1170
RAIN   43 8.665 8.682 8.698 8.716 8.729 8.742 8.755 8.774 8.783 8.795 8.805 8.817 8.834 8.840
TIME   57  1171  1172  1173  1174  1175  1176  1177  1178  1179  1180  1181  1182  1183  1184
RAIN   57 8.852 8.863 8.873 8.884 8.894 8.904 8.913 8.922 8.932 8.942 8.952 8.962 8.971 8.981
TIME   71  1185  1186  1187  1188  1189  1190  1191  1192  1193  1194  1195  1196  1197  1198
RAIN   71 8.991 9.000 9.010 9.020 9.030 9.039 9.049 9.058 9.068 9.078 9.088 9.097 9.107 9.117
TIME   85  1199  1200  1201  1202  1203  1204  1205  1206  1207  1208  1209  1210  1211  1212
RAIN   85 9.126 9.136 9.144 9.153 9.161 9.170 9.178 9.186 9.195 9.203 9.212 9.220 9.228 9.237
TIME   99  1213  1214  1215  1216  1217  1218  1219  1220  1221  1222  1223  1224  1225  1226
RAIN   99 9.246 9.254 9.262 9.271 9.280 9.288 9.296 9.305 9.314 9.322 9.330 9.339 9.348 9.356
TIME  113  1227  1228  1229  1230  1231  1232  1233  1234  1235  1236  1237  1238  1239  1240
RAIN  113 9.364 9.373 9.382 9.390 9.398 9.407 9.415 9.423 9.432 9.440 9.448 9.457 9.465 9.473
TIME  127  1241  1242  1243  1244  1245  1246  1247  1248  1249  1250  1251  1252  1253  1254
RAIN  127 9.482 9.490 9.498 9.507 9.515 9.523 9.532 9.540 9.548 9.557 9.565 9.573 9.582 9.590
TIME  141  1255  1256  1257  1258  1259  1260  1261  1262  1263  1264  1265  1266  1267  1268
RAIN  141 9.598 9.607 9.615 9.623 9.632 9.640 9.648 9.655 9.662 9.670 9.678 9.685 9.692 9.700
TIME  155  1269  1270  1271  1272  1273  1274  1275  1276  1277  1278  1279  1280  1281  1282
RAIN  155 9.708 9.715 9.722 9.730 9.738 9.745 9.752 9.760 9.768 9.775 9.782 9.790 9.798 9.805
TIME  169  1283  1284  1285  1286  1287  1288  1289  1290  1291  1292  1293  1294  1295  1296
RAIN  169 9.812 9.820 9.828 9.835 9.842 9.850 9.858 9.865 9.872 9.880 9.887 9.895 9.902 9.910
TIME  183  1297  1298  1299  1300   1310   1320   1330   1340   1350   1360   1370   1380   1390   1400
RAIN  183 9.918 9.925 9.932 9.940 10.002 10.065 10.128 10.190 10.237 10.283 10.330 10.377 10.423 10.470
TIME  197   1420   1440   1460   1500
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RAIN  197 10.535 10.600 10.600 10.600
MASSCRV L 10 L10 7.21
TIME    1     0   100   200   300   400   500   600   700   800   900  1000  1050  1100  1110
RAIN    1 0.000 0.100 0.220 0.390 0.600 0.875 1.240 1.700 2.240 2.890 3.700 4.162 4.698 4.821
TIME   15  1120  1130  1135  1140  1145  1147  1148  1149  1150  1151  1152  1153  1154  1155
RAIN   15 4.965 5.115 5.198 5.281 5.368 5.418 5.449 5.490 5.558 5.638 5.768 5.808 5.828 5.843
TIME   29  1160  1170  1180  1190  1210  1230  1260  1300  1340  1400  1440  1500
RAIN   29 5.905 6.023 6.123 6.220 6.390 6.520 6.710 6.900 7.040 7.160 7.210 7.210
MASSCRV L 25 L25 8.808
TIME    1     0   100   200   300   400   500   600   700   800   900  1000  1050  1100  1110
RAIN    1 0.000 0.092 0.233 0.453 0.748 1.117 1.603 2.198 2.906 3.729 4.690 5.278 5.893 6.023
TIME   15  1120  1130  1135  1140  1145  1147  1148  1149  1150  1151  1152  1153  1154  1155
RAIN   15 6.167 6.345 6.435 6.526 6.639 6.692 6.719 6.800 6.881 6.963 7.046 7.131 7.156 7.175
TIME   29  1160  1170  1180  1190  1210  1230  1260  1300  1340  1400  1440  1500
RAIN   29 7.265 7.406 7.526 7.635 7.802 7.966 8.198 8.439 8.617 8.758 8.808 8.808
MASSCRV L 50 L50 11.000
TIME    1     0   100   200   300   400   500   600   700   800   900  1000  1050  1100  1110
RAIN    1 0.000 0.080 0.250 0.540 0.950 1.450 2.100 2.880 3.820 4.880 6.090 6.765 7.507 7.657
TIME   15  1120  1130  1135  1140  1145  1147  1148  1149  1150  1151  1152  1153  1154  1155
RAIN   15 7.820 8.000 8.103 8.220 8.350 8.410 8.445 8.500 8.565 8.670 8.835 8.910 8.950 8.975
TIME   29  1160  1170  1180  1190  1210  1230   1260   1300   1340   1400   1440   1500
RAIN   29 9.066 9.228 9.364 9.498 9.740 9.950 10.240 10.550 10.780 10.950 11.000 11.000
MASSCRV L 100 C99 15.000
TIME    1      0    100    200    300    400    500    600    700    800    900   1000   1050   1100   1110
RAIN    1  0.000  0.720  1.500  2.300  3.120  3.960  4.820  5.750  6.710  7.800  9.070  9.780 10.550 10.720
TIME   15   1120   1130   1131   1132   1133   1134   1135   1136   1137   1138   1139   1140   1141   1142
RAIN   15 10.891 11.093 11.113 11.133 11.158 11.182 11.207 11.232 11.256 11.279 11.302 11.326 11.359 11.392
TIME   29   1143   1144   1145   1146   1147   1148   1149   1150   1151   1152   1153   1154   1155   1156
RAIN   29 11.424 11.457 11.491 11.525 11.559 11.593 11.695 11.796 11.898 12.000 12.102 12.136 12.168 12.192
TIME   43   1157   1158   1159   1160   1161   1162   1163   1164   1165   1166   1167   1168   1169   1170
RAIN   43 12.217 12.241 12.260 12.277 12.296 12.313 12.330 12.348 12.364 12.380 12.396 12.413 12.428 12.444
TIME   57   1171   1172   1173   1174   1175   1176   1177   1178   1179   1180   1181   1182   1183   1184
RAIN   57 12.460 12.477 12.492 12.506 12.521 12.536 12.550 12.563 12.576 12.588 12.602 12.616 12.631 12.645
TIME   71   1185   1186   1187   1188   1189   1190   1191   1192   1193   1194   1195   1196   1197   1198
RAIN   71 12.659 12.674 12.688 12.702 12.721 12.740 12.753 12.766 12.780 12.793 12.806 12.819 12.832 12.846
TIME   85   1199   1200   1201   1202   1203   1204   1205   1206   1207   1208   1209   1210   1211   1212
RAIN   85 12.859 12.872 12.885 12.898 12.910 12.923 12.936 12.949 12.962 12.974 12.987 13.000 13.012 13.025
TIME   99   1213   1214   1215   1216   1217   1218   1219   1220   1221   1222   1223   1224   1225   1226
RAIN   99 13.038 13.050 13.062 13.075 13.088 13.100 13.112 13.125 13.138 13.150 13.162 13.175 13.188 13.200
TIME  113   1227   1228   1229   1230   1231   1232   1233   1234   1235   1236   1237   1238   1239   1240
RAIN  113 13.212 13.225 13.238 13.250 13.262 13.273 13.285 13.297 13.308 13.320 13.332 13.343 13.355 13.367
TIME  127   1241   1242   1243   1244   1245   1246   1247   1248   1249   1250   1251   1252   1253   1254
RAIN  127 13.378 13.390 13.402 13.413 13.425 13.437 13.448 13.460 13.472 13.483 13.495 13.507 13.518 13.530
TIME  141   1255   1256   1257   1258   1259   1260   1261   1262   1263   1264   1265   1266   1267   1268
RAIN  141 13.542 13.553 13.565 13.577 13.588 13.600 13.610 13.621 13.632 13.642 13.652 13.663 13.674 13.684
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TIME  155   1269   1270   1271   1272   1273   1274   1275   1276   1277   1278   1279   1280   1281   1282
RAIN  155 13.694 13.705 13.716 13.726 13.736 13.747 13.758 13.768 13.778 13.789 13.800 13.810 13.820 13.831
TIME  169   1283   1284   1285   1286   1287   1288   1289   1290   1291   1292   1293   1294   1295   1296
RAIN  169 13.842 13.852 13.862 13.873 13.884 13.894 13.904 13.915 13.926 13.936 13.946 13.957 13.968 13.978
TIME  183   1297   1298   1299   1300   1310   1320   1330   1340   1350   1360   1370   1380   1390   1400
RAIN  183 13.988 13.999 14.010 14.020 14.110 14.200 14.290 14.380 14.450 14.520 14.590 14.660 14.730 14.800
TIME  197   1420   1440   1460   1500
RAIN  197 14.900 15.000 15.000 15.000
MASSCRV T 01 T01 8.00
TIME    1      0    100    200    300    400    500    600    700    800    900   1000   1050   1100   1110
RAIN    1  0.000  0.100  0.280  0.510  0.810  1.180  1.640  2.175  2.770  3.470  4.340  4.784  5.311  5.426
TIME   15   1120   1130   1131   1132   1133   1134   1135   1136   1137   1138   1139   1140   1141   1142
RAIN   15  5.560  5.701  5.716  5.731  5.746  5.761  5.776  5.798  5.820  5.842  5.864  5.886  5.913  5.940
TIME   29   1143   1144   1145   1146   1147   1148   1149   1150   1151   1152   1153   1154   1155   1156
RAIN   29  5.966  5.993  6.020  6.050  6.080  6.111  6.146  6.195  6.290  6.400  6.490  6.520  6.540  6.556
TIME   43   1157   1158   1159   1160   1161   1162   1163   1164   1165   1166   1167   1168   1169   1170
RAIN   43  6.572  6.588  6.604  6.620  6.631  6.642  6.653  6.664  6.675  6.686  6.697  6.708  6.719  6.730
TIME   57   1171   1172   1173   1174   1175   1176   1177   1178   1179   1180   1181   1182   1183   1184
RAIN   57  6.740  6.750  6.760  6.770  6.780  6.790  6.800  6.810  6.820  6.830  6.840  6.850  6.860  6.870
TIME   71   1185   1186   1187   1188   1189   1190   1191   1192   1193   1194   1195   1196   1197   1198
RAIN   71  6.880  6.890  6.900  6.910  6.920  6.930  6.938  6.947  6.956  6.964  6.972  6.981  6.990  6.998
TIME   85   1199   1200   1201   1202   1203   1204   1205   1206   1207   1208   1209   1210   1211   1212
RAIN   85  7.006  7.015  7.024  7.032  7.040  7.049  7.058  7.066  7.074  7.083  7.092  7.100  7.107  7.114
TIME   99   1213   1214   1215   1216   1217   1218   1219   1220   1221   1222   1223   1224   1225   1226
RAIN   99  7.121  7.128  7.135  7.142  7.149  7.156  7.163  7.170  7.177  7.184  7.191  7.198  7.205  7.212
TIME  113   1227   1228   1229   1230   1231   1232   1233   1234   1235   1236   1237   1238   1239   1240
RAIN  113  7.219  7.226  7.233  7.240  7.246  7.252  7.258  7.264  7.270  7.276  7.282  7.288  7.294  7.300
TIME  127   1241   1242   1243   1244   1245   1246   1247   1248   1249   1250   1251   1252   1253   1254
RAIN  127  7.306  7.312  7.318  7.324  7.330  7.336  7.342  7.348  7.354  7.360  7.366  7.372  7.378  7.384
TIME  141   1255   1256   1257   1258   1259   1260   1261   1262   1263   1264   1265   1266   1267   1268
RAIN  141  7.390  7.396  7.402  7.408  7.414  7.420  7.426  7.431  7.436  7.442  7.448  7.453  7.458  7.464
TIME  155   1269   1270   1271   1272   1273   1274   1275   1276   1277   1278   1279   1280   1281   1282
RAIN  155  7.470  7.475  7.480  7.486  7.492  7.497  7.502  7.508  7.514  7.519  7.524  7.530  7.536  7.541
TIME  169   1283   1284   1285   1286   1287   1288   1289   1290   1291   1292   1293   1294   1295   1296
RAIN  169  7.546  7.552  7.557  7.563  7.568  7.574  7.580  7.585  7.590  7.596  7.602  7.607  7.612  7.618
TIME  183   1297   1298   1299   1300   1310   1320   1330   1340   1350   1360   1370   1380   1390   1400
RAIN  183  7.624  7.629  7.634  7.640  7.680  7.720  7.760  7.800  7.825  7.850  7.875  7.900  7.925  7.950
TIME  197   1420   1440   1460   1500
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EXHIBIT 20A. TC CALCULATION FORM FOR HAND CALCULATIONS- PART 1

VENTURA COUNTY WATERSHED PROTECTION DISTRICT

TIME OF CONCENTRATION CALCULATION FORM

PROJECT _____ PROJECT NO. _____ RAINFALL ZONE _____

COMPUTED _____ DATE _____

SUBAREA _____ SOIL No. _____ RAINFALL FREQUENCY _____

Infil. Rate in/hr

TOTAL AREA _____ ac % IMPERVIOUS _____ TYPE DEVELOPMENT _____ SHEET ____ OF ____

ASSUMPTION NO.	T_c (min.)	INTENSITY (in./hr.)	C-coeff	AREA (acres)	Q (cfs)
1					
2					

FINAL T_C =		min.

IDENT. NO.	AREA PLAN.		ACRES	% OF AREA	Q-Trial 1 (cfs)	Q-Trial 2 (cfs)
a					0.0	0.0
b					0.0	0.0
c					0.0	0.0
d					0.0	0.0
e					0.0	0.0
TOTAL			0.0	0%	0.0	0.0

TRIAL NO.	Length ft	Elev. Top	Elev. Bott.	SLOPE		EFFEC. SLOPE	VELOCITY		LENGTH (ft.)		TIME (min.)
1											
2											

CONVEYANCE	TRIALS 1	2	3
LOT/OVERLAND	0.00	0.00	
NATURAL CHAN.			
STREET	0.00	0.00	
PIPE			
RECT CHANNEL			
TRAP CHANNEL			
TOTAL	0.0	0.0	

MOUNTAIN OVERLAND FLOW VELOCITY CHECK

VEL. CHECK	SLOPE THRU REACH	EFFEC. SLOPE	VELOCITY<6.0 fps

LENGTH (ft.)	ELEVATION TOP	BOT.	Δ

MOUNTAIN OR VALLEY CHANNEL ROUTING

REACH	LENGTH (ft.)	ELEVATION TOP	BOT.	Δ	SLOPE MAP	EFFEC.	Q (cfs) TOP	BOT.	VELOCITY TOP	BOT.	AVE.	WAVE	TIME (min.)
Trial 1													
Trial 2													

STREET TRIAL 1 WIDTH _____ CURB HEIGHT _____

REACH	LENGTH (ft.)	ELEVATION TOP	BOT.	Δ	SLOPE MAP	EFFEC.	Q (cfs) TOP	BOT.	VELOCITY TOP	BOT.	AVE.	WAVE	TIME (min.)
1													
2													
3													
												Sum	

STREET TRIAL 2 WIDTH _____ CURB HEIGHT _____

REACH	LENGTH (ft.)	ELEVATION TOP	BOT.	Δ	SLOPE MAP	EFFEC.	Q (cfs) TOP	BOT.	VELOCITY TOP	BOT.	AVE.	WAVE	TIME (min.)
1													
2													
3													

PIPE

$d^{8/3} = \frac{Qn}{S^{1/2} \times 0.463}$ = _____ = _____ d = _____ ft USE D = _____ ft

$Q_{full} = \frac{Kd^{8/3} \times S^{1/2}}{n} = \frac{0.463 \times d^{8/3} \times S^{1/2}}{0.012}$ = _____ = _____ c.f.s.

AREA = $\frac{\Pi d^2}{4}$ = _____ = _____ ft.^{2} Vn = $\frac{Q_{full}}{AREA}$ = _____ = _____ ft./sec.

REACH	LENGTH (ft.)	ELEVATION TOP	BOT.	SLOPE	Q (cfs) TOP	BOT.	Qave cfs	DIA. (ft)	Nom DIA.	n	FULL PIPE K	Q	V	%Q	%V_W	V_W	TIME (min.)
1																	
2																	

RECTANGULAR-TRAPEZOIDAL CHANNEL

			Type		Width	2	ft	Sideslope		0	H:	1V	N Value	0.015		
REACH	LENGTH (ft.)	ELEVATION TOP	BOT.	Δ	SLOPE MAP	EFFEC.	Q (cfs) TOP	BOT.	Calc. Q Top	Bott.						
Trial 1																
Trial 2																

Normal Depth (ft)	Mean Depth	VELOCITY	TIME

EXHIBIT 20B. TC CALCULATION FORM FOR HAND CALCULATIONS- PART 2

VENTURA COUNTY WATERSHED PROTECTION DISTRICT

TIME OF CONCENTRATION CALCULATION FORM

PROJECT _____ PROJECT NO. _____ RAINFALL ZONE _____

COMPUTED _____ DATE _____

SUBAREA _____ SOIL No. _____ RAINFALL FREQUENCY _____

Infil. Rate _____ in/hr

TOTAL AREA _____ ac % IMPERVIOUS _____ TYPE DEVELOPMENT _____ SHEET ____ OF ____

Subarea Figure showing:
1. Subarea boundary
2. Scale
3. North Arrow
4. Topography or elevations used for slope calculations
5. Development
6. Flowpaths and associated subarea portions with labels

APPENDIX B - TIME OF CONCENTRATION CALCULATION EXAMPLES AND YIELD ADJUSTMENT

B-1. EXAMPLE 1- LAS POSAS-FORTUNA TRACT

1. Subarea Boundaries- Carefully outline the drainage boundary on a topographic map. With reference to other larger scale maps, known improvement plans, and planned improvements, decisions governed by topography alone must be adjusted to reflect an ultimate drainage boundary. The study watershed used in this example is shown in Exhibit B-1.1

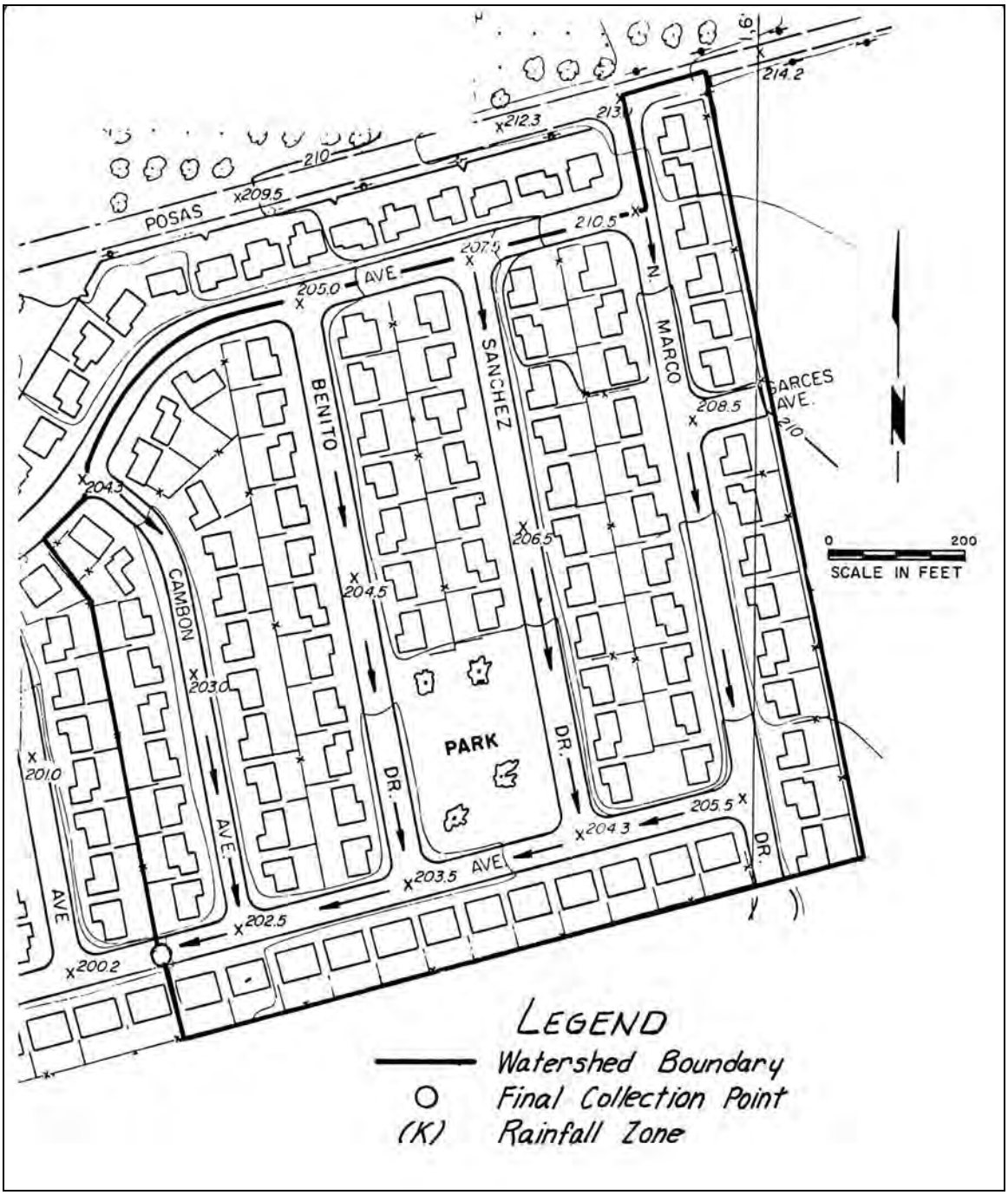
2. Field Verification- Verify boundary correctness by a field trip to the area and incorporate any changes on the map.

3. Rainfall and Soil Zones- From the hydrologic maps and GIS files in Appendix E, determine the dominant rainfall intensity zones for the study watershed. Indicate this zone on the watershed map. From the same hydrologic map, evaluate the soil types of the project watershed using an overlay or the provided GIS shapefile.

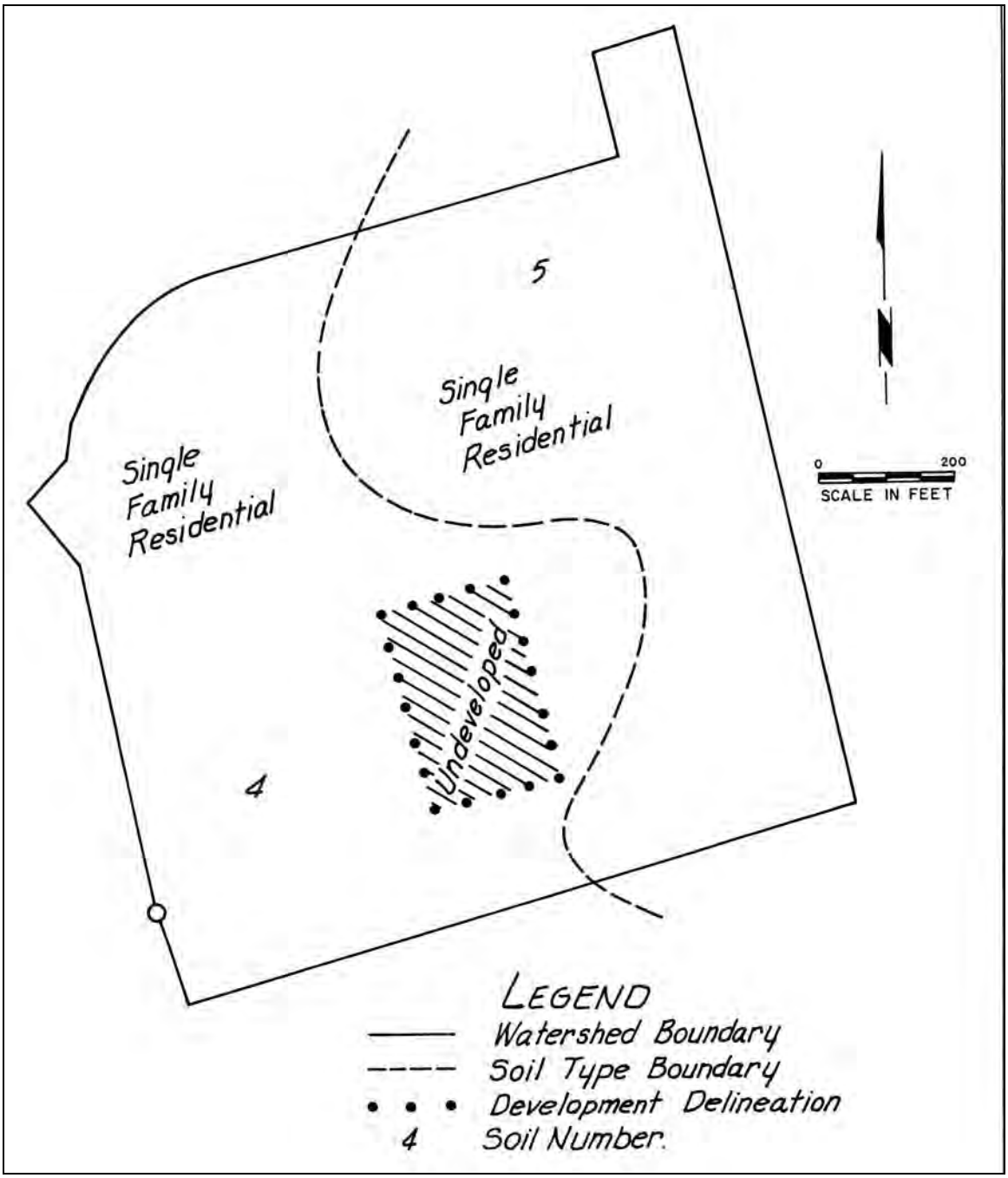
4. Future Land Use- Determine anticipated ultimate development from best sources available (current zoning, Planning Department master plans, development trends in surrounding area). Undeveloped, single family residential, and commercial development types describe most areas with occasional classifications of heavy industrial or large estate lots.

5. Percent Imperviousness- Calculate percent impervious values for your development. Assign effective imperviousness percentages to each development type using the values in Exhibit 14a&b.

B-1.1 Example 1- Las Posas-Fortuna Tract Watershed Map



B-1.2 Soils and Development Map



6. Watershed Area- Planimeter or use GIS to calculate the area associated with each soil and development type combination and indicate as shown in Appendix B-1.3.

7. Composite Runoff Coefficient- Calculate composite runoff coefficient curve as shown in Appendix B-1.3, by first listing the appropriate runoff coefficients for selected rainfall intensities from Exhibits 6a-g. The composite runoff coefficient is weighted according to the drainage area of each soil and development classification. Plot composite runoff coefficient curve as shown in Appendix B-1.4.

8. Compute the time of concentration for the watershed using the form for hand calculations shown in Exhibit 20 or use the Tc Calculator Program described above. This trial-and-error hand computation includes the following general procedures:

a. Using engineering judgment, select a time of concentration for the project watershed. From the appropriate rainfall intensity-duration table, Exhibits 2a-5d, select the peak period intensity for the duration equal to the assumed time of concentration. Using the selected rainfall intensity, find an appropriate runoff coefficient "C" from the composite runoff coefficient curve from Exhibits 6a-g. Solve Q=CIA for an initial peak flow estimate.

b. Divide the project watershed into several contributing parts by streets, topographic barriers, or fence lines, and proportion the initial flow rate to the various parts by area.

c. Start at most remote point in the project watershed, select an appropriate parcel, and assign an overland flow velocity (Exhibit 8). Using street velocity-discharge-slope graphs (Exhibits 11a-d), pipe or channel hydraulic tables (not provided- use Manning's Equation), compute flow velocities from collection point to collection point gathering discharge on your selected path to the point of concentration. Average velocity is increased to wave velocity in streets and natural channels by a factor of 1.5. Pipe and trapezoid channel wave velocities are provided in Exhibits 12a-c.

d. Compute and sum travel times associated with lot, street, and pipe or channel flow. Compare to assumed.time of concentration. If original assumption was incorrect, select a revised time of concentration, compute a new peak flow rate, distribute as before, and determine revised travel time.

e. When the computed travel time equals the estimated time of concentration within 0. 5 minutes, the associated discharge represents the desired peak flow rate.

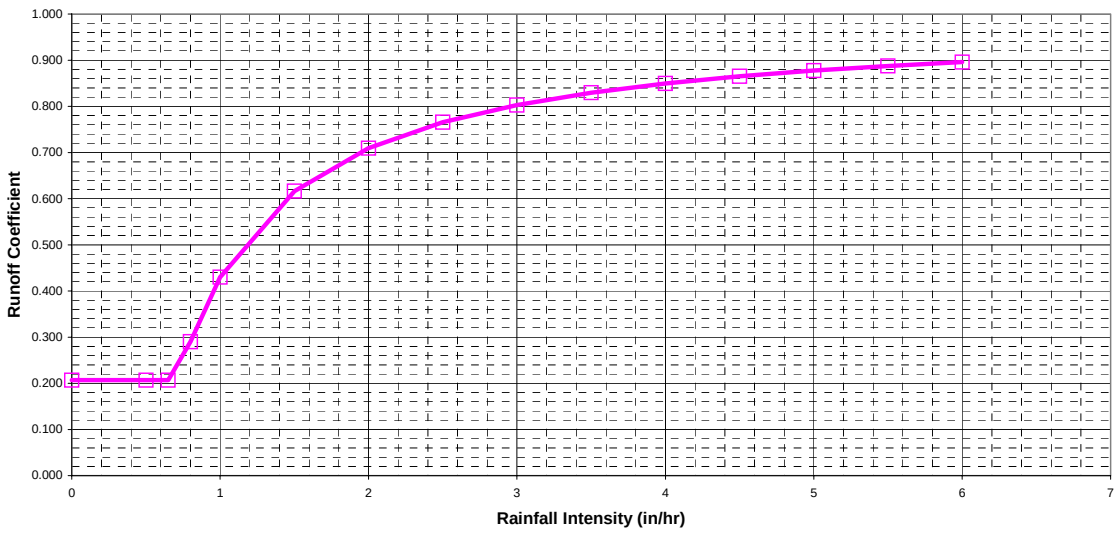
A detailed discussion of the Tc calculation procedures is provided in the Tc Calculator Manual provided with the program.

B-1.3 Composite Runoff Coefficient Curve Data

	Soil Number						
	4			5			
	Undeveloped	Single Family 1/4 ac. lots	Commercial	Undeveloped	Single Family 1/4 ac. lots	Commercial	
	Effective Imperviousness (%)						
	0	23	-	-	23	-	
	Land Use Area (ac)						Total Area
	1.3	12.2	-	-	10.5	-	24.0
	Percent of Total Area (%)						Total Percent
	5.4	50.8	-	-	43.8	-	100.0
	Pervious Area Infiltration Rate (in/hr)						
	0.65			0.80			
Intensity (in/hr)	Runoff Coefficients						Composite Runoff Coeff.
0	0.000	0.219	-		0.219	-	0.207
0.5	0.000	0.219	-		0.219	-	0.207
0.65	0.000	0.219	-		0.219	-	0.207
0.8	0.188	0.363	-		0.219	-	0.290
1	0.350	0.488	-		0.373	-	0.430
1.5	0.567	0.655	-		0.578	-	0.616
2	0.675	0.738	-		0.681	-	0.710
2.5	0.740	0.788	-		0.742	-	0.765
3	0.783	0.822	-		0.783	-	0.803
3.5	0.814	0.846	-		0.813	-	0.829
4	0.838	0.863	-		0.835	-	0.849
4.5	0.856	0.877	-		0.852	-	0.865
5	0.870	0.888	-		0.865	-	0.877
5.5	0.882	0.898	-		0.877	-	0.887
6	0.892	0.905	-		0.886	-	0.896

Sample Calculation for Intensity = 2.0 in/hr:
Composite C=(0.675*5.4/100)+(0.738*50.8/100)+(0.681*43.8/100) = 0.710

B-1.4 Composite Runoff Coefficient Curve



B-2 EXAMPLE 1 (CONT.) - CALCULATING A RUNOFF HYDROGRAPH

If only an instantaneous peak flow rate is desired at the reference point, the peak flow can be computed with A=CIA using the appropriate intensity and runoff coefficient. However, if flood routing is necessary, or a flood-detention basin is to be sized for a small development, a runoff hydrograph will need to be computed. The procedure continues as follows.

1. Using an appropriate tabulation of rainfall intensities selected from 2a-5d, tabulate intensity for selected storm times as shown in Exhibit B-2.1.

2. Using the composite runoff coefficient curve for the watershed, tabulate as shown in Exhibit B-2.1 the runoff coefficient for each intensity value.

3. Compute the flow rate for each storm time using the rational equation and plot the resulting runoff hydrograph as shown in Exhibit B-2.3.

4. Calculate the area under the hydrograph and convert to runoff volume in inches as shown in Exhibit B-2.2, and compare with the 24-hour rainfall amount at the centroid of the watershed as shown in the isohyetal maps in Appendix E. Expected runoff volume can be estimated from nearby raingage and streamflow records if available. Expected volume can also be estimated from synthetic rainfall-runoff relationships such as the Soil Conservation Service method for computing runoff using 24-hour rainfall and an appropriate runoff curve number as described in Section 4.

5. If the percentage of runoff is less than the expected volume from that watershed, the hydrograph should be adjusted using a technique similar to that shown in Exhibit B-2.2. The adjustment procedure is as follows:

    a. Compute a runoff coefficient curve adjustment factor by determining the ratio of desired yield to actual yield.

    b. Adjust the runoff coefficient curve using the adjustment factor, and plot a new curve as shown in Exhibit B-2.1.

    c. Using the peak flow determined above, compute C*I in cfs/acre.

    d. From the adjusted runoff coefficient curve, find a combination of C and I such that their product equals the value determined in c., above.

    e. From the appropriate intensity-duration curve, select a revised duration corresponding to the average rainfall intensity determined in d. and use as a revised time of concentration for the watershed.

    f. As shown in Exhibit B-2.1, tabulate adjusted rainfall intensities, adjusted runoff coefficients, and compute an adjusted runoff hydrograph.

6. Plot the adjusted hydrograph and check its runoff volume as shown in Exhibit B-2.3

B-2.1 Hydrograph and Hydrograph Adjustment Calculations

K Zone 10-Year Recurrence Storm								
Storm Time (min)	Rainfall Intensity (in/hr) Tc=15 min	Runoff Coefficient C	Q=CIA (cfs) A=24 ac	Incremen-tal Hydro-graph Volume (ac-ft)	Rainfall Intensity (in/hr) Tc=22 min	Adjusted Runoff Coeff C(P)	Qadj = Cadj I A (cfs) A=24 ac	Incremen-tal Hydro-graph Volume (ac-ft)
0	0.00	0.207	0.00		0	0.256	0.00	
200	0.07	0.207	0.35	0.05	0.07	0.256	0.43	0.06
400	0.10	0.207	0.50	0.12	0.10	0.256	0.62	0.14
600	0.15	0.207	0.74	0.17	0.15	0.256	0.92	0.21
900	0.28	0.207	1.39	0.44	0.28	0.256	1.72	0.55
1000	0.39	0.207	1.93	0.23	0.39	0.256	2.40	0.28
1050	0.43	0.207	2.13	0.14	0.43	0.256	2.65	0.17
1100	0.47	0.207	2.33	0.15	0.47	0.256	2.89	0.19
1110	0.55	0.207	2.73	0.03	0.53	0.256	3.26	0.04
1120	0.63	0.207	3.12	0.04	0.61	0.256	3.75	0.05
1130	0.66	0.212	3.36	0.04	0.65	0.263	4.11	0.05
1140	0.82	0.304	5.99	0.06	0.77	0.377	6.98	0.08
1145	0.97	0.409	9.52	0.05	0.87	0.508	10.60	0.06
1150	1.28	0.534	16.42	0.09	1.12	0.663	17.82	0.10
1152	1.83	0.678	29.77	0.06	1.53	0.841	30.89	0.07
1154	2.04	0.714	34.96	0.09	1.68	0.886	35.72	0.09
1156	2.02	0.712	34.51	0.10	1.68	0.883	35.61	0.10
1158	1.98	0.706	33.54	0.09	1.68	0.876	35.31	0.10
1160	1.95	0.700	32.77	0.09	1.67	0.869	34.83	0.10
1162	1.86	0.683	30.51	0.09	1.63	0.848	33.18	0.09
1166	1.31	0.546	17.15	0.13	1.53	0.677	24.86	0.16
1170	0.66	0.212	3.36	0.06	1.39	0.263	8.79	0.09
1175	0.53	0.207	2.63	0.02	0.64	0.256	3.94	0.04
1180	0.48	0.207	2.38	0.02	0.54	0.256	3.32	0.03
1200	0.40	0.207	1.98	0.06	0.40	0.256	2.46	0.08
1225	0.30	0.207	1.49	0.06	0.33	0.256	2.03	0.08
1300	0.20	0.207	0.99	0.13	0.20	0.256	1.23	0.17
1400	0.09	0.207	0.45	0.10	0.09	0.256	0.55	0.12
1440	0.06	0.207	0.30	0.02	0.06	0.256	0.37	0.03
			Total				Total	
			Vol (ac-ft)	2.74			Vol (ac-ft)	3.33

B-2.2 Hydrograph Volume Adjustment Steps

Hydrograph Volume Adjustment

1. Watershed Yield
Areally Weighted CN=73.5
From Contour Map, 10Yr Rainfall= 4.3 inches
From SCS Direct Runoff Figure, Runoff = 1.7 inches
Watershed Yield = 1.7/4.3=0.395 or 0.40

2. Hydrograph Volume, Tc=15 min= 2.74 ac-ft
Yield (24 ac) = 1.370 inches

3. Desired Yield Adjustment Factor
P=Desired Yield/Actual Yield = 1.7/1.37 = 1.24

4. Calculate (CI) for Peak Q
CI= Q/A= 2.04 in/hr * 0.714 = 1.46 cfs/ac

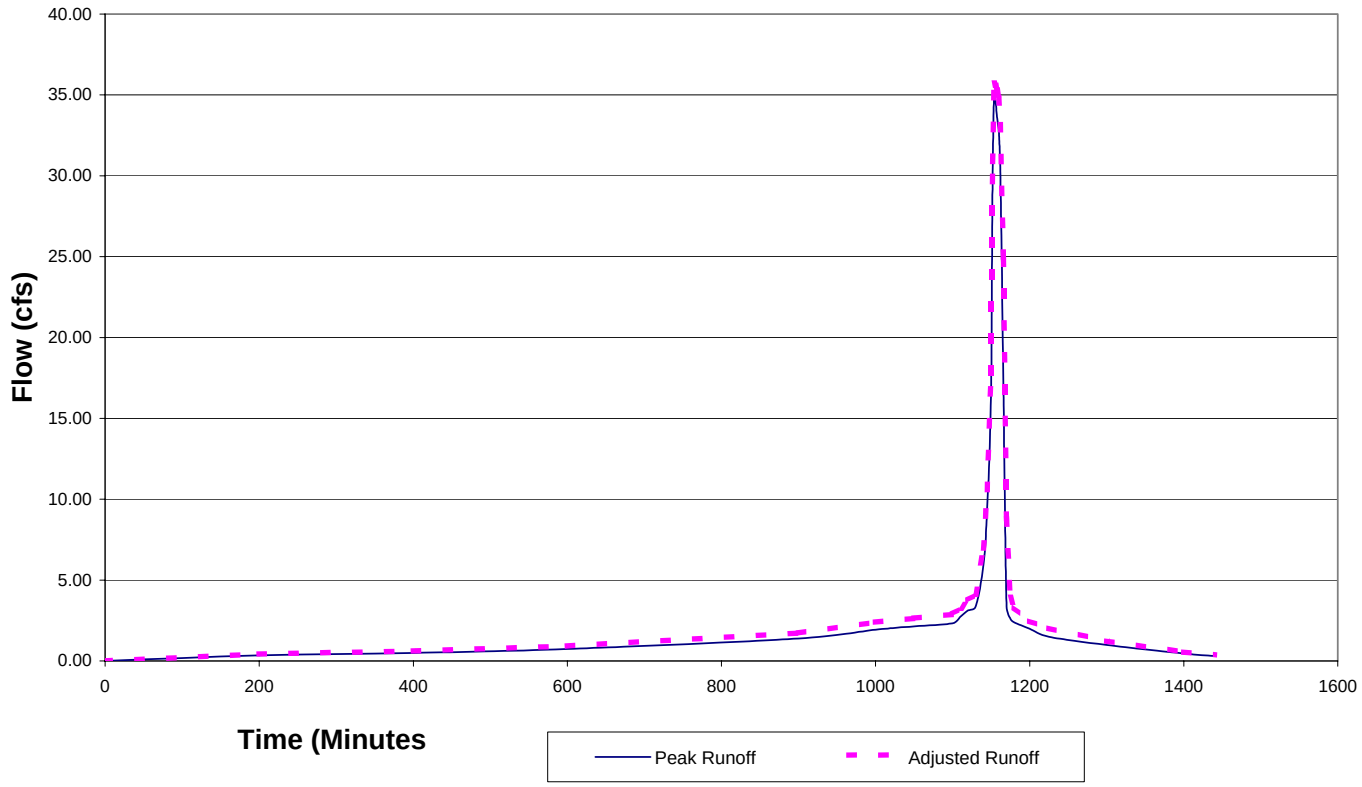
5. Increase C Coefficients By Adjustment Factor

6. Find intensity with increased C that gives same CI
Max C= 0.886024
I= C*I/C=1.46/0.886= 1.644 in/hr

7. Find Tc on K Zone 10-Yr Intensity Table with peak intensity
Tc= 22 min

8. Recalculate Q's Using
C from adjusted runoff coeffient curve
I for Tc= 22 min
Area as above (24 ac)

B-2.3 Runoff Hydrograph with Adjustment



B-3 EXAMPLE 2 - VCRAT PROGRAM USE FOR MULTIPLE SUBAREAS

1. Watershed Delineation- Carefully outline the drainage boundary on a topographic map. With reference to other larger scale maps, known improvement plans, and planned improvements, decisions governed by topography alone must be adjusted to reflect an ultimate drainage boundary.

2. Field Verification- Verify drainage boundary map with a field trip to the area and incorporate any changes on the map.

3. Subarea Delineation- Divide the watershed into subareas ranging from 40 to 80 acres in size. Where areas tributary to the main collector channel exceed the maximum size, a separate lateral channel is delineated and the contributing area is also subdivided.

4. Beginning with the point of concentration of the hydraulically most remote subarea, assign a number representing each point in the drainage system where a Q is to be determined. The main channel is designated the "A"-line and subareas are numbered sequentially in VCRat 2.2 (i. e., lA, 2A, 3A, etc.).

5. Laterals are assigned a letter from B to F preceded by the next number in sequence (i.e., llB, 12B, 14C, etc.).

6. At a lateral-main line confluence, the next number in sequence is followed by letters representing both lines, with the primary channel listed first (i. e. l6AB).

7. Using the hydrologic maps or GIS files in Appendix E, prepare a soils overlay of the watershed. Place the soils map over the watershed and determine which soil type is dominant in each subarea.

8. Determine anticipated ultimate development from best sources available (current zoning, Planning Department master plans, development trends in surrounding area). Undeveloped, single family residential and commercial development should encompass most areas, with occasional classifications of heavy industrial or large estate lots. Prepare land-use map of watershed.

9. Assign an impervious percentage to each development using the general classifications in Exhibit 15. When a subarea has more than one development type, a weighted average imperviousness should be determined.

10. Planimeter or use GIS to calculate the area of each subarea and check by totaling all subareas and comparing with the total watershed area.

11. From provided maps or shapefiles, determine the appropriate rainfall intensity zone.

12. Using the form and the hand-calculation procedures described above or Tc calculator program, compute time of concentration for all subareas.

13. Determine the length and average slope of conveyance channels between collection points.

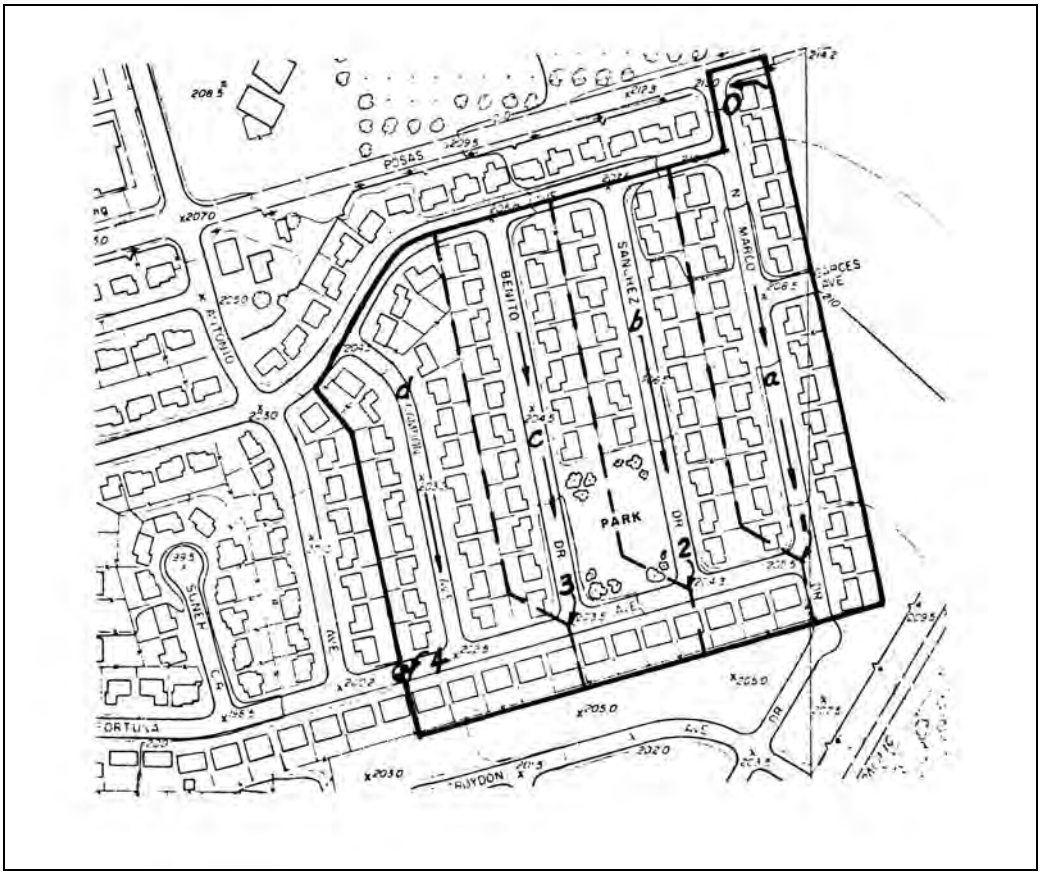
14. Sufficient watershed data is now available to code the input for VCRat 2.2 or VCRat 2.5. A detailed description of input data for each column is included in Appendix C. An input data line is needed for each subarea and confluence with sufficient data listed for the computation of a runoff hydrograph and flood routing of each hydrograph through the indicated conveyance channel. To clear the hydrograph memory at the start of a run, a letter G should be placed in Column 64, Row 1, in the first 006 data line for each VCRat 2.2 job. Place a number 1 in Column 63 in each row where confluence flow and timing data are required, and in Column 62 in each row where a printed hydrograph is desired. A page heading data line, is needed for each job that will clearly identify the job, and for each point at which a hydrograph has been specified.

15. Data input for the seven runoff coefficient curves are included as input for the program in the default file VCRAIN.DAT. If composite runoff coefficient curves are needed for a watershed, they should be calculated and entered in the VCRAIN.DAT file.

Computer input and output for an example watershed are provided in Appendix D.

NOTE: The VCRat programs perform complex channel routing calculations with wave velocity so that it is not possible to reproduce the results of the VCRat model by hand at this time. If several subareas are modeled and require channel routing, the hydrologist much obtain the VCRat program from the District in order to perform the design study correctly.

B-3.1 Multiple Subarea Watershed- Las Posas



VENTURA COUNTY WATERSHED PROTECTION DISTRICT
TIME OF CONCENTRATION
Project: Las Posas Manual Example
Date: 8/18/06
Engineer: TMB
Consultant: VCWPD

Watershed Name: Las Posas

Sub-Area Name: Single Family and Park
Tc: 15.003 Minutes
DATA FOR SUB AREA 1

SUB AREA TIME OF CONCENTRATION: 15.003 min. = 15 min.

SUB AREA INPUT DATA

Sub Area Name: Single Family and Park
Total Area (ac): 24
Flood Zone: 3
Rainfall Zone: K
Storm Frequency (years): 10
Development Type: Residential

Soil Type: 4.00
Percent Impervious: 23
SUB AREA OUTPUT

Intensity (in/hr): 2.044
C Total: 0.720
Sum Q Segments (cfs): 35.31
Q Total (cfs): 35.31
Sum Percent Area (%): 100.0
Sum of Flow Path Travel Times (sec): 900.17
Time of Concentration (min): 15.003

DATA FOR FLOW PATH 1

Flow Path Name: Overland
FLOW PATH TRAVEL TIME (min): 5.7681
Flow Type: Overland
Length (ft): 140
Top Elevation (ft): 214
Bottom Elevation (ft): 213
Percent of Sub-Area: 5
Overland Type: Valley
Development Type: Residential
Map Slope: 0.0071
Effective Slope: 0.0071
Q (cfs): 1.77
Avg Velocity (ft/s): 0.40

DATA FOR FLOW PATH 2

Flow Path Name: Subarea A
FLOW PATH TRAVEL TIME (min): 5.5823
Flow Type: Street
Length (ft): 1040
Top Elevation (ft): 213
Bottom Elevation (ft): 205.5
Percent of Sub-Area: 18
Street Width (ft): 32
Curb Height (in): 6
Map Slope: 0.0072
Q (cfs): 6.36
Q Top (cfs): 1.77
Q Bottom (cfs): 8.12
Velocity Top (ft/s): 1.68
Velocity Bottom (ft/s): 2.46
Avg Velocity (ft/s): 2.07
Wave Velocity (ft/s): 3.11

DATA FOR FLOW PATH 3

Flow Path Name: Subarea B
FLOW PATH TRAVEL TIME (min): 1.1873
Flow Type: Street
Length (ft): 250

Top Elevation (ft): 205.5
Bottom Elevation (ft): 204.3
Percent of Sub-Area: 27
Street Width (ft): 32
Curb Height (in): 6
Map Slope: 0.0048
Q (cfs): 9.53
Q Top (cfs): 8.12
Q Bottom (cfs): 17.65
Velocity Top (ft/s): 2.11
Velocity Bottom (ft/s): 2.57
Avg Velocity (ft/s): 2.34
Wave Velocity (ft/s): 3.51

DATA FOR FLOW PATH 4

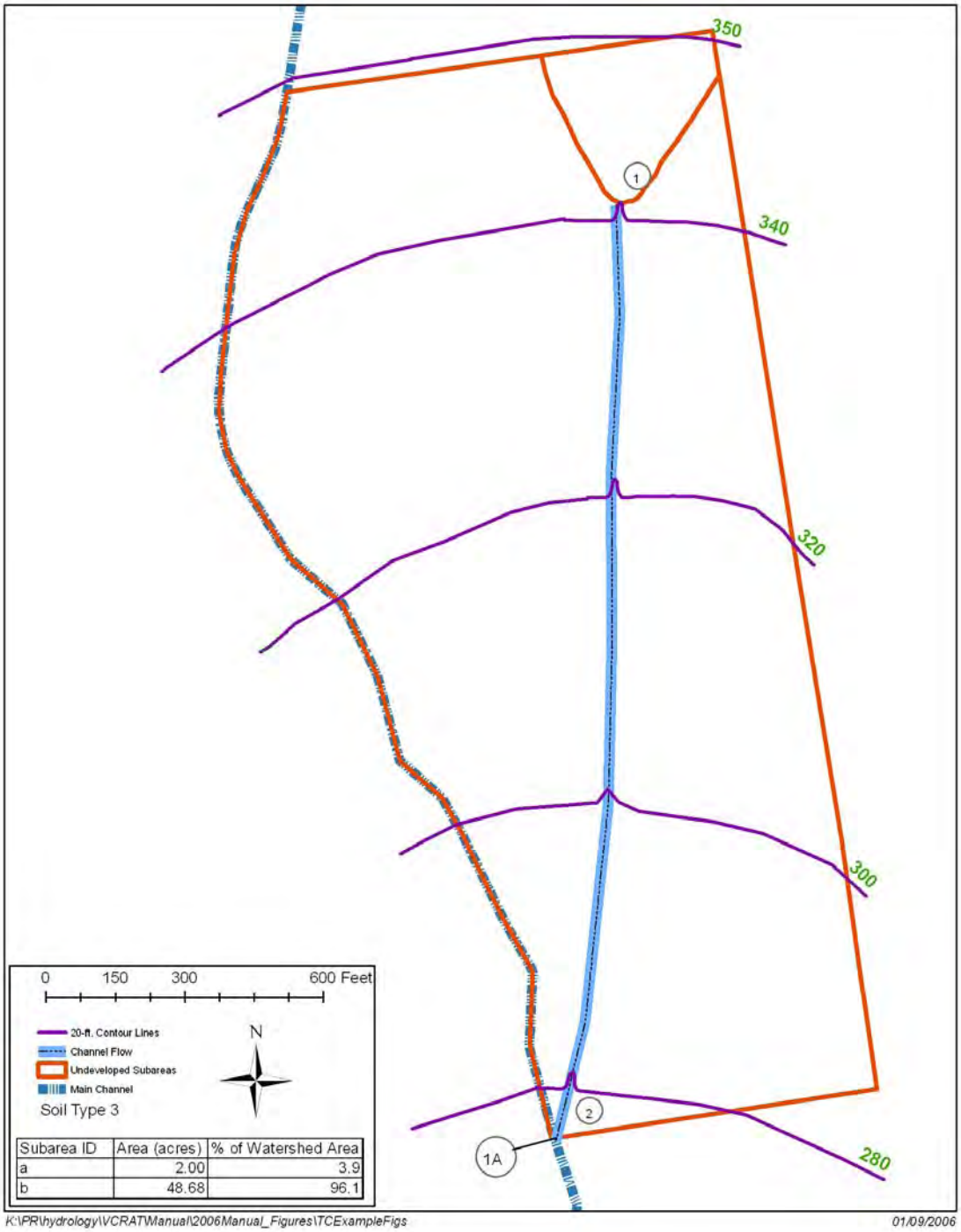
Flow Path Name: Subarea C
FLOW PATH TRAVEL TIME (min): 1.1988
Flow Type: Street
Length (ft): 250
Top Elevation (ft): 204.3
Bottom Elevation (ft): 203.5
Percent of Sub-Area: 24
Street Width (ft): 32
Curb Height (in): 6
Map Slope: 0.0032
Q (cfs): 8.47
Q Top (cfs): 17.65
Q Bottom (cfs): 26.13
Velocity Top (ft/s): 2.20
Velocity Bottom (ft/s): 2.43
Avg Velocity (ft/s): 2.32
Wave Velocity (ft/s): 3.48

DATA FOR FLOW PATH 5

Flow Path Name: Subarea D
FLOW PATH TRAVEL TIME (min): 1.2663
Flow Type: Street
Length (ft): 370
Top Elevation (ft): 203.5
Bottom Elevation (ft): 201.2
Percent of Sub-Area: 26
Street Width (ft): 32
Curb Height (in): 6
Map Slope: 0.0062
Q (cfs): 9.18
Q Top (cfs): 26.13
Q Bottom (cfs): 35.31
Velocity Top (ft/s): 3.12
Velocity Bottom (ft/s): 3.37
Avg Velocity (ft/s): 3.25
Wave Velocity (ft/s): 4.87

B-4 EXAMPLE 3 UNDEVELOPED WATERSHED- CLARKE BARRANCA

B-4.1 Watershed Map



Subarea ID	Area (acres)	% of Watershed Area
a	2.00	3.9
b	48.68	96.1

K:\PR\hydrology\VCRAT\Manual\2006Manual_Figures\TCExampleFigs 01/09/2006

B-4.2 Tc Calculator Results

VENTURA COUNTY WATERSHED PROTECTION DISTRICT
TIME OF CONCENTRATION
Project: Clark Barranca - Tc Example 3
Date: 12:00:00 AM
Engineer: TMB
Consultant: VCWPD

Watershed Name: Watershed

Sub-Area Name: Clark Barranca
Tc: 12.186 Minutes
DATA FOR SUB AREA 1

SUB AREA TIME OF CONCENTRATION: 12.186 min. = 12 min.

SUB AREA INPUT DATA

Sub Area Name: Clark Barranca
Total Area (ac): 50.6
Flood Zone: 2
Rainfall Zone: K
Storm Frequency (years): 100
Development Type: Undeveloped
Soil Type: 3.00
Percent Impervious: 0
SUB AREA OUTPUT

Intensity (in/hr): 3.230
C Total: 0.788
Sum Q Segments (cfs): 128.72
Q Total (cfs): 128.72
Sum Percent Area (%): 100.0
Sum of Flow Path Travel Times (sec): 731.15
Time of Concentration (min): 12.186

DATA FOR FLOW PATH 1

Flow Path Name: Overland Area A
FLOW PATH TRAVEL TIME (min): 8.5319
Flow Type: Overland
Length (ft): 424
Top Elevation (ft): 350
Bottom Elevation (ft): 340

Percent of Sub-Area: 3.9
Overland Type: Valley
Development Type: Undeveloped
Map Slope: 0.0236
Effective Slope: 0.0236
Q (cfs): 5.02
Avg Velocity (ft/s): 0.83

DATA FOR FLOW PATH 2

Flow Path Name: Valley Channel
FLOW PATH TRAVEL TIME (min): 3.6539
Flow Type: Natural Channel
Length (ft): 2040
Top Elevation (ft): 340
Bottom Elevation (ft): 280
Percent of Sub-Area: 96.1
Overland Type: Valley
Map Slope: 0.0294
Effective Slope: 0.0294
Q (cfs): 123.70
Q Top (cfs): 5.02
Q Bottom (cfs): 128.72
Velocity Top (ft/s): 3.62
Velocity Bottom (ft/s): 8.79
Avg Velocity (ft/s): 6.20
Wave Velocity (ft/s): 9.31

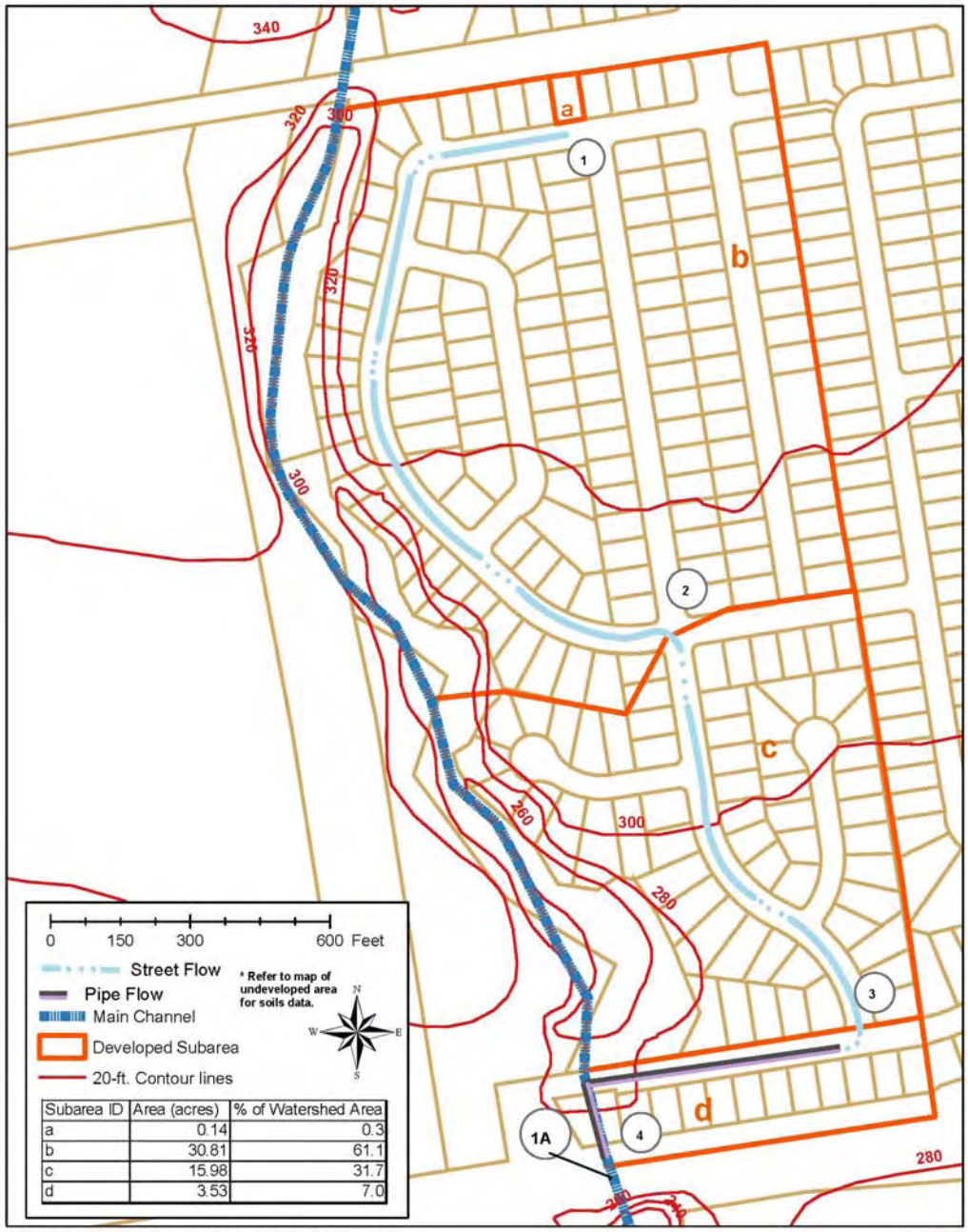
B-5 EXAMPLE 4 DEVELOPED WATERSHED- CLARKE BARRANCA

B-5.1 Aerial Map

Subarea ID	Area (acres)	% of Watershed Area
a	0.14	0.3
b	30.81	61.1
c	15.98	31.7
d	3.53	7.0

K:\PR\hydrology\VCRAT\Manual\2006Manual_Figures\TCExampleFigs 01/09/2007

B-5.2 Parcel Map



Subarea ID	Area (acres)	% of Watershed Area
a	0.14	0.3
b	30.81	61.1
c	15.98	31.7
d	3.53	7.0

K:\PR\hydrology\VCRAT\Manual\2006Manual_Figures\TCExampleFigs 01/09/2007

B-5.3 Tc Calculator Results

VENTURA COUNTY WATERSHED PROTECTION DISTRICT
TIME OF CONCENTRATION
Project: Clark Barranca - Tc Example 4
Date: 12:00:00 AM
Engineer: TMB
Consultant: VCWPD

Watershed Name: Watershed

Sub-Area Name: Clark Barranca
Tc: 8.288 Minutes
DATA FOR SUB AREA 1

SUB AREA TIME OF CONCENTRATION: 8.288 min. = 8 min.

SUB AREA INPUT DATA

Sub Area Name: Clark Barranca
Total Area (ac): 50.6
Flood Zone: 2
Rainfall Zone: K
Storm Frequency (years): 100
Development Type: Residential
Soil Type: 3.00
Percent Impervious: 50
SUB AREA OUTPUT

Intensity (in/hr): 3.953
C Total: 0.882
Sum Q Segments (cfs): 176.62
Q Total (cfs): 176.44
Sum Percent Area (%): 100.1
Sum of Flow Path Travel Times (sec): 497.27
Time of Concentration (min): 8.288

DATA FOR FLOW PATH 1

Flow Path Name: Overland Area A
FLOW PATH TRAVEL TIME (min): 2.0317
Flow Type: Overland
Length (ft): 100
Top Elevation (ft): 347
Bottom Elevation (ft): 345

Percent of Sub-Area: 0.3
Overland Type: Valley
Development Type: Residential
Map Slope: 0.0200
Effective Slope: 0.0200
Q (cfs): 0.53
Avg Velocity (ft/s): 0.82

DATA FOR FLOW PATH 2

Flow Path Name: Street Area B
FLOW PATH TRAVEL TIME (min): 4.4373
Flow Type: Street
Length (ft): 1750
Top Elevation (ft): 345
Bottom Elevation (ft): 310
Percent of Sub-Area: 61.1
Street Width (ft): 32
Curb Height (in): 6
Map Slope: 0.0200
Q (cfs): 107.81
Q Top (cfs): 0.53
Q Bottom (cfs): 108.34
Velocity Top (ft/s): 1.82
Velocity Bottom (ft/s): 6.94
Avg Velocity (ft/s): 4.38
Wave Velocity (ft/s): 6.57

DATA FOR FLOW PATH 3

Flow Path Name: Street Area C
FLOW PATH TRAVEL TIME (min): 1.3622
Flow Type: Street
Length (ft): 925
Top Elevation (ft): 310
Bottom Elevation (ft): 290
Percent of Sub-Area: 31.7
Street Width (ft): 32
Curb Height (in): 6
Map Slope: 0.0216
Q (cfs): 55.93
Q Top (cfs): 108.34
Q Bottom (cfs): 164.27
Velocity Top (ft/s): 7.15
Velocity Bottom (ft/s): 7.94

Avg Velocity (ft/s): 7.54
Wave Velocity (ft/s): 11.32

DATA FOR FLOW PATH 4

Flow Path Name: Pipe Area D
FLOW PATH TRAVEL TIME (min): 0.4567
Flow Type: Pipe
Length (ft): 600
Top Elevation (ft): 290
Bottom Elevation (ft): 280
Percent of Sub-Area: 7
Pipe Diameter (in): 48
Manning's N: 0.012
Map Slope: 0.0167
Q (cfs): 12.35
Q Top (cfs): 164.27
Q Bottom (cfs): 176.62
Avg Velocity (ft/s): 17.90
Wave Velocity (ft/s): 21.89

APPENDIX C VCRAT 2.2 PROGRAM INPUT DATA

VCRat 2.2 program input data must be included in the order shown except for the data marked as optional in the following list:

a. System Data.
b. Page Heading Data.
c. System Data.
d. Hydrograph Header Data. (Optional)
e. Hydrograph Data (Optional)
f. System Data.
g. Location Data.
h. Reservoir Routing and Yield Adjustment Data
i. System Data.
j. Runoff Coefficient Curve Data.
k. Rainfall Mass Curve Header Data.
l. Rainfall Mass Curve Data.
m. System Data.

VCRat 2.5 requires the same data but the Windows interfaces formats the input file for the modeler.

C.1 INPUT DATA PREPARATION

Page Heading Input Data (Code 005)- Required

Column	Entry	Description
1-3	005	Input code number.
4-9	integer	Job number to identify watershed or drain. For VCWPD models, this is the 5-digit project number associated with each jurisdictional channel.
10-14	integer	Identification point which must be identical to the most upstream point on the location layout sheet.
15-16	alphabetic	Drain label which must be identical to those indicated on location layout sheet Column..
17-80	alphanumeric	Description to be printed.

The end of the 005 input data is specified by entering 999 in the first three columns of the line after the last 005 data.

Hydrograph Data Header (Code 007) - Required

This line is required for all locations where the user wants import a hydrograph into the model.

Column	Entry	Description
1-3	007	Input code number.
4-9	integer	Job number to identify watershed or drain. For VCWPD, this is the 5-digit project number associated with each redline channel.
10-15	alphanumeric	Location number of point where hydrograph to be read in.
16-23	integer	Drainage area tributary to location in acres. If omitted the total watershed area of the model will be incorrect.

Column	Entry	Description
24-26	integer	Number of points used to define rising limb of hydrograph (point number of peak Q).
27-30	integer	Time of peak flow in minutes.
31-38	integer	Peak flow rate in cubic feet per second.
39-41	integer	Total number of points used to define hydrograph.
42-44	1	If first day of four-day design storm.
	2	If second day of four-day design storm.
	3	If third day of four-day design storm.
	4	If fourth day of four-day design storm.

Hydrograph Data (Code 008) Input

This input is required after 007 input data are provided.

Column	Entry	Description
1-3	008	Input code number.
4-6	integer	Maximum cumulative point number on each input line.
7-11	integer	Selected storm time in minutes.
12-20	integer	Instantaneous flow rate in cubic feet per second corresponding to storm time listed in Column 7-11.
20-24	integer	Selected storm time.
25-32	integer	Instantaneous flow rate corresponding to storm time listed in Column 20-24.
33-37	integer	Selected storm time.
38-45	integer	Instantaneous flow rate corresponding to storm time listed in Column 33-37.
46-50	integer	Selected storm time.
51-58	integer	Instantaneous flow rate corresponding to storm time listed in Column 46-50.
59-63	integer	Selected storm time.
64-71	integer	Instantaneous flow rate corresponding to storm time listed in Column 59-63.
Selected storm times may vary between 0 and 1500 minutes up to a maximum 200 points and must be listed chronologically. If default J through L zone rainfall mass curves are used, all hydrograph points for times described in the Exhibit 17 must be used. If A through I or T storm patterns are used, times to define a hydrograph must be the same times used to define the cumulative storm rainfall curve.		

The end of the 007 and 008 input is specified by entering 999 in the first three columns of the last 008 data line.

Location Data (Code 006) - Required

This data input line generally follows 005 input data, or 007 and 008 input lines if a hydrograph has been imported for use in the simulation. A line with 999 in the first three columns precedes the first 006 line signifying the end of the header data lines or hydrograph import section.

Column	Entry	Description
1-3	006	Input code number.
4-9	integer	Job number to identify watershed or drain.
10-14	integer	Location number or model ID of point in the watershed where a calculation is to be made. Location numbers must be listed in the sequence calculations are to be made and numbered sequentially from upstream to downstream without gaps.
15	A	If hydrograph in main line of the drainage system located in primary storage.
	B	If hydrograph in main line of the drainage system located in primary storage.
	C	If hydrograph in Lateral C located in primary storage.
	D	If hydrograph in Lateral D located in primary storage.
	E	If hydrograph in Lateral E located in primary storage.
	F	If hydrograph in Lateral F located in primary storage.
		The alphabetic code identifies the drain where flow rate is to be modified by: (1) addition of a hydrograph from a lateral or subarea; (2) separation of flow by junction with a relief drain; (3) flood routing and channel storage effects. A letter must be listed on each location data input line.
16	B	If hydrograph in principal Lateral B to be combined with hydrograph in the main line.
	C	If hydrograph in Lateral C to be combined with hydrograph in Line A or B.
	D	If hydrograph in Lateral D to be combined with hydrograph in Lines A, B or C.
	E	If hydrograph in Lateral E to be combined with hydrograph in Lines A, B, C, or D.
	F	If hydrograph in Lateral F to be combined with hydrograph in Lines A, B, C, D, or E.
		For relief drains (See Column 53-59.) the alphanumeric code indicates the lateral receiving flow separated from the primary drain.
17	integer	Place 0 in this column when one of seven standard runoff coefficient curves is used.
18	integer	When one of the seven standard runoff coefficient curves are used, place a number from 1 through 7 in this column.
19	integer	Place 0 in this column when one of seven standard runoff coefficient curves is used.
		When a composite runoff coefficient curve is used, any integer designation between 002 through 199 may be used in columns 17-19.
20-22	integer	Effective imperviousness of subarea in percent.
23-26	integer	Subarea tributary drainage in acres.
27-28	integer	Time of concentration in minutes. An arbitrary time for a zero acre subarea in Column 23-26 must be shown if flood routing through a reach with no tributary area is desired- 99 is typically used.
29	alphabetic	If storm pattern D through I for other than design storm rainfall to be used.
	J (or A)	If J or J' zone design storm rainfall pattern to be used. (For 100-year frequency rainfall use A; also for areal reduction runs.)
	K (or B)	If K zone design storm rainfall pattern to be used. (For 100-year frequency

Column	Entry	Description
		rainfall use B.)
	L (or C)	If L zone design storm rainfall pattern to be used. (For 100-year frequency rainfall use C, also for areal reduction runs.)
	T	If design thunderstorm rainfall pattern to be used. Also used for simulations to evaluate areal reduction for K Zone 50-yr storms
30-31	integer	If A through I storm pattern to be used, an identification number between 1 and 99 must also be used.
	01	If thunderstorm (convective storm) design rainfall pattern to be used. Also used for simulations to evaluate areal reduction for K zone 50-yr storms.
	10	If 10 - year frequency rainfall for J, K, L zone rainfall to be used.
	25	If 25 - year frequency rainfall for J, K, L zone rainfall to be used.
	50	If 50 - year frequency rainfall for J, K, L zone rainfall to be used.
	97	If 100-year frequency rainfall for A zone rainfall to be used.
	98	If 100-year frequency rainfall for B zone rainfall to be used.
	99	If 100-year frequency rainfall for C zone rainfall to be used.
32	integer	Specify the type of channel to use for routing to next confluence point
	1	If mountain channel reach to be used. (See Exhibit 9.)
	2	If natural valley channel reach to be used. (SeeExhibit 10)
	3	If typical 40-foot road width, 8-inch curb street to be used. (SeeExhibit 11d)
	4	If circular pipe to be used, or if street flow is undesirable.
	5	If rectangular or trapezoidal channel base width or depth to be specified. (Trapezoidal section side slope can be specified as well as Manning's n values.)
	6	If trapezoidal channel side slope, maximum peak velocity, and either width or depth to be specified. The trapezoidal channel (6) may involve composite lining with unlined bottom to facilitate channel percolation, or for economic or other design considerations. In steeper areas where scour of the channel bottom could occur, the system routes flow by adjusting channel slope as necessary (drop structures assumed) to not exceed the specified maximum velocity at peak flow rate in Cols 76-77. Specified values would be: (1) maximum velocity and maximum depth; or (2) maximum velocity and base width.
	blank	If the system is to begin flood routing in a street section and change from street to pipe section when flow depth reaches the property line, from pipe to rectangular channel when pipe diameter of 8 feet is exceeded, and from the hydraulically most efficient rectangular section to a maximum depth of 13 feet when that depth is reached. [This change in conveyance is also automatic if either street (3) or pipe (4, with no size listed) is specified].
33-37	integer	Length of channel reach between subarea collection points in feet.
38-43	numeric	Slope of drain in feet per foot. Decimal is not used but is assumed to be between columns 37 and 38.
44-46	numeric	If trapezoidal channel (5 or 6 in Column 32). Computed as horizontal projection of channel wall divided by depth in feet per foot. Decimal is not used but is assumed to be between columns 44 and 45.
	blank	If rectangular section.
47-52	numeric	If specified circular pipe diameter in feet is to be used (4 in Column 32). Decimal is not used but is assumed to be between columns 50 and 51.

Column	Entry	Description
	numeric	If specified bottom width of rectangular channel in feet is to be used (5 in Column 32).
	numeric	If specified bottom width of trapezoidal channel in feet is to be used (6 in Column32).
	blank	For channel types 1,2, and 3, or if you wish the program to size the appropriate channel for types 4, 5, or 6.
53-59	integer	Peak flow rate in cubic feet per second (no decimal) to remain in main line or lateral listed in Column 15 at junction with relief drain specified (3 or 4 in Column 60).
	integer	Flow rate to be used to as the basis to calculate a percent used to proportion hydrograph and transfer excess to relief drain (1 in Column 60).
	integer	Percent (no decimal) to be applied to hydrograph ordinate to proportion the hydrograph and transfer excess to relief drain (2 in Column 60).
60	1	If hydrograph in drain listed in Column 15 to be proportioned on percentage basis with residual flow transferred to relief drain listed in Column 16. Percentage is calculated by dividing flow number in Columns 53-59 by peak flow calculated by program. Hydrograph remaining in drain will have peak flow listed in Column 53-59.
	2	If hydrograph in drain listed in Column 15 to be proportioned on percentage basis such that hydrograph remaining in drain has percentage of total flow specified in Column 53-59 with excess flow transferred to relief drain listed in Column 16.
	3	If hydrograph in drain listed in Column 15 to be separated such that all flow up to peak flow rate listed in Column 53-59 remains in the drain with excess flow transferred to relief drain listed in Column 16.
	4	If hydrograph in drain listed in Column 15 to be separated such that only flow above the value listed in Column 53-59) remains in the drain with all other flow transferred to relief drain listed in Column 16.
61	1	If hydrograph for all four days of a four-day design storm to be computed.
	2	If hydrograph for second, third, and fourth days of four-day design storm to be computed.
	3	If hydrograph for third and fourth days of four-day design storm to be computed.
	blank	If hydrograph for only fourth day (maximum day rainfall) of four-day design storm to be computed, or hydrograph for thunderstorm, or other selected storm rainfall to be computed.
62	1	If hydrograph printout only desired. Requires 005 input data containing location for hydrograph
	2	If hydrograph printout plus output hydrograph file desired.
63	1	Confluence Q printout listing peak flow and time for primary drain and lateral and combined peak and time at downstream end of confluence.
64	A	If hydrograph stored in Line A to be erased.
	B	If hydrograph stored in Line B to be erased.
	C	If hydrograph stored in Line C to be erased.
	D	If hydrograph stored in Line D to be erased.
	E	If hydrograph stored in Line E to be erased.
	F	If hydrograph stored in Line F to be erased.

Column	Entry	Description
	G	If all hydrographs stored in system to be erased (beginning of model).
65	1	If project description heading at beginning of printout and heading for hydrograph printout sheets desired.
	2	If end of job- last data input line.
66	A	Hydrograph data input read into main line or lateral listed in Column 15.
67	blank	If area reduction not to be computed.
	1	If main line flow to be recomputed using area reduction factor for total drainage area and initially computed drain sizes.
	2	If Lateral B flow to be recomputed using area reduction factor for total drainage area and initially computed drain sizes.
	3	If Lateral C flow to be recomputed using area reduction factor for total drainage area and initially computed drain sizes.
	4	If Lateral D flow to be recomputed using area reduction factor for total drainage area and initially computed drain sizes.
	5	If Lateral E flow to be recomputed using area reduction factor for total drainage area and initially computed drain sizes.
	7	If area reduction to be set at 1.0.
68-70	blank	If minimum n of .014 to be used for channel bottom- channel type 5 or 6.
	numeric	If higher n value for rougher channel bottom to be used for channel type 5 or 6. Decimal is not used but is assumed to be between columns 67 and 68.
71-73	blank	If minimum n of .014 to be used for channel side walls- types 5 and 6.
	numeric	If higher n value for rougher surface to be used for types 5 and 6. Decimal is not used but is assumed to be between columns 37 and 38.
74-75	blank	If rectangular or trapezoidal channel maximum depth 13 feet to be used.
	integer	If rectangular or trapezoidal channel, maximum channel depth in whole feet other than 13 feet to be used.
76-77	integer	Maximum velocity in whole feet per second when trapezoidal channel (6) specified in Column 32.

C.2 RAINFALL AND RUNOFF COEFFICIENT FILE DATA INPUT

Runoff Coefficient Curve Data (Code 009) – Required

These data are entered in a separate rainfall and runoff coefficient data file. Currently the default filename used in VCRat 2.2 is vcrain.dat.

Column	Entry	Description
1-3	009	Code number.
4-6	integer	Soil type number specified by Code 010 through 070.If composite runoff coefficient curve is available, use numbers between 002 and 199.
7	1	If runoff coefficient curve is used.
	2	If infiltration rate (loss rate) curve is used.
8-10	integer	Total number of points (maximum of 14) used to define runoff coefficient curve. This number must appear on all input lines.
11-13	integer	Maximum cumulative point number appearing on each input line.

Column	Entry	Description
14-17	numeric	Runoff coefficient as decimal corresponding to rainfall intensity listed in Column 18-22. The initial point on first input line must be 0.000. If decimal is not included it is assumed to be between the first and second columns.
18-22	numeric	Rainfall intensity in inches per hour corresponding to point value listed in Column 14-17. The initial point on first input line must be 00.000. If decimal is not included it is assumed to be betweenincluded the second and third columns
23-26	numeric	Runoff coefficient corresponding to rainfall intensity listed in Column 27-31. If decimal is not included it is assumed to be between the first and second columns
27-31	numeric	Rainfall intensity corresponding to point value listed in column 23-26. If decimal is not included it is assumed to be between the second and third columns
32-35	numeric	Runoff coefficient corresponding to rainfall intensity listed in Column 36-40.
36-40	numeric	Rainfall intensity corresponding to point value listed in Column 32-35. If decimal is not included it is assumed to be between the second and third columns
41-44	numeric	Runoff coefficient corresponding to rainfall intensity listed in Column 45-49. If decimal is not be included it is assumed to be between the first and second columns
45-49	numeric	Rainfall intensity corresponding to point value listed in Column 41-44. If decimal is not included it is assumed to be between the second and third columns
50-53	numeric	Runoff coefficient corresponding to rainfall intensity listed in Column 54-58. If decimal is not be included it is assumed to be between the first and second columns
54-58	numeric	Rainfall intensity corresponding to point value listed in Column 50-53. If decimal is not included it is assumed to be between the second and third columns
59-76	numeric	Repeat procedure described above for Columns14-58.

These data are currently included in the VCRAIN.DAT file that is the default runoff coefficient and rainfall mass curve file for VCRat 2.2. VCRat 2.2 and 2.5 use this file to generate a model and rainfall combined input file that is used by the FORTRAN VCRat calculation engine.

Rainfall Mass Curve Header Data (Code 010) – Required

These data currently follow the 009 data entered in a rainfall and runoff coefficient file. Currently the default file used in VCRat 2.2 is vcrain.dat.

Column	Entry	Description
1-3	010	Code number for first line of rainfall hydrograph data line.
4	alphabetic	If storm pattern D through I for other than design storm rainfall to be used.
	J (or A)	If J zone design storm rainfall pattern to be used. (For 100-year frequency rainfall only use A.)
	K (or B)	If K zone design storm rainfall pattern to be used. (For 100-year frequency rainfall only use B.)

	L (or C)	If L zone design storm rainfall pattern to be used. (For 100-year frequency rainfall only use C.)
	T	If design thunderstorm rainfall pattern to be used. Also used for simulations to evaluate areal reduction
5-6	integer	If A through I storm pattern to be used, an identification number between 1 and 99 must also be used.
	01	If thunderstorm (convective storm) design rainfall pattern to be used. Also used for simulations to evaluate areal reduction
	10	If 10 - year frequency rainfall for J, K, L zone rainfall to be used.
	25	If 25 - year frequency rainfall for J, K, L zone rainfall to be used.
	50	If 50 - year frequency rainfall for J, K, L zone rainfall to be used.
	97	If 100-year frequency rainfall for A zone rainfall to be used.
	98	If 100-year frequency rainfall for B zone rainfall to be used.
	99	If 100-year frequency rainfall for C zone rainfall to be used.
7-9	Integer	Number of points in the hydrograph contained in the following 011 data lines

In VCRat 2.2, J and J' zones use the same zone designations in the VCRAIN.DAT file and the modeler has to use the correct rain mass curve data to get the right results.

Rainfall Mass Curve Data (Code 011)– Required

These data currently follow the 010 data entered in a rainfall and runoff coefficient file. Currently the default file used in VCRat 2.2 is vcrain.dat.

Column	Entry	Description
1-3	011	Code number for lines following 010 line of rainfall mass curve data.
4	J, K, L, A, B, or C	Must match zone description on 010 line preceding 011 line
5-6	integer	Design frequency of storm, must match frequency entered on 010 line preceding 011 line.
7-9	Integer	Total number of points in the rainfall mass curve contained in the 011 data lines
10-12	Integer	Subtotal of mass curve ordinates contained in this and preceding 011 lines – generally 7 points per line.
13-17	Integer	Time in minutes of first mass curve point. First point must be 0000
18-22	Numeric	Cumulative rainfall corresponding to preceding time entry. If decimal is not entered it is assumed to occur between columns 19 and 20.
23-26	Integer	Time in minutes of next mass curve point
27-31	Numeric	Cumulative rainfall corresponding to preceding time entry. If decimal is not entered it is assumed to occur between columns 19 and 20.
32-72	Numeric	Remaining hydrograph times and cumulative rainfall pairs until the total number of pairs matches the entry in columns 10-12.

More than one rainfall mass curve can be included in a rainfall and runoff coefficient file. When all desired rainfall mass curves are included, the last line of the file should have 999 entered in the first three columns.

C.3 RESERVOIR ROUTING INFORMATION

The data input lines can follow any 006 in a VCRat 2.2 input file except the last one. Decimal points must be included with all numbers on any of the these data lines. A dummy node must be used in a regular reservoir routing. A dummy node must be used after fattening. A confluence must be used in a split flow or bypass reservoir. The possible data input lines for reservoir routing include the following:

a. 110 (required for areal reduction, fattening and/or reservoir routing)
b. 111 (required for areal reduction, fattening and/or reservoir routing)
c. 112 (required for reservoir routing)
d. 113 (required for reservoir routing)
e. 114 (required for reservoir routing)
f. 115 (required for channel routing directly below the reservoir)
g. 116 (required for channel routing directly below the reservoir)
h. 110 (required for fattening and/or reservoir routing)

Start of Reservoir Routing, Areal Reduction, and Fattening Data Input Line (110)

Required to signify beginning and ending of reservoir routing and/or fattening. Can be preceded by a 006, 114, or 116 data line.

Column	Entry	Description
1-3	110	Code number for lines following 006 subarea line with dummy information.

Reservoir Routing, Areal Reduction, and Fattening Data Input Line (111)

Required after a 110 data input line. The numeric entries MUST contain a decimal point.

Column	Entry	Description
1-3	111	Code number for reservoir and hydrograph information.
4-11	numeric	Spillage elevation- usually corresponds to emergency spillway invert elevation. (elevation in feet) Used in reservoir routing only. This numeric entry MUST be in the form #####.##
	blank	No reservoir routing.
12-22	numeric	Hydrograph adjustment or areal reduction factor. Each point on the hydrograph will be multiplied by this adjustment factor. This numeric entry MUST be in the form #####.#####
	blank	Hydrograph will not be adjusted.
23-30	numeric	Runoff factor. (inches) Used in fattening only. This numeric entry MUST be in the form #####.##
31-38	numeric	Drainage area tributary to location. (acres) Overrides drainage area in node directly below the reservoir. This entry is the same as column16-23 on a 007 card for a read in hydrograph. This numeric entry MUST be in the form #####.##
	blank	No drainage area change.

Reservoir Routing Data- Stage Information (112)

Required if reservoir routing is performed. The reservoir stage (elevation in feet) information is entered on this data line. Up to 10 numeric entries can be placed on each 112 line, and up to five 112 lines are allowed. Elevation values must be larger than zero. The numeric entries MUST contain a decimal point and be in the form #####.##. VCRat 2.2 does not check to make sure the values are entered in ascending order.

Column	Entry	Description
1-3	112	Card code number.
4-11	numeric	The reservoir stage. (elevation in feet)
12-19	numeric	The reservoir stage. (elevation in feet)
20-27	numeric	The reservoir stage. (elevation in feet)
28-35	numeric	The reservoir stage. (elevation in feet)
36-43	numeric	The reservoir stage. (elevation in feet)
44-51	numeric	The reservoir stage. (elevation in feet)
52-59	numeric	The reservoir stage. (elevation in feet)
60-67	numeric	The reservoir stage. (elevation in feet)
68-75	numeric	The reservoir stage. (elevation in feet)
76-83	numeric	The reservoir stage. (elevation in feet)

Reservoir Routing Data- Storage Information (113)

Required after a 112 line. The reservoir storage (volume in acre-feet) information is entered in this line corresponding to the elevations entered on the 112 data lines. Up to 10 numeric entries can be placed on each 113 line, and up to five 113 lines are allowed. The numeric entries MUST contain a decimal point and be in the form #####.##. VCRat 2.2 does not check to make sure the values are entered in ascending order.

Column	Entry	Description
1-3	113	Card code number.
4-11	numeric	The reservoir storage (acre-feet)
12-19	numeric	The reservoir storage (acre-feet)
20-27	numeric	The reservoir storage (acre-feet)
28-35	numeric	The reservoir storage (acre-feet)
36-43	numeric	The reservoir storage (acre-feet)
44-51	numeric	The reservoir storage (acre-feet)
52-59	numeric	The reservoir storage (acre-feet)
60-67	numeric	The reservoir storage (acre-feet)
68-75	numeric	The reservoir storage (acre-feet)
76-83	numeric	The reservoir storage (acre-feet)

Reservoir Routing Data- Discharge Information (114)

Required after a 113 line. The reservoir discharge (cfs) information is entered in this line corresponding to the elevations entered on the 112 lines. Up to 10 numeric entries can be placed on each 114 line, and up to five *114* lines are allowed. The numeric entries MUST contain a decimal point and be in the form *#####.##*. VCRat 2.2 does not check to make sure the values are entered in ascending order.

Column	Entry	Description
1-3	114	Card code number.
4-11	numeric	The reservoir discharge (cfs)
12-19	numeric	The reservoir discharge (cfs)
20-27	numeric	The reservoir discharge (cfs)
28-35	numeric	The reservoir discharge (cfs)
36-43	numeric	The reservoir discharge (cfs)
44-51	numeric	The reservoir discharge (cfs)
52-59	numeric	The reservoir discharge (cfs)
60-67	numeric	The reservoir discharge (cfs)
68-75	numeric	The reservoir discharge (cfs)
76-83	numeric	The reservoir discharge (cfs)

Start of Channel Routing, Areal Reduction, and Fattening Data Input Line (115)

Required after a 114 data line at the end of reservoir routing or a 111 data line after areal reduction and fattening to signify that channel routing below the reservoir or upstream subarea will be performed next.

Column	Entry	Description
1-3	115	Code number for line following 114 end of reservoir routing or 111 end of areal reduction/fattening data input.

Channel Routing Below Reservoir Data Input Line (116)

Required after a 115 data line to provide channel routing information. Dummy information for a subarea should be provided on this line along with the routing information. Please see the explanation for the routing data required for a 006 data line for the required parameters.

End of Channel Routing, Areal Reduction, and Fattening Data Input Line (110)

Required after a 111, 114, or 116 line to signify the end of reservoir and/or channel routing and/or areal reduction and fattening information.

Column	Entry	Description
1-3	110	Code number for line following 111, 114 or 116 data input.

Example data input lines with added column numbers (not used in model input file)

```
Column Numbering
0        10        20        30        40        50        60        70
12345678901234567890123456789012345678901234567890123456789012345678901234567890
********************************************************************************
006 15031  056B 020      099B98                                1
110
111 1130.5     1.00000    4.50
112 1110.   1112.   1114.   1116.   1118.   1119.   1120.   1121.   1122.   1123.
112 1124.   1125.   1126.   1127.   1128.   1129.   1130.   1131.   1132.   1133.
113    0.0     2.5     5.4     8.9    12.0    15.1    17.4    19.9    22.5    25.2
113   28.0    31.0    34.1    37.4    40.9    44.5    48.3    52.4    56.6    60.5
114    0.0    30.0   100.0   195.0   310.0   360.0   400.    430.    463.    492.
114  520.    545.    570.    594.    616.    639.    660.    713.    871.   1088.
115
116 15031  056B 020      099B982 1100002277
110
```

C.4 RUNNING VCRAT 2.2

Copy the input files (model input and rainfall and runoff coefficient input) to a directory containing the VCRat 2.2 programs. Run program VCRat 2.exe and enter the following data:

1. Model input data filename
2. Rainfall and runoff coefficient mass curve data file
3. Output model data filename.

If the program does not run, the following sections discuss some common error messages that occur.

C.5 VCRAT 2.2 ERROR CHECKING

VCRat 2.2 is designed to edit runoff coefficient curves, rainfall mass curves, and hydrograph data input, and to verify the consistency of subarea data and various computation instructions. It checks input data prior to hydrologic computations. When errors are encountered, further processing is terminated and error messages are produced.

Runoff Coefficient Curve and Rainfall Data Mass Curve Editor (PROGRAM F0601M)

Error messages produced by this program are of the following form:

CURVE NAME ERROR NO.

Error Number	Description
1	The code (Column 1-3) on first line of a mass curve not 009 (runoff coefficient curve) or 010 (rainfall mass curve).
2	Number in Column 7 on the first line outside the range 1-5.
3	Total number of points indicated for the curve exceeds 14 (runoff coefficient curve) or 199 (rainfall mass curve).

Error Number	Description
4	On lines following the first input line of a curve either (a) The input line code (Column 1-3) not equal to 009 (runoff coefficient curve) or 011 (rainfall mass curve), (b) The curve number in Column 4-6 does not match or (c) The curve number in Column 7 does not match.
5	The number of points in a line exceeds the total number indicated on the header line.
6	The data input lines are out of sequence.
7	Initial data point not zero, negative runoff coefficient curve number, or points on rainfall mass curve not in chronological or cumulative sequence.
8	The curve number (Column 4-6) listed in the first header line, not (a) 002 through 199 for runoff coefficient curve, (b) A through I in Column 4 and 01 through 99 in Column 5-6, for selected storm rainfall mass curve, (c) J through L in Column 4 and 10, 25 or 50 in Column 5-6 for standard design storm rainfall curve, or (d) T in Column 4 and 01 in Column 5-6 for thunderstorm (convective storm) rainfall mass curve.

Subarea and Hydrograph Data Editor (PROGRAM F06010)

Error messages produced by this program are of the following form:

LOCATION NAME ERROR NO.

Error Number	Description
1	The line code (Column 1-3) of a subarea data input line not 006.
2	Subarea data not in ascending sequence (hydrograph input may be specified on the same line, and hydrograph modification may be specified on the preceding line) or a thunderstorm specified in Column 67 and Line A not specified in Column 15.
3	Column 15 (primary storage location), Column 17-19 (runoff coefficient curve) or Column 29-31 (rainfall mass curve) contains all blanks or an invalid value.
4	Secondary hydrograph is specified and (a) alphanumeric character other than A through F listed in Column 16, (b) hydrograph computation is also specified, (c) read hydrograph also specified, (d) number in Column 60 outside the range 0-4, (e) number in Column 63 outside range 0-1, or (f) negative number in Column 53-59.
5	Hydrograph input and hydrograph computation both indicated.
6	Hydrograph computation specified and (a) time of concentration not listed in Column 27-28 or hydrograph input, (b) confluence output also specified, (c) hydrograph modification also specified, (d) control Q also specified, or (e) negative number in Column 20-28. Read hydrograph specified with confluence output, hydrograph modification or control Q specified also results in error 6 printout.
7	Routing errors with (a) number in Column 32 outside range 0-6, (b) 1-6 specified in Column 32 with slope and channel length not specified in Column 33-43 or, (c) 6 specified in Column 32 and combination of Column 47-52, and Column 74-75, Column 47-52 and Column 76-77, or Column 74-75 and Column 76-77 not specified, (d) number specified in Column 74-75 outside range 0-29, or (e) negative number in Column 33-52 or Column 68-77.

Error Number	Description
8	Location input line instruction errors with (a) number in Column 61 inconsistent or outside range 0-3, (b) number in both Column 61 and Column 67 other than 0, 1, 2, 3, 5, 7 specified in Column 67, (c) other than alphabetic code A through G specified in Column 64, or (d) negative number in Column 65.
9	Hydrograph header input line errors with (a) input line code (column 1-3) not 007, (b) missing job or location number in Column 4-14, (c) drain A through F not specified in Column 15, (d) number in Column 24-26 outside range 1-200, (e) number in Column 27-30 outside range 1-1500, (f) negative number in Column 16-23 or Column 31-38, (g) number in Column 39-41 outside range 1-200, or (h) number in Column 42-44 outside range 1-4.
10	Hydrograph data input line errors with (a) input line code (Column 1-3) not 008, (b) number of points on input line less or greater than total number indicated on header input line, or (c) data input lines not in sequence.
11	Hydrograph error affecting the associated subarea data set.
12	Initial hydrograph data point not zero, or points on hydrograph not in chronological sequence.
13	Total hydrograph data points not equal to number of points specified in header line.
14	The line code (Column 1-3) not 005 on first page heading input line.
15	Hydrograph output specified and (a) the associated page heading line is missing, (b) the line code (Column 1-3) not 005 on associated page heading line, or (c) the location name on the associated page heading line and location point line not identical.
16	More than 1000 lines of input data submitted for job. (This limitation applies to VCRat 1.0. VCRat 2.2 has been recompiled to allow up to 5,000 subareas.)
18	End of job not specified by number 2 in Column 65.

Hydrologic Computation (PROGRAM F0601A)

Error messages produced by this program are of the following form:

PAGE HEADING
PROCESSING DISCONTINUED AT LOCATION NAME ERROR NO.

Error Number	Description
2	Device failure has occurred while reading from file. Program should be restarted.
3	The name on a runoff coefficient curve or rainfall mass curve does not match the one called for on a location point line or the number of points exceeds the maximum allowable points.
4	Failure in search of table for partially full pipe sections when computing wave velocities.
5	Hydrograph input indicated and the referenced hydrograph not in the input stream.
6	The number or time of points for an input hydrograph not identical with points used in rainfall mass curve.
7	The specified time of concentration is greater than the interval between zero time and the first time specified on the rainfall mass curve.
8	Failure in search for bottom width of trapezoidal channel.
9	Failure in search for depth while computing wave velocities in trapezoidal channel.
10	Failure in search for area reduction factor during computation of subarea hydrograph.
11	Failure in search for runoff rate during computation of subarea hydrograph.
12	Failure in hydrograph routing due to magnitude of channel flow rate.

Error Number	Description
99	Recycle past the beginning of the job during thunderstorm computations attempted, or more than 1,000 location point and page heading input lines were submitted. (This limitation applies to VCRat 1.0. VCRat 2.2 has been recompiled to allow up to 5,000 subareas.)

C.6 COMPUTATION PROCEDURES

Storm Rainfall Relationships

The system interpolates rainfall mass curve data entered as data input and constructs a system storage table of accumulated total rainfall by one minute increments from zero rainfall to the time of the last point indicated by input data.

Design storm rainfall mass curve data included in vcrain.dat are:

Fourth Day Total, Inches

Rainfall Zone	100-Year Storm	50-Year Storm	25-Year Storm	10-Year Storm
J	7.00	5.0	3.91	3.17
J' (J prime)	6.66	6.0	5.28	4.38
K	10.60	8.0	6.41	5.53
L	15.00	11.0	8.81	7.21

The average rainfall intensity for any specified duration at a specified storm time is calculated by subtracting from the cumulative storm rainfall at the specified storm time from the cumulative storm rainfall at the earlier storm time or determined by the specified duration. Rainfall intensity in inches per hour is calculated as the incremental cumulative storm total, times 60 (minutes in an hour) divided by the specified duration (time of concentration in minutes). These results are shown in Plates XX through XX.

For the design storm, rainfall intensities are reduced if computations for other than the fourth day (maximum day) rainfall are specified. The reduction factor is 0.10, 0.40, 0.35, and 1.00 for first through fourth day, respectively. Thunderstorm rainfall intensities are reduced by a reduction curve coded into the program by to decrease rainfall intensity with increasing watershed size.

VCRatP.for data from FORTRAN PROGRAM

ac	sq mi	Factor	ac	sq mi	Factor
0	0	1.0000	19200	30	0.7850
800	1.25	0.9450	22400	35	0.7730
1600	2.5	0.9250	25600	40	0.7625
3200	5	0.8950	28800	45	0.7520
6400	10	0.8600	32000	50	0.7420
9600	15	0.8350	48000	75	0.7020
12800	20	0.8150	64000	100	0.6700
16000	25	0.8000			

APPENDIX D – VCRAT 2.2 AND VCRAT 2.5 DATA FILES

D-1 VCRAT 2.2 PARTIAL INPUT FILE

```
005 48651   99E  IMPORTED HYDROGRAPH FN=SAMPLE1.DAT VCRat 2 VER. 2.2
005 48651  105A  OUTFLOW HYDROGRAPH AT THIS POINT
005 48651  170AB THIS HYDROGRAPH IS ADJUSTED FOR AREAL REDUCTION & FATTENING
005 48651  171AE INFLOW HYDROGRAPH TO DETENTION BASIN
005 48651  172A  DETENTION BASIN ROUTING
005 48651  173A  DATA LINE ALWAYS NEEDED ONLY IF END OF FILE FOLLOWS
999
007 48651   99E    4220 441158    3582200  4
008  5    0       0  100      91  200     216  300     288  400     343
008 10  500     387  600     433  700     502  800     604  900     756
008 15 1000    1047 1050    1410 1100    1804 1110    2087 1120    2245
008 20 1130    2451 1131    2494 1132    2532 1133    2568 1134    2601
008 25 1135    2633 1136    2669 1137    2707 1138    2744 1139    2782
008 30 1140    2820 1141    2857 1142    2890 1143    2923 1144    2956
008 35 1145    2988 1146    3022 1147    3057 1148    3096 1149    3138
008 40 1150    3177 1151    3191 1152    3209 1153    3298 1154    3428
008 45 1155    3502 1156    3546 1157    3570 1158    3582 1159    3582
008 50 1160    3568 1161    3545 1162    3514 1163    3477 1164    3437
008 55 1165    3398 1166    3362 1167    3329 1168    3300 1169    3279
008 60 1170    3266 1171    3258 1172    3253 1173    3249 1174    3245
008 65 1175    3242 1176    3238 1177    3234 1178    3230 1179    3225
008 70 1180    3220 1181    3219 1182    3218 1183    3216 1184    3214
008 75 1185    3212 1186    3210 1187    3211 1188    3217 1189    3251
008 80 1190    3289 1191    3301 1192    3300 1193    3293 1194    3285
008 85 1195    3277 1196    3266 1197    3247 1198    3220 1199    3214
008 90 1200    3206 1201    3194 1202    3181 1203    3141 1204    3089
008 95 1205    3044 1206    3006 1207    2972 1208    2941 1209    2913
008100 1210    2888 1211    2864 1212    2839 1213    2815 1214    2790
008105 1215    2766 1216    2741 1217    2717 1218    2693 1219    2669
008110 1220    2645 1221    2625 1222    2605 1223    2585 1224    2566
008115 1225    2546 1226    2527 1227    2508 1228    2490 1229    2472
008120 1230    2455 1231    2438 1232    2422 1233    2406 1234    2390
008125 1235    2373 1236    2356 1237    2340 1238    2324 1239    2309
008130 1240    2294 1241    2279 1242    2264 1243    2250 1244    2235
008135 1245    2221 1246    2207 1247    2194 1248    2180 1249    2167
008140 1250    2154 1251    2140 1252    2128 1253    2115 1254    2102
008145 1255    2089 1256    2077 1257    2065 1258    2053 1259    2041
008150 1260    2024 1261    2010 1262    1997 1263    1985 1264    1975
008155 1265    1964 1266    1954 1267    1944 1268    1933 1269    1922
008160 1270    1911 1271    1900 1272    1889 1273    1878 1274    1867
008165 1275    1856 1276    1845 1277    1833 1278    1822 1279    1810
008170 1280    1798 1281    1787 1282    1775 1283    1763 1284    1751
008175 1285    1740 1286    1728 1287    1717 1288    1706 1289    1695
008180 1290    1685 1291    1675 1292    1665 1293    1656 1294    1647
008185 1295    1638 1296    1629 1297    1621 1298    1613 1299    1605
```

```
008190 1300    1598 1310    1546 1320    1453 1330    1361 1340    1271
008195 1350    1178 1360    1080 1370     988 1380     908 1390     845
008200 1400     795 1420     736 1440     676 1460     625 1500     570
999
006 48651   99E 010         B98                                G1A
006 48651  100A 020 23  4910B983  650 0140
006 48651  101A 020 40  2310B984  400 0100
006 48651  102A 020 14  62 8B98
006 48651  103A 020      099C99
------------ADDITIONAL SUBAREAS FROM 103A TO 169B-----------
006 48651  169B 030015  2709B98
006 48651  170AB010         B98                             1
110
111            .877      6.0
110
006 48651  171AE030         B98                             1
------------RESERVOIR ROUTING SEQUENCE----------------------
006 48651  172A 030      099B98                             1
110
111  642.5
112  634.50  640.00  640.50  641.99  642.06  642.16  642.27  642.40  643.48
113    0.00  314.59  415.21  615.98  817.07 1018.61 1320.32 1522.33 1723.57
114    0.00 1905.00 2320.00 2830.00 3540.00 5550.00 5860.00 6870.00 8875.00
115
116 48651  172A 030      099B986 12000001  2    85                 020022  20
110
006 48651  173A 030      099B98                             1  2
```

D-2 VCRAT 2.2 PARTIAL OUTPUT FILE

```
                                        VENTURA COUNTY FLOOD CONTROL DISTRICT
                                   MODIFIED RATIONAL METHOD HYDROLOGY / PC 2.21-950
          SAMPLE CALCULATION FN=SAMPLE1.DAT VCRat 2 VER. 2.2                                                    STORM DAY 4
                      SUBAREA  SUBAREA     TOTAL     TOTAL  CONV   CONV     CONV     CONV   CONV   CONTROL SOIL      RAIN  PCT
         LOCATION      AREA      Q        AREA        Q    TYPE   LNGTH   SLOPE     SIZE     Z       Q    NAME  TC  ZONE  IMPV
        48651   99E   4220.     3582.     4220.     3582.   0       0.  0.00000     0.00  0.00        0.   10   0   B98  0.00
        48651  100A     49.      153.       49.      153.   3     650.  0.01400     0.00  0.00        0.   20  10   B98  0.23
        48651  101A     23.       73.       72.      212.   4     400.  0.01000     4.75  0.00        0.   20  10   B98  0.40
        48651  102A     62.      215.      134.      406.   0       0.  0.00000     0.00  0.00        0.   20   8   B98  0.14
        48651  103A      0.        0.      134.      406.   0       0.  0.00000     0.00  0.00        0.   20  99   C99  0.00
------------------ADDITIONAL OUTPUT FOR SUBAREAS 104A THROUGH 168B--------------------
        48651  169B     27.       84.      264.      812.   0       0.  0.00000     0.00  0.00        0.   30   9   B98  0.15
        48651  170AB   264.      812.     2317.     4057.   0       0.  0.00000     0.00  0.00        0.   10   0   B98  0.00
     ***********************************************************************************************************************
     *                                          HYDROGRAPH FATTENED AT   170AB                                              *
     *   INCOMING HYDROGRAPH PEAK     =   4056.80                INCOMING HYDROGRAPH VOLUME      =    898.16 AC.FT.          *
     *   HYDROGRAPH ADJUSTMENT FACTOR =      0.87700              RUNOFF FACTOR                   =      6.00 IN.             *
     *   ADJUSTED HYDROGRAPH PEAK     =   3557.82                ADJUSTED HYDROGRAPH VOLUME      =    787.69 AC.FT.          *
```

```
*   ADJ/FATTENED HYDROGRAPH PEAK =   3557.82                    ADJ/FATTENED HYDROGRAPH VOLUME  =   1157.95 AC.FT.          *
*****************************************************************************************************************************
   48651  170AB     0.       812.     2317.     3558.   0       0.  0.00000     0.00  0.00        0.    0   0     0  0.00
   48651  171AE  4220.      3582.     6537.     6812.   0       0.  0.00000     0.00  0.00        0.   30   0   B98  0.00
   48651  172A      0.         0.     6537.     6812.   0       0.  0.00000     0.00  0.00        0.   30  99   B98  0.00
*****************************************************************************************************************************
*                                                RESERVOIR ROUTING AT   172A                                                 *
*   INCOMING HYDROGRAPH PEAK     =   6811.68                    INCOMING HYDROGRAPH VOLUME      =   2879.38 AC.FT.          *
*   HYDROGRAPH ADJUSTMENT FACTOR =      1.00000                                                                               *
*   RESERVOIR INFLOW  PEAK =   6811.68  TIME OF PEAK =   1171  VOLUME UNDER INFLOW  HYDROGRAPH =   2879.38 AC.FT.           *
*   MAXIMUM ELEVATION      =    642.03  TIME         =   1249  SPILLAGE ELEVATION  =    642.50  DIFFERENCE =      -0.47    *
*   NO SPILLAGE                                                                                                               *
*   RESERVOIR OUTFLOW PEAK =   3273.38  TIME OF PEAK =   1252  VOLUME UNDER OUTFLOW HYDROGRAPH =   2428.98 AC.FT.           *
*****************************************************************************************************************************
   48651  172A      0.         0.     6537.     3273.   6    1200.  0.00100    85.00  2.00        0.   30  99   B98  0.00
                                        VENTURA COUNTY FLOOD CONTROL DISTRICT
                                   MODIFIED RATIONAL METHOD HYDROLOGY / PC 2.21-950
    SAMPLE CALCULATION FN=SAMPLE1.DAT VCRat 2 VER. 2.2                                                          STORM DAY 4
                SUBAREA  SUBAREA     TOTAL     TOTAL  CONV   CONV     CONV     CONV   CONV   CONTROL SOIL      RAIN  PCT
    LOCATION      AREA      Q        AREA        Q    TYPE   LNGTH   SLOPE     SIZE     Z       Q    NAME  TC  ZONE  IMPV
   48651  173A      0.         0.     6537.     3273.   0       0.  0.00000     0.00  0.00        0.   30  99   B98  0.00

                                   MODIFIED RATIONAL METHOD HYDROLOGY / PC 2.21-950
                              OUTFLOW HYDROGRAPH AT THIS POINT
                       HYDROGRAPH AT  48651  105A          STORM DAY 4          REDUCTION FACTOR =  1.000

                       TIME      Q      TIME      Q      TIME      Q      TIME      Q      TIME      Q
                          0       0.    100       7.    200       8.    300       9.    400       9.
                        500      10.    600      10.    700      11.    800      12.    900      17.
                       1000      27.   1050      38.   1100      43.   1110      62.   1120      62.
                       1130      85.   1131      87.   1132      88.   1133      91.   1134      94.
                       1135      96.   1136      97.   1137     100.   1138     103.   1139     106.
                       1140     109.   1141     113.   1142     117.   1143     121.   1144     128.
                       1145     136.   1146     146.   1147     155.   1148     165.   1149     198.
                       1150     236.   1151     244.   1152     317.   1153     363.   1154     384.
                       1155     398.   1156     406.   1157     384.   1158     356.   1159     352.
                       1160     282.   1161     238.   1162     211.   1163     181.   1164     158.
                       1165     134.   1166     114.   1167      97.   1168      84.   1169      79.
                       1170      70.   1171      65.   1172      58.   1173      56.   1174      53.
                       1175      51.   1176      49.   1177      44.   1178      44.   1179      42.
                       1180      40.   1181      40.   1182      38.   1183      37.   1184      36.
                       1185      36.   1186      36.   1187      36.   1188      35.   1189      35.
                       1190      35.   1191      35.   1192      34.   1193      34.   1194      35.
                       1195      35.   1196      34.   1197      34.   1198      35.   1199      34.
                       1200      35.   1201      34.   1202      33.   1203      32.   1204      32.
                       1205      31.   1206      29.   1207      29.   1208      28.   1209      28.
                       1210      27.   1211      26.   1212      26.   1213      26.   1214      26.
                       1215      25.   1216      25.   1217      25.   1218      25.   1219      25.
                       1220      25.   1221      25.   1222      25.   1223      25.   1224      25.
                       1225      25.   1226      25.   1227      25.   1228      25.   1229      25.
                       1230      25.   1231      25.   1232      25.   1233      25.   1234      25.
```

1235	25.	1236	25.	1237	24.	1238	25.	1239	24.
1240	24.	1241	24.	1242	24.	1243	24.	1244	24.
1245	24.	1246	24.	1247	24.	1248	24.	1249	24.
1250	24.	1251	24.	1252	24.	1253	24.	1254	24.
1255	24.	1256	24.	1257	24.	1258	24.	1259	24.
1260	24.	1261	24.	1262	23.	1263	23.	1264	22.
1265	22.	1266	21.	1267	20.	1268	20.	1269	19.
1270	19.	1271	19.	1272	18.	1273	18.	1274	18.
1275	18.	1276	18.	1277	18.	1278	18.	1279	18.
1280	18.	1281	18.	1282	18.	1283	18.	1284	17.
1285	18.	1286	18.	1287	18.	1288	17.	1289	17.
1290	18.	1291	18.	1292	17.	1293	17.	1294	18.
1295	17.	1296	17.	1297	17.	1298	18.	1299	17.
1300	17.	1310	12.	1320	11.	1330	10.	1340	10.
1350	9.	1360	8.	1370	8.	1380	8.	1390	8.
1400	8.	1420	7.	1440	7.	1460	5.	1500	5.

```
*****************************************************************************************************************
*                                          HYDROGRAPH FATTENED AT   170AB                                       *
*   HYDROGRAPH ADJUSTMENT FACTOR =      0.87700                RUNOFF FACTOR                    =      6.00 IN.  *
*   ADJUSTED HYDROGRAPH PEAK     =   3557.82                   ADJUSTED HYDROGRAPH VOLUME       =   1157.95 AC.FT.*
*****************************************************************************************************************
```

ADJUSTED HYDROGRAPH AFTER FATTENING

HYDROGRAPH AT 48651 170AB STORM DAY 4 ADJUSTMENT FACTOR = 0.877

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	0.	100	133.	200	157.	300	193.	400	225.
500	249.	600	288.	700	341.	800	403.	900	527.
1000	773.	1050	1002.	1100	1331.	1110	1438.	1120	1556.
1130	1726.	1131	1746.	1132	1766.	1133	1786.	1134	1807.
1135	1828.	1136	1849.	1137	1872.	1138	1895.	1139	1918.
1140	1942.	1141	1967.	1142	1993.	1143	2021.	1144	2049.
1145	2082.	1146	2116.	1147	2152.	1148	2191.	1149	2246.
1150	2304.	1151	2353.	1152	2445.	1153	2533.	1154	2622.
1155	2717.	1156	2799.	1157	2871.	1158	2945.	1159	3006.
1160	3085.	1161	3152.	1162	3228.	1163	3301.	1164	3356.
1165	3400.	1166	3442.	1167	3475.	1168	3501.	1169	3524.
1170	3542.	1171	3554.	1172	3558.	1173	3551.	1174	3536.
1175	3508.	1176	3469.	1177	3420.	1178	3361.	1179	3293.
1180	3218.	1181	3138.	1182	3062.	1183	2984.	1184	2907.
1185	2829.	1186	2749.	1187	2672.	1188	2598.	1189	2530.
1190	2468.	1191	2408.	1192	2350.	1193	2293.	1194	2239.
1195	2188.	1196	2139.	1197	2093.	1198	2050.	1199	2013.
1200	1979.	1201	1945.	1202	1911.	1203	1878.	1204	1846.
1205	1815.	1206	1784.	1207	1755.	1208	1728.	1209	1701.
1210	1677.	1211	1653.	1212	1631.	1213	1610.	1214	1589.
1215	1570.	1216	1551.	1217	1534.	1218	1517.	1219	1500.
1220	1484.	1221	1469.	1222	1454.	1223	1439.	1224	1425.
1225	1412.	1226	1399.	1227	1386.	1228	1374.	1229	1363.
1230	1352.	1231	1341.	1232	1331.	1233	1320.	1234	1310.
1235	1301.	1236	1291.	1237	1282.	1238	1272.	1239	1263.
1240	1253.	1241	1244.	1242	1234.	1243	1225.	1244	1216.

```
                    1245     1206.   1246     1197.   1247     1188.   1248     1179.   1249     1171.
                    1250     1163.   1251     1154.   1252     1146.   1253     1138.   1254     1130.
                    1255     1122.   1256     1115.   1257     1107.   1258     1100.   1259     1093.
                    1260     1086.   1261     1080.   1262     1073.   1263     1066.   1264     1060.
                    1265     1053.   1266     1046.   1267     1040.   1268     1033.   1269     1027.
                    1270     1021.   1271     1014.   1272     1008.   1273     1002.   1274      995.
                    1275      989.   1276      983.   1277      978.   1278      972.   1279      966.
                    1280      961.   1281      956.   1282      950.   1283      944.   1284      939.
                    1285      934.   1286      928.   1287      923.   1288      917.   1289      912.
                    1290      907.   1291      901.   1292      896.   1293      891.   1294      886.
                    1295      881.   1296      877.   1297      872.   1298      867.   1299      863.
                    1300      858.   1310      804.   1320      748.   1330      699.   1340      655.
                    1350      606.   1360      556.   1370      514.   1380      477.   1390      445.
                    1400      419.   1420      372.   1440      337.   1460      309.   1500      279.
*****************************************************************************************************************
*                                                RESERVOIR ROUTING AT   172A                                    *
*   INCOMING HYDROGRAPH PEAK     =   6811.68                  INCOMING HYDROGRAPH VOLUME      =   2879.38 AC.FT.  *
*   HYDROGRAPH ADJUSTMENT FACTOR =      1.00000                                                                  *
*   RESERVOIR INFLOW  PEAK =   6811.68  TIME OF PEAK =   1171  VOLUME UNDER INFLOW  HYDROGRAPH =   2879.38 AC.FT.  *
*   MAXIMUM ELEVATION      =    642.03  TIME         =   1249  SPILLAGE ELEVATION  =    642.50  DIFFERENCE =      -0.47  *
*   NO SPILLAGE                                                                                                   *
*   RESERVOIR OUTFLOW PEAK =   3273.38  TIME OF PEAK =   1252  VOLUME UNDER OUTFLOW HYDROGRAPH =   2428.98 AC.FT.  *
*****************************************************************************************************************
```

D-3 VCRAT 2.5 PARTIAL INPUT FILE

```
PROGRAM VCRat 2.5PROJ
PROJECT 1 SAMPLE1
DESCRIP SAMPLE CALCULATION FN=SAMPLE1.DAT VCRat 2 VER. 2.2
JOB 48651 99 100
OUTPUT C:\Program Files\VCWPD Hydrology\VCRat 25\SAMPLE1.out
HYDROFILE C:\Program Files\VCWPD Hydrology\VCRat 25\SAMPLE1.hyd
TCOUTPUT C:\Program Files\VCWPD Hydrology\VCRat 25\SAMPLE1
SUBAREA 99 E 4
DESCRIP SAMPLE CALCULATION FN=SAMPLE1.DAT VCRat 2 VER. 2.2
MISCPARAMS N
IMPORT 4220 99E N
SUBAREA 100 A 0
SUBPARAMS 49 23 020 K 10
MISCPARAMS N
ROUTING 3 650 0.01400
SUBAREA 101 A 0
SUBPARAMS 23 40 020 K 10
MISCPARAMS N
ROUTING 4 400 0.01000 -1.00
SUBAREA 102 A 0
SUBPARAMS 62 14 020 K 8
MISCPARAMS N
SUBAREA 103 A 1
MISCPARAMS N
---------------------ADDITIONAL SUBAREAS BETWEEN 103A AND 169B----------------------
SUBAREA 169 B 0
SUBPARAMS 27 15 030 K 9
MISCPARAMS N
SUBAREA 170 A 2 B
DESCRIP THIS HYDROGRAPH IS ADJUSTED FOR AREAL REDUCTION & FATTENING
MISCPARAMS Y N
RESERVOIR 170 A NORES
ADJFACT 0.87700
FATRUN 6.00
SUBAREA 171 A 2 E
DESCRIP INFLOW HYDROGRAPH TO DETENTION BASIN
MISCPARAMS Y N
SUBAREA 172 A 1
DESCRIP DETENTION BASIN ROUTING
MISCPARAMS Y
RESERVOIR 172 A 642.50 643.48
ADJFACT 0.00000
STAGE   1    634.50   640.00   640.50   641.99   642.06   642.16   642.27   642.40
STORAGE 1      0.00   314.59   415.21   615.98   817.07  1018.61  1320.32  1522.33
OUTFLOW 1      0.00  1905.00  2320.00  2830.00  3540.00  5550.00  5860.00  6870.00
STAGE   9    643.48
STORAGE 9   1723.57
OUTFLOW 9   8875.00
ROUTING2 6 1200 0.00100 85
CHANLDATA2 2.00000 0.022 0.020
MAXVEL2 20 0
SUBAREA 173 A 1
DESCRIP DATA LINE ALWAYS NEEDED ONLY IF END OF FILE FOLLOWS
MISCPARAMS Y
```

D-4 VCRAT 2.5 PARTIAL OUTPUT FILE

(Note- # next to channel type indicates program has automatically changed conveyance type to accommodate flows)

```
                                    Ventura County Watershed Protection District
                                 Modified Rational Method Hydrology Program (VCRat v2.5)
                                         Modified Rational Model Results Report
                                             Job:  48651  Project: SAMPLE1
      Project Description
      ---------------------------------------------------------------------------------------------------------------------------
      SAMPLE CALCULATION FN=SAMPLE1.DAT VCRat 2 VER. 2.2


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

      VCRat version:   2.5.200604
      VCRain version:  200604
      DOS EXE version: PC 2.2-20060

                                             Job:  48651  Project: SAMPLE1
Page:     2
                                                   Model Results
   |---------- SUBAREA DATA AND RESULTS --------|-- ACCUMULATED DATA --|------------ ROUTING AFTER ACCUMULATION ---------------------------------|
   | NODE   SOIL  RAIN   TC    %    AREA  FLOW  |  AREA    FLOW   TIME |  CHANNEL  LENGTH   SLOPE     SIZE    H:V       N VALUES      VEL  DEPTH |
   |  ID    TYPE  ZONE (MIN)  IMP   (AC)  (CFS) |  (AC)    (CFS)  (MIN)|    TYPE    (FT)   (FT/FT)    (FT)    (Z)     CHNL   SIDES  (FT/S)  (FT) |
   |-------------------------------------------|----------------------|-----------------------------------------------------------------------|
      99E :  SAMPLE CALCULATION FN=SAMPLE1.DAT VCRat 2 VER. 2.2
      99E :  Import Hydro: 99E
      99E   ---   ---    --   --   4220   3582     4220    3582   1158    -------    ----  -------    ---     ----    -----  -----    --      --
     100A   020   K100   10   23     49    153       49     153   1154    40' ROAD    650  0.01400    ---     ----    -----  -----    --      --
     101A   020   K100   10   40     23     73       72     212   1157    PIPE        400  0.01000      4.75  ----    -----  -----    --      --
     102A   020   K100    8   14     62    215      134     406   1156    -------    ----  -------    ---     ----    -----  -----    --      --
     103A   ---   ---    --   --    ---    ---      134     406   1156    -------    ----  -------    ---     ----    -----  -----    --      --
--------------ADDITIONAL OUTPUT BETWEEN 103A AND 169B-----------------------------------------------
     169B   030   K100    9   15     27     84      264     812   1160    -------    ----  -------    ---     ----    -----  -----    --      --
     170AB:  THIS HYDROGRAPH IS ADJUSTED FOR AREAL REDUCTION & FATTENING
     170AB  ---   ---    --   --    264    812     2317    4057   1172    -------    ----  -------    ---     ----    -----  -----    --      --
            ***********************************************************************************************
            *      INCOMING HYDROGRAPH  PEAK (cfs):   4056.80         VOLUME (acre-ft):    898.16      *
            *      HYDROGRAPH ADJUSTMENT FACTOR:         0.87700                                       *
            *      ADJUSTED HYDROGRAPH  PEAK (cfs):   3557.82         VOLUME (acre-ft):    787.69      *
            *      RUNOFF FACTOR(in):   6.00                                                            *
            *      FATTENED HYDROGRAPH  PEAK (cfs):   3557.82         VOLUME (acre-ft):   1157.95      *
            ***********************************************************************************************
     170A   ---   ---    --   --    ---    ---     2317    3558   ----    -------    ----  -------    ---     ----    -----  -----    --      --
     171AE:  INFLOW HYDROGRAPH TO DETENTION BASIN
     171AE  ---   ---    --   --   4220   3582     6537    6812   1171    -------    ----  -------    ---     ----    -----  -----    --      --
```

```
                                   Ventura County Watershed Protection District
                                 Modified Rational Method Hydrology Program (VCRat v2.5)

                                              Job:  48651  Project: SAMPLE1
Page:     4
                                                   Model Results
   |---------- SUBAREA DATA AND RESULTS --------|-- ACCUMULATED DATA --|------------ ROUTING AFTER ACCUMULATION ---------------------------------|
   | NODE   SOIL  RAIN   TC    %    AREA  FLOW  |  AREA    FLOW   TIME |  CHANNEL  LENGTH   SLOPE     SIZE    H:V       N VALUES      VEL  DEPTH |
   |  ID    TYPE  ZONE (MIN)  IMP   (AC)  (CFS) |  (AC)    (CFS)  (MIN)|    TYPE    (FT)   (FT/FT)    (FT)    (Z)     CHNL   SIDES  (FT/S)  (FT) |
   |-----------------------------------------|----------------------|-----------------------------------------------------------------------------|
     172A :  DETENTION BASIN ROUTING
     172A   ---   ---    --   --    ---    ---     6537    6812   1171    -------    ----  -------    ---     ----    -----  -----    --     --
            ***************************************************************************************
            *      INCOMING HYDROGRAPH  PEAK (cfs):   6811.68         VOLUME (acre-ft):   2879.38      *
            *      NO HYDROGRAPH ADJUSTMENT                                                            *
            *      NO HYDROGRAPH FATTENING                                                             *
            *      RESERVOIR INFLOW:    PEAK (cfs):   6811.68 @ 1171  VOLUME (acre-ft):   2879.38      *
            *      MAXIMUM ELEVATION:   STAGE (ft):    642.03 @ 1249  VOLUME (acre-ft):    730.89      *
            *      EMERGENCY SPILLWAY:   ELEV (ft):    642.50         VOLUME (acre-ft):   1540.96      *
            *          DIFFERENCE:   IN STAGE (ft):     -0.47      IN VOLUME (acre-ft):    810.07      *
            *          NO SPILL EXPECTED.       PERCNT OF VOLUME REMAINING TO SPILLWAY:     52.6%      *
            *      TOP OF DAM:           ELEV (ft):    643.48         VOLUME (acre-ft):   1723.57      *
            *          DIFFERENCE    IN STAGE (ft):     -1.45      IN VOLUME (acre-ft):    992.68      *
            *          NO OVERTOP EXPECTED.   PERCNT OF VOLUME REMAINING TO TOP OF DAM:     57.6%      *
            *      RESERVOIR OUTFLOW:   PEAK (cfs):   3273.38 @ 1252  VOLUME (acre-ft):   2428.98      *
            ***************************************************************************************
     172A   ---   ---    --   --    ---    ---     6537    3273   1252    CHANNELV   1200  0.00100     85     2.00  0.020    0.022    20      0
     173A :  DATA LINE ALWAYS NEEDED ONLY IF END OF FILE FOLLOWS
     173A   ---   ---    --   --    ---    ---     6537    3273   1256    -------    ----  -------    ---     ----    -----  -----    --     --


                                                   Warning Messages
      TYPE      ERR NO   PROCEEDURE   LOCATION   MESSAGE
     ---------------------------------------------------------------------------------------------------------------------------------------------
       NO MESSAGES OR WARNINGS DETECTED
                                   Ventura County Watershed Protection District
                                 Modified Rational Method Hydrology Program (VCRat v2.5)

                                              Job:  48651  Project: SAMPLE1
Page:     5
                                                 Hydrograph Printouts

-------------------------------------------------------------------------------------------------
            HYDROGRAPH PRINTOUT AT:  105A
-------------------------------------------------------------------------------------------------
            DESCRIPTION: OUTFLOW HYDROGRAPH AT THIS POINT
            TOTAL AREA TO HYDROGRAPH:     134    acres
            HYDROGRAPH PEAK:              406    cfs
            TIME OF PEAK:                1156    minutes
            HYDROGRAPH VOLUME:             39.42 acre-ft
```

TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)
0	0.	100	7.	200	8.	300	9.	400	9.
500	10.	600	10.	700	11.	800	12.	900	17.
1000	27.	1050	38.	1100	43.	1110	62.	1120	62.
1130	85.	1131	87.	1132	88.	1133	91.	1134	94.
1135	96.	1136	97.	1137	100.	1138	103.	1139	106.
1140	109.	1141	113.	1142	117.	1143	121.	1144	128.
1145	136.	1146	146.	1147	155.	1148	165.	1149	198.
1150	236.	1151	244.	1152	317.	1153	363.	1154	384.
1155	398.	1156	406.	1157	384.	1158	356.	1159	352.
1160	282.	1161	238.	1162	211.	1163	181.	1164	158.
1165	134.	1166	114.	1167	97.	1168	84.	1169	79.
1170	70.	1171	65.	1172	58.	1173	56.	1174	53.
1175	51.	1176	49.	1177	44.	1178	44.	1179	42.
1180	40.	1181	40.	1182	38.	1183	37.	1184	36.
1185	36.	1186	36.	1187	36.	1188	35.	1189	35.
1190	35.	1191	35.	1192	34.	1193	34.	1194	35.
1195	35.	1196	34.	1197	34.	1198	35.	1199	34.
1200	35.	1201	34.	1202	33.	1203	32.	1204	32.
1205	31.	1206	29.	1207	29.	1208	28.	1209	28.
1210	27.	1211	26.	1212	26.	1213	26.	1214	26.
1215	25.	1216	25.	1217	25.	1218	25.	1219	25.
1220	25.	1221	25.	1222	25.	1223	25.	1224	25.
1225	25.	1226	25.	1227	25.	1228	25.	1229	25.
1230	25.	1231	25.	1232	25.	1233	25.	1234	25.
1235	25.	1236	25.	1237	24.	1238	25.	1239	24.
1240	24.	1241	24.	1242	24.	1243	24.	1244	24.
1245	24.	1246	24.	1247	24.	1248	24.	1249	24.
1250	24.	1251	24.	1252	24.	1253	24.	1254	24.
1255	24.	1256	24.	1257	24.	1258	24.	1259	24.
1260	24.	1261	24.	1262	23.	1263	23.	1264	22.
1265	22.	1266	21.	1267	20.	1268	20.	1269	19.
1270	19.	1271	19.	1272	18.	1273	18.	1274	18.
1275	18.	1276	18.	1277	18.	1278	18.	1279	18.
1280	18.	1281	18.	1282	18.	1283	18.	1284	17.
1285	18.	1286	18.	1287	18.	1288	17.	1289	17.
1290	18.	1291	18.	1292	17.	1293	17.	1294	18.
1295	17.	1296	17.	1297	17.	1298	18.	1299	17.
1300	17.	1310	12.	1320	11.	1330	10.	1340	10.
1350	9.	1360	8.	1370	8.	1380	8.	1390	8.
1400	8.	1420	7.	1440	7.	1460	5.	1500	5.

APPENDIX E - DESIGN RAINFALL MAPS ON CD- (PDF) AND GIS SHAPEFILES

E-1 10-YR RAINFALL PDF MAP

E-2 25-YR RAINFALL PDF MAP

E-3 50-YR RAINFALL PDF MAP

E-4 100-YR RAINFALL PDF MAP

E-5 10-YR RAINFALL SHAPEFILE

E-6 25-YR RAINFALL SHAPEFILE

E-7 50-YR RAINFALL SHAPEFILE

E-8 100-YR RAINFALL SHAPEFILE

E-9 SOILS PDF MAP

E-10 SOILS MAP SHAPEFILE

E-11 RAINFALL ZONES SHAPEFILE

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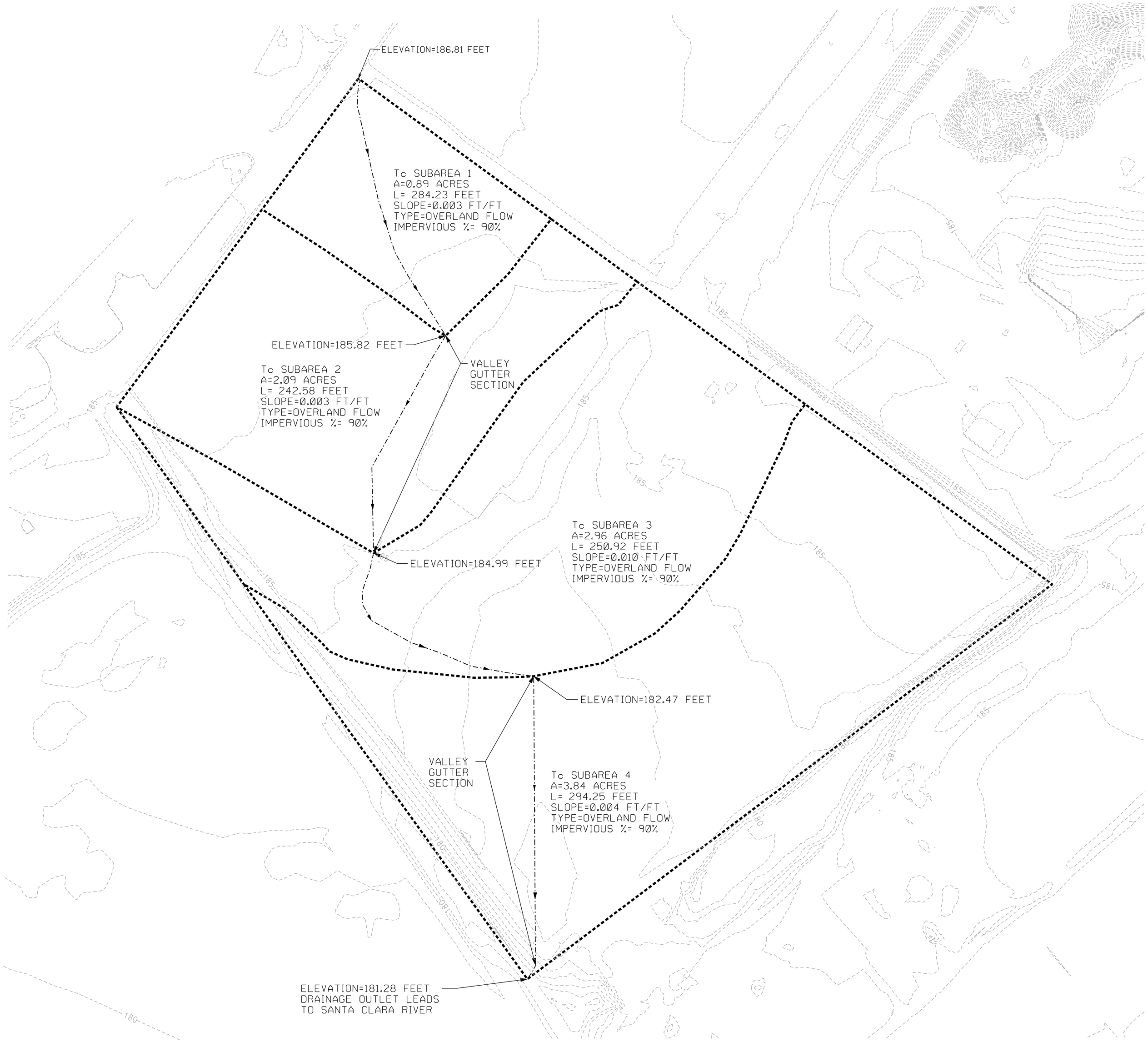
APPENDIX E – PRE AND POST DEVELOPED CONDITIONS AND DRAINAGE CALCULATIONS



LEGEND

- LONGEST WATER COURSE WITHIN SUB-BASIN AREA
- Tc SUBAREA WATERSHED BOUNDARY
- EXISTING 1 FOOT CONTOURS

NOTES

1. 1 FOOT CONTOURS PROVIDED BY JENSEN DESIGN AND SURVEY, INC.
2. DEVELOPMENT TYPE= COMMERCIAL (THIS APPLIES FOR THE ENTIRE SITE)

0 50 100
1" = 50'

WorleyParsons
resources & energy

CLIENT/PROJECT TITLE

CALPINE MISSION ROCK

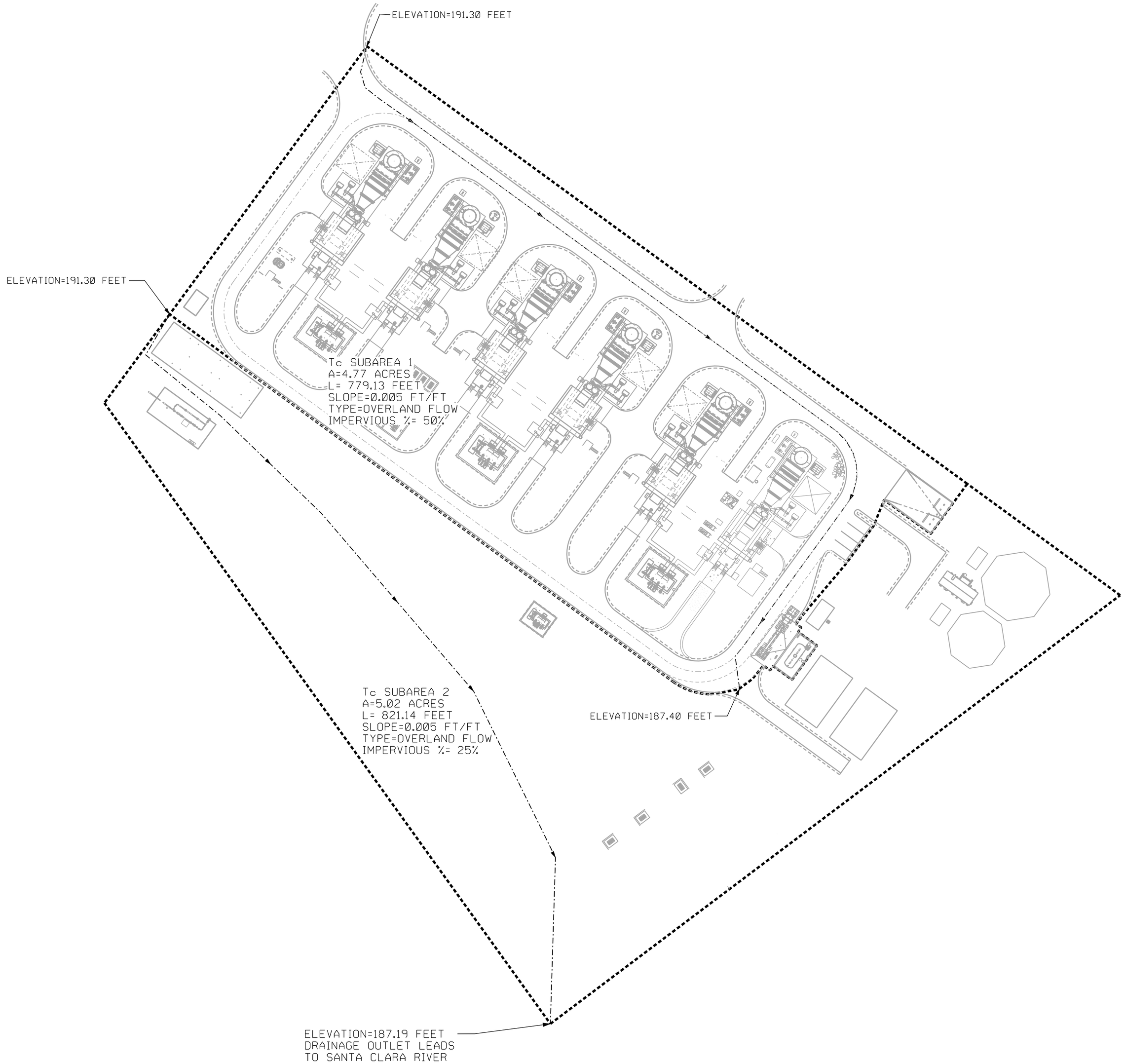
PRE-DRAINAGE PLAN EXHIBIT

SCALE 1"=50'

DRAWING SIZE 24x36

$$DESIGN-FILE-NAME$$
$$$$DATE$$$ $$$$TIME$$$$

..\Engineering\Civil\Pre_Trib.dgn 11/5/2015 10:39:12 AM



LEGEND

LONGEST WATER COURSE WITHIN SUB-BASIN AREA

Tc SUBAREA WATERSHED BOUNDARY

PROPOSED MISSION ROCK POWER PLANT EQUIPMENT

NOTES

1. 1 FOOT CONTOURS PROVIDED BY JENSEN DESIGN AND SURVEY, INC.
2. DEVELOPMENT TYPE= COMMERCIAL (THIS APPLIES FOR THE ENTIRE SITE)

0 50 100
1" = 50'

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CLIENT/PROJECT TITLE

CALPINE MISSION ROCK

POST-DRAINAGE PLAN EXHIBIT

SCALE 1"=50'

DRAWING SIZE 24x36

$$DESIGN-FILE-NAME$$
$$$$DATE$$$$ $$$$TIME$$$$

...\Civil\Post_Trib.dgn 11/5/2015 10:45:31 AM

VENTURA COUNTY WATERSHED PROTECTION DISTRICT

TIME OF CONCENTRATION

TC Program Version: 2.6.2009.7

Project: Calpine Mission Rock

Date: 12:00:00 AM

Engineer: Jonas Dahlgren

Consultant: Worley Parsons

S U M M A R Y O F C O M P U T A T I O N S

Watershed Name: Existing Conditions Watershed

Name	Zone	Storm	Soil	Area (acres)	TC (min)
Tc SubArea 1	K	100	7.00	0.9 / 1	5.969 / 6
Tc SubArea 2	K	100	7.00	2.1 / 2	5.095 / 5
Tc SubArea 3	K	100	7.00	3.0 / 3	5.193 / 5
Tc SubArea 4	K	100	7.00	3.8 / 4	6.174 / 6

Watershed Name: Existing Conditions Watershed

Sub-Area Name: Tc SubArea 1

Tc: 5.969 Minutes

DATA FOR SUB AREA 1

SUB AREA TIME OF CONCENTRATION: 5.969 min. = 6 min.

SUB AREA INPUT DATA

Sub Area Name: Tc SubArea 1

Total Area (ac): 0.89

Flood Zone: 2

Rainfall Zone: K

Storm Frequency (years): 100

Development Type: Undeveloped

Soil Type: 7.00

Percent Impervious: 90

SUB AREA OUTPUT

Intensity (in/hr): 4.590

C Total: 0.904

Sum Q Segments (cfs): 3.69

Q Total (cfs): 3.69

Sum Percent Area (%): 100.0

Sum of Flow Path Travel Times (sec): 358.13

Time of Concentration (min): 5.969

DATA FOR FLOW PATH 1

Flow Path Name: 1

FLOW PATH TRAVEL TIME (min): 5.9688

Flow Type: Overland

Length (ft): 284.23

Top Elevation (ft): 186.81

Bottom Elevation (ft): 185.82

Contributing Area (acres): 0.89

Percent of Sub-Area (%): 100.0

Overland Type: Valley

Development Type: Undeveloped

Map Slope: 0.0035

Effective Slope: 0.0035

Q for Flow Path (cfs): 3.69

Avg Velocity (ft/s): 0.79

Passed Scour Check: YES

Scour Velocity (ft/sec): 1.14

Project: Calpine Mission Rock

Date: 12:00:00 AM

Engineer: Jonas Dahlgren

Consultant: Worley Parsons

Sub-Area Name: Tc SubArea 2

Tc: 5.095 Minutes

DATA FOR SUB AREA 2

SUB AREA TIME OF CONCENTRATION: 5.095 min. = 5 min.

SUB AREA INPUT DATA

Sub Area Name: Tc SubArea 2

Total Area (ac): 2.09

Flood Zone: 2

Rainfall Zone: K

Storm Frequency (years): 100

Development Type: Undeveloped

Soil Type: 7.00

Percent Impervious: 90

SUB AREA OUTPUT

Intensity (in/hr): 5.100

C Total: 0.907

Sum Q Segments (cfs): 9.67

Q Total (cfs): 9.67

Sum Percent Area (%): 100.0

Sum of Flow Path Travel Times (sec): 305.67

Time of Concentration (min): 5.095

DATA FOR FLOW PATH 1

Flow Path Name: 2

FLOW PATH TRAVEL TIME (min): 5.0946

Flow Type: Overland

Length (ft): 242.58

Top Elevation (ft): 185.82

Bottom Elevation (ft): 184.99

Contributing Area (acres): 2.09

Percent of Sub-Area (%): 100.0

Overland Type: Valley

Development Type: Undeveloped

Map Slope: 0.0034

Effective Slope: 0.0034

Q for Flow Path (cfs): 9.67

Avg Velocity (ft/s): 0.79

Passed Scour Check: YES

Scour Velocity (ft/sec): 1.41

Project: Calpine Mission Rock

Date: 12:00:00 AM

Engineer: Jonas Dahlgren

Consultant: Worley Parsons

Sub-Area Name: Tc SubArea 3

Tc: 5.193 Minutes

DATA FOR SUB AREA 3

SUB AREA TIME OF CONCENTRATION: 5.193 min. = 5 min.

SUB AREA INPUT DATA

Sub Area Name: Tc SubArea 3

Total Area (ac): 2.96

Flood Zone: 2

Rainfall Zone: K

Storm Frequency (years): 100

Development Type: Undeveloped

Soil Type: 7.00

Percent Impervious: 90

SUB AREA OUTPUT

Intensity (in/hr): 5.100

C Total: 0.907

Sum Q Segments (cfs): 13.69

Q Total (cfs): 13.69

Sum Percent Area (%): 100.0

Sum of Flow Path Travel Times (sec): 311.60

Time of Concentration (min): 5.193

DATA FOR FLOW PATH 1

Flow Path Name: 3

FLOW PATH TRAVEL TIME (min): 5.1933

Flow Type: Overland

Length (ft): 250

Top Elevation (ft): 184.99

Bottom Elevation (ft): 182.47

Contributing Area (acres): 2.96

Percent of Sub-Area (%): 100.0

Overland Type: Valley

Development Type: Undeveloped

Map Slope: 0.0101

Effective Slope: 0.0101

Q for Flow Path (cfs): 13.69

Avg Velocity (ft/s): 0.80

Passed Scour Check: YES

Scour Velocity (ft/sec): 2.65

Project: Calpine Mission Rock

Date: 12:00:00 AM

Engineer: Jonas Dahlgren

Consultant: Worley Parsons

Sub-Area Name: Tc SubArea 4

Tc: 6.174 Minutes

DATA FOR SUB AREA 4

SUB AREA TIME OF CONCENTRATION: 6.174 min. = 6 min.

SUB AREA INPUT DATA

Sub Area Name: Tc SubArea 4

Total Area (ac): 3.84

Flood Zone: 2

Rainfall Zone: K

Storm Frequency (years): 100

Development Type: Undeveloped

Soil Type: 7.00

Percent Impervious: 90

SUB AREA OUTPUT

Intensity (in/hr): 4.590

C Total: 0.904

Sum Q Segments (cfs): 15.94

Q Total (cfs): 15.94

Sum Percent Area (%): 100.0

Sum of Flow Path Travel Times (sec): 370.46

Time of Concentration (min): 6.174

DATA FOR FLOW PATH 1

Flow Path Name: 4

FLOW PATH TRAVEL TIME (min): 6.1743

Flow Type: Overland

Length (ft): 294.25

Top Elevation (ft): 182.47

Bottom Elevation (ft): 181.28

Contributing Area (acres): 3.84

Percent of Sub-Area (%): 100.0

Overland Type: Valley

Development Type: Undeveloped

Map Slope: 0.0040

Effective Slope: 0.0040

Q for Flow Path (cfs): 15.94

Avg Velocity (ft/s): 0.79

Passed Scour Check: YES

Scour Velocity (ft/sec): 1.75

Ventura County Watershed
Protection District
Modified Rational Method Hydrology
Program (VCRat v2.6)

Modified Rational Model
Results Report

Job: 1 Project: Calpine
Mission Rock

Project Description

Pre Developed Conditions Mission Rock

VCRat version: 2.6.2009.7
VCRain version: 200703
DOS EXE version: PC 2.2-200809

♀

Ventura County Watershed
Protection District
Modified Rational Method Hydrology
Program (VCRat v2.6)

Job: 1 Project: Calpine
Mission Rock
Page: 2

```
                                                                    Model Results
   |---------- SUBAREA DATA AND RESULTS --------|-- ACCUMULATED DATA --|------------
ROUTING AFTER ACCUMULATION ---------------------------------|
   | NODE   SOIL  RAIN   TC    %    AREA  FLOW  |  AREA    FLOW   TIME |  CHANNEL
LENGTH   SLOPE     SIZE    H:V       N VALUES      VEL  DEPTH |
   |  ID    TYPE  ZONE (MIN)  IMP   (AC)  (CFS) |  (AC)    (CFS)  (MIN)|    TYPE
(FT)   (FT/FT)    (FT)    (Z)     CHNL   SIDES  (FT/S)  (FT) |

|-------------------------------------------|----------------------|---------------
-------------------------------------------------------------|
       1A :  Sub Area 1
       1A :  Clearing Hydrograph Bank:  A
       1A   ---   ---    --   --    ---    ---        0       0   ----    -------
----  -------    ---     ----    -----  -----    --     --
       2B :  Subarea 2
       2B :  Clearing Hydrograph Bank:  B
       2B   070   K100    6   90     10     42       10      42   1153    -------
----  -------    ---     ----    -----  -----    --     --
```

Issue/Warning Messages

```
      TYPE      ERR NO   PROCEDURE    LOCATION   MESSAGE

--------------------------------------------------------------------------------
-------------------------------------------------------
       NO ISSUES OR WARNINGS DETECTED
♀                                                    Ventura County Watershed
Protection District
                                                 Modified Rational Method Hydrology
Program (VCRat v2.6)

                                                        Job:      1  Project: Calpine
Mission Rock
Page:     3
                                                                  Hydrograph Printouts

--------------------------------------------------------------------------------
-----------------
            HYDROGRAPH PRINTOUT AT:    2B
--------------------------------------------------------------------------------
-----------------
            DESCRIPTION: Subarea 2
       2B :  Clearing Hydrograph Bank:  B
            TOTAL AREA TO HYDROGRAPH:      10    acres
            HYDROGRAPH PEAK:               42    cfs
            TIME OF PEAK:                1153    minutes
            HYDROGRAPH VOLUME:              7.21 acre-ft

     TIME     FLOW    TIME     FLOW    TIME     FLOW    TIME     FLOW    TIME
FLOW
     (min)    (cfs)   (min)    (cfs)   (min)    (cfs)   (min)    (cfs)   (min)
(cfs)

--------------------------------------------------------------------------------
        0       0.00   100       2.31   200       2.51   300       2.87   400
2.87
      500       3.03   600       3.18   700       3.33   800       3.49   900
3.85
     1000       4.46  1050       5.23  1100       5.51  1110       7.18  1120
6.62
     1130       8.72  1131       8.72  1132       8.72  1133       8.98  1134
9.32
     1135       9.58  1136       9.41  1137       9.83  1138      10.18  1139
10.26
     1140      10.35  1141      10.86  1142      11.71  1143      11.97  1144
12.40
     1145      13.51  1146      14.54  1147      15.22  1148      16.01  1149
21.75
     1150      27.29  1151      25.70  1152      36.77  1153      41.52  1154
41.52
     1155      35.94  1156      30.08  1157      30.26  1158      17.47  1159
11.37
     1160      10.00  1161       8.98  1162       8.21  1163       7.70  1164
7.87
     1165       7.27  1166       6.76  1167       6.50  1168       6.41  1169
6.76
     1170       5.64  1171       5.90  1172       5.81  1173       5.81  1174
5.73
     1175       5.13  1176       5.47  1177       5.22  1178       5.05  1179
5.05
     1180       4.96  1181       4.96  1182       4.96  1183       4.96  1184
5.05
     1185       5.05  1186       4.96  1187       4.96  1188       4.96  1189
```

```
5.05
     1190       4.96  1191       4.96  1192       4.96  1193       4.96  1194
4.96
     1195       4.96  1196       4.96  1197       4.96  1198       5.05  1199
4.96
     1200       4.96  1201       4.79  1202       4.79  1203       4.62  1204
4.53
     1205       4.45  1206       4.28  1207       4.36  1208       4.28  1209
4.36
     1210       4.28  1211       4.28  1212       4.36  1213       4.36  1214
4.36
     1215       4.28  1216       4.36  1217       4.45  1218       4.36  1219
4.28
     1220       4.36  1221       4.45  1222       4.36  1223       4.28  1224
4.36
     1225       4.45  1226       4.36  1227       4.28  1228       4.36  1229
4.45
     1230       4.36  1231       4.28  1232       4.36  1233       4.36  1234
4.28
     1235       4.28  1236       4.28  1237       4.28  1238       4.28  1239
4.28
     1240       4.28  1241       4.28  1242       4.28  1243       4.28  1244
4.28
     1245       4.28  1246       4.28  1247       4.28  1248       4.28  1249
4.28
     1250       4.28  1251       4.28  1252       4.28  1253       4.28  1254
4.28
     1255       4.28  1256       4.28  1257       4.28  1258       4.28  1259
4.28
     1260       4.28  1261       4.28  1262       4.10  1263       4.02  1264
4.02
     1265       3.93  1266       3.85  1267       3.76  1268       3.85  1269
3.93
     1270       3.85  1271       3.76  1272       3.85  1273       3.93  1274
3.85
     1275       3.76  1276       3.85  1277       3.93  1278       3.85  1279
3.76
     1280       3.85  1281       3.93  1282       3.85  1283       3.76  1284
3.85
     1285       3.93  1286       3.85  1287       3.76  1288       3.85  1289
3.93
     1290       3.85  1291       3.76  1292       3.85  1293       3.85  1294
3.85
     1295       3.76  1296       3.85  1297       3.93  1298       3.85  1299
3.85
     1300       3.85  1310       3.18  1320       3.23  1330       3.23  1340
3.18
     1350       2.41  1360       2.36  1370       2.41  1380       2.41  1390
2.36
     1400       2.41  1420       1.67  1440       1.67  1460       0.00  1500
0.00
```

♀ Ventura County Watershed
Protection District
Modified Rational Method Hydrology
Program (VCRat v2.6)

Job: 1 Project: Calpine
Mission Rock
Page: 4

VCRat Model Input
Model Lines

```
--------------------------------------------------------------------------------
-----------------
005     1  001A Header place holder
005     1  002B Header place holder
999
999
006     1  001A 010      099A97                                G1
006     1  002B 070090001006B98                              1 B2
999
```

VENTURA COUNTY WATERSHED PROTECTION DISTRICT

TIME OF CONCENTRATION

TC Program Version: 2.6.2009.7

Project: Calpine Mission Rock

Date: 12:00:00 AM

Engineer: Jonas Dahlgren

Consultant: Worley Parsons

S U M M A R Y O F C O M P U T A T I O N S

Watershed Name: Post Conditions Watershed

Name	Zone	Storm	Soil	Area (acres)	TC (min)
Tc SubArea 1	K	100	7.00	4.8 / 5	16.325 / 16
Tc SubArea 2	K	100	7.00	5.0 / 5	17.206 / 17

Watershed Name: Post Conditions Watershed

Sub-Area Name: Tc SubArea 1

Tc: 16.325 Minutes

DATA FOR SUB AREA 1

SUB AREA TIME OF CONCENTRATION: 16.325 min. = 16 min.

SUB AREA INPUT DATA

Sub Area Name: Tc SubArea 1

Total Area (ac): 4.77

Flood Zone: 2

Rainfall Zone: K

Storm Frequency (years): 100

Development Type: Undeveloped

Soil Type: 7.00

Percent Impervious: 50

SUB AREA OUTPUT

Intensity (in/hr): 2.790

C Total: 0.637

Sum Q Segments (cfs): 8.48

Q Total (cfs): 8.48

Sum Percent Area (%): 100.0

Sum of Flow Path Travel Times (sec): 979.53

Time of Concentration (min): 16.325

DATA FOR FLOW PATH 1

Flow Path Name: 1

FLOW PATH TRAVEL TIME (min): 16.3255

Flow Type: Overland

Length (ft): 779.13

Top Elevation (ft): 191.3

Bottom Elevation (ft): 187.4

Contributing Area (acres): 4.77

Percent of Sub-Area (%): 100.0

Overland Type: Valley

Development Type: Undeveloped

Map Slope: 0.0050

Effective Slope: 0.0050

Q for Flow Path (cfs): 8.48

Avg Velocity (ft/s): 0.80

Passed Scour Check: YES

Scour Velocity (ft/sec): 1.68

Project: Calpine Mission Rock

Date: 12:00:00 AM

Engineer: Jonas Dahlgren

Consultant: Worley Parsons

Sub-Area Name: Tc SubArea 2

Tc: 17.206 Minutes

DATA FOR SUB AREA 2

SUB AREA TIME OF CONCENTRATION: 17.206 min. = 17 min.

SUB AREA INPUT DATA

Sub Area Name: Tc SubArea 2

Total Area (ac): 5.02

Flood Zone: 2

Rainfall Zone: K

Storm Frequency (years): 100

Development Type: Undeveloped

Soil Type: 7.00

Percent Impervious: 25

SUB AREA OUTPUT

Intensity (in/hr): 2.704

C Total: 0.469

Sum Q Segments (cfs): 6.37

Q Total (cfs): 6.37

Sum Percent Area (%): 100.0

Sum of Flow Path Travel Times (sec): 1,032.35

Time of Concentration (min): 17.206

DATA FOR FLOW PATH 1

Flow Path Name: 2

FLOW PATH TRAVEL TIME (min): 17.2058

Flow Type: Overland

Length (ft): 821.14

Top Elevation (ft): 191.3

Bottom Elevation (ft): 187.19

Contributing Area (acres): 5.02

Percent of Sub-Area (%): 100.0

Overland Type: Valley

Development Type: Undeveloped

Map Slope: 0.0050

Effective Slope: 0.0050

Q for Flow Path (cfs): 6.37

Avg Velocity (ft/s): 0.80

Passed Scour Check: YES

Scour Velocity (ft/sec): 0.50

Ventura County
Watershed Protection District
Modified Rational
Method Hydrology Program (VCRat v2.6)

Modified
Rational Model Results Report

Job: 1
Project: Calpine Mission Rock

Project Description

Post Conditions Mission Rock

VCRat version: 2.6.2009.7
VCRain version: 200703
DOS EXE version: PC 2.2-200809

Model Results

```
   |---------- SUBAREA DATA AND RESULTS --------|-- ACCUMULATED
DATA --|------------ ROUTING AFTER ACCUMULATION
---------------------------------|
   | NODE   SOIL  RAIN   TC    %    AREA  FLOW  |  AREA    FLOW
TIME |  CHANNEL  LENGTH   SLOPE     SIZE    H:V       N VALUES
VEL  DEPTH |
   |  ID    TYPE  ZONE (MIN)  IMP   (AC)  (CFS) |  (AC)    (CFS)
(MIN)|    TYPE    (FT)   (FT/FT)    (FT)    (Z)     CHNL   SIDES
(FT/S)  (FT) |
   |---------------------------------------------
|----------------------
|------------------------------------------------------------------
---------|
       1A :  Sub Area 1
       1A :  Clearing Hydrograph Bank:  A
       1A   ---   ---    --   --    ---    ---        0       0
----    -------    ----  -------    ---     ----    -----  -----
--     --
       2B :  Subarea 2
       2B :  Clearing Hydrograph Bank:  B
       2B   070   K100   17   37     10     15       10      15
1156    -------    ----  -------    ---     ----    -----  -----
--     --
```

Issue/Warning Messages

```
      TYPE      ERR NO   PROCEDURE    LOCATION   MESSAGE
     ------------------------------------------------------------
------------------------------------------------------------------
----------------
       NO ISSUES OR WARNINGS DETECTED
```

Hydrograph Printouts

HYDROGRAPH PRINTOUT AT: 2B

DESCRIPTION: Subarea 2
2B : Clearing Hydrograph Bank: B
TOTAL AREA TO HYDROGRAPH: 10 acres
HYDROGRAPH PEAK: 15 cfs
TIME OF PEAK: 1156 minutes
HYDROGRAPH VOLUME: 3.06 acre-ft

TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)
0	0.00	100	0.95	200	1.04	300	1.18	400	1.18
500	1.25	600	1.31	700	1.37	800	1.44	900	1.58
1000	1.84	1050	2.16	1100	2.27	1110	2.67	1120	2.82
1130	3.24	1131	3.29	1132	3.34	1133	3.43	1134	3.53
1135	3.61	1136	3.64	1137	3.75	1138	3.80	1139	3.85
1140	3.92	1141	4.03	1142	4.13	1143	4.23	1144	4.34
1145	4.55	1146	4.76	1147	4.97	1148	5.18	1149	6.03
1150	7.52	1151	7.36	1152	12.00	1153	14.26	1154	14.63
1155	14.76	1156	14.79	1157	14.69	1158	14.42	1159	14.13
1160	13.91	1161	13.49	1162	12.81	1163	12.13	1164	11.64
1165	10.83	1166	8.28	1167	6.15	1168	6.09	1169	4.40
1170	3.42	1171	3.14	1172	2.97	1173			

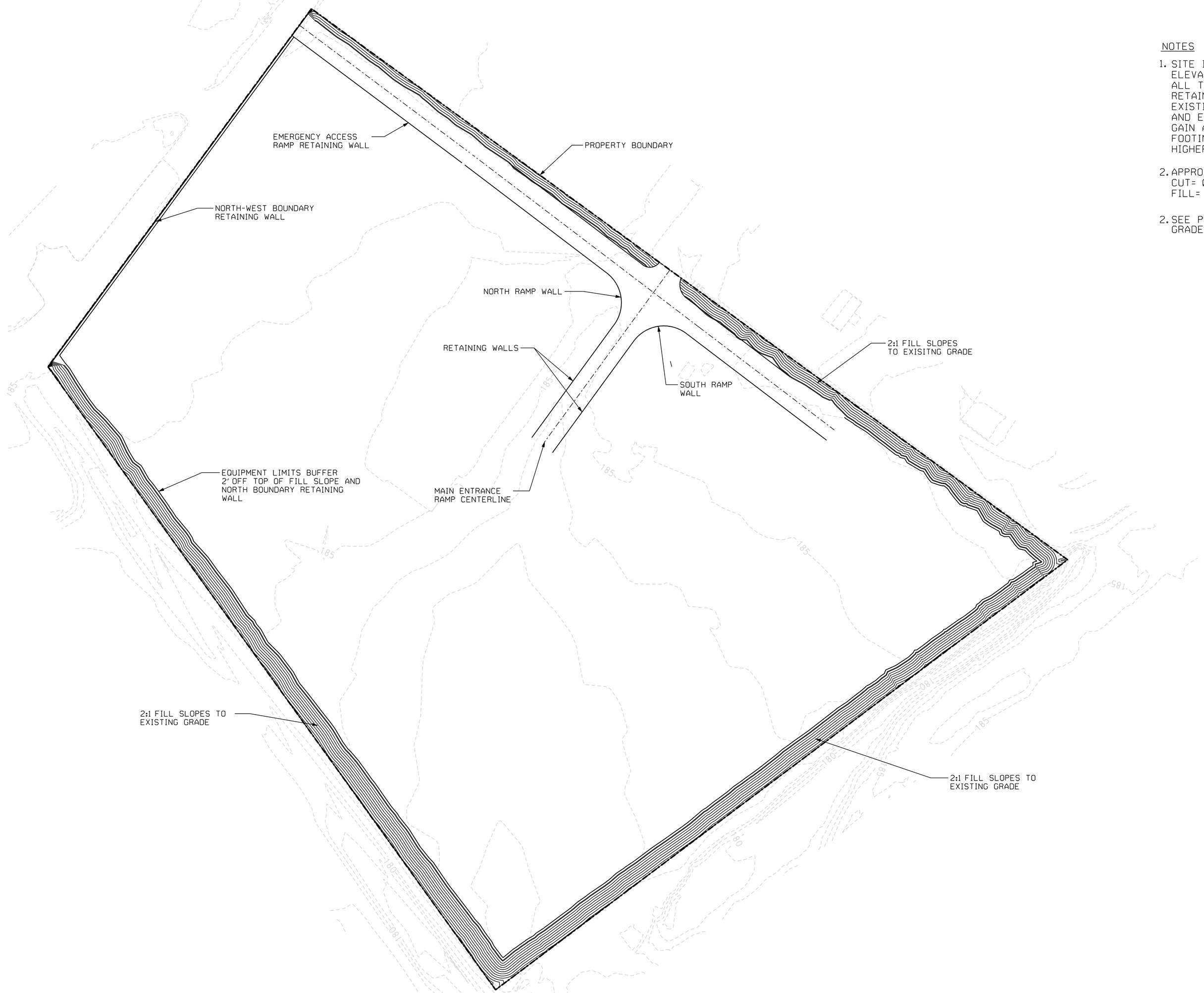
2.82	1174	2.72					
	1175	2.64	1176	2.56	1177	2.45	1178
2.40	1179	2.36					
	1180	2.32	1181	2.21	1182	2.22	1183
2.19	1184	2.19					
	1185	2.16	1186	2.06	1187	2.11	1188
2.09	1189	2.08					
	1190	2.06	1191	2.05	1192	2.04	1193
2.04	1194	2.05					
	1195	2.06	1196	2.05	1197	2.05	1198
2.05	1199	2.04					
	1200	2.05	1201	2.03	1202	2.01	1203
2.00	1204	1.99					
	1205	1.96	1206	1.94	1207	1.94	1208
1.91	1209	1.91					
	1210	1.89	1211	1.86	1212	1.85	1213
1.85	1214	1.83					
	1215	1.80	1216	1.80	1217	1.79	1218
1.79	1219	1.78					
	1220	1.79	1221	1.79	1222	1.79	1223
1.79	1224	1.79					
	1225	1.80	1226	1.79	1227	1.79	1228
1.80	1229	1.80					
	1230	1.79	1231	1.79	1232	1.80	1233
1.79	1234	1.78					
	1235	1.79	1236	1.79	1237	1.78	1238
1.78	1239	1.78					
	1240	1.78	1241	1.78	1242	1.77	1243
1.77	1244	1.78					
	1245	1.77	1246	1.75	1247	1.77	1248
1.77	1249	1.75					
	1250	1.77	1251	1.77	1252	1.75	1253
1.77	1254	1.77					
	1255	1.75	1256	1.77	1257	1.77	1258
1.75	1259	1.77					
	1260	1.77	1261	1.75	1262	1.74	1263
1.73	1264	1.72					
	1265	1.72	1266	1.70	1267	1.68	1268
1.68	1269	1.68					
	1270	1.65	1271	1.64	1272	1.64	1273
1.63	1274	1.62					
	1275	1.60	1276	1.59	1277	1.59	1278
1.58	1279	1.58					
	1280	1.59	1281	1.59	1282	1.58	1283
1.58	1284	1.59					
	1285	1.59	1286	1.58	1287	1.58	1288
1.59	1289	1.59					
	1290	1.58	1291	1.58	1292	1.59	1293
1.58	1294	1.58					
	1295	1.58	1296	1.59	1297	1.59	1298
1.58	1299	1.58					
	1300	1.59	1310	1.43	1320	1.32	1330

1.33 1340 1.32
1350 1.12 1360 0.98 1370 0.98 1380
0.99 1390 0.98
1400 0.98 1420 0.69 1440 0.69 1460
0.00 1500 0.00

VCRat Model Input
Model Lines

```
-------------------------------------------------------------------
-------------------------------------
005     1  001A Header place holder
005     1  002B Header place holder
999
999
006     1  001A 010      099A97                                G1
006     1  002B 070037001017B98                              1 B2
999
```

APPENDIX F – CONCEPTUAL GRADING PLANS



LEGEND

- EXISTING CONTOUR
- PROPOSED CONTOUR
- PROPERTY BOUNDARY

NOTES

1. SITE IS TO BE RAISED TO THE 100 YEAR FLOOD PLAIN ELEVATION OF 191.3 AND 3:1 SLOPES TO EXISTING GRADE AROUND ALL THE SIDES, EXCEPT THE NORTH-WEST SIDE WILL HAVE A SMALL RETAINING WALL AROUND 4 FEET TALL. RAMPS FROM EXISTING GRADE WILL BE INSTALLED AT THE MAIN ENTRANCE AND EMERGENCY ACCESS AT THE NORTH-WEST CORNER TO GAIN ACCESS TO THE SITE. ALL TOP OF EQUIPMENT FOUNDATION FOOTINGS WILL CONSTRUCTED AT ELEVATION 192.3 ONE FOOT OR HIGHER ABOVE THE 100 YEAR FLOOD PLAIN ELEVATION OF 191.3.

2. APPROXIMATE EXCAVATION QUANTITIES:
   CUT= 0 CUBIC YARDS
   FILL= 110,000 CUBIC YARDS

2. SEE PROFILE SHEET FOR RAMPS INTO SITE FROM EXISTING GRADES.

N

0 50 100

1"=50'

PRELIMINARY
NOT FOR CONSTRUCTION

WorleyParsons
resources & energy

CLIENT/PROJECT TITLE

CALPINE MISSION ROCK

GRADING PLAN EXHIBIT

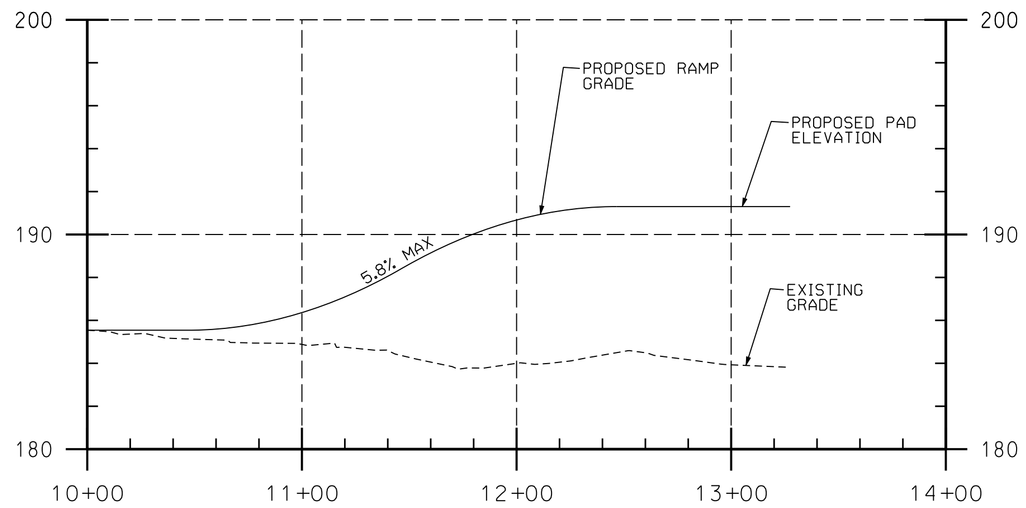
SCALE	DRAWING SIZE
1"=40'	24x36

WORLEYPARSONS DWG. NO.

REV

$$DESIGN-FILE-NAME$$
$$$DATE$$$ $$$$TIME$$$$

...\Grading Exhibit 092915.dgn 10/7/2015 11:03:13 AM

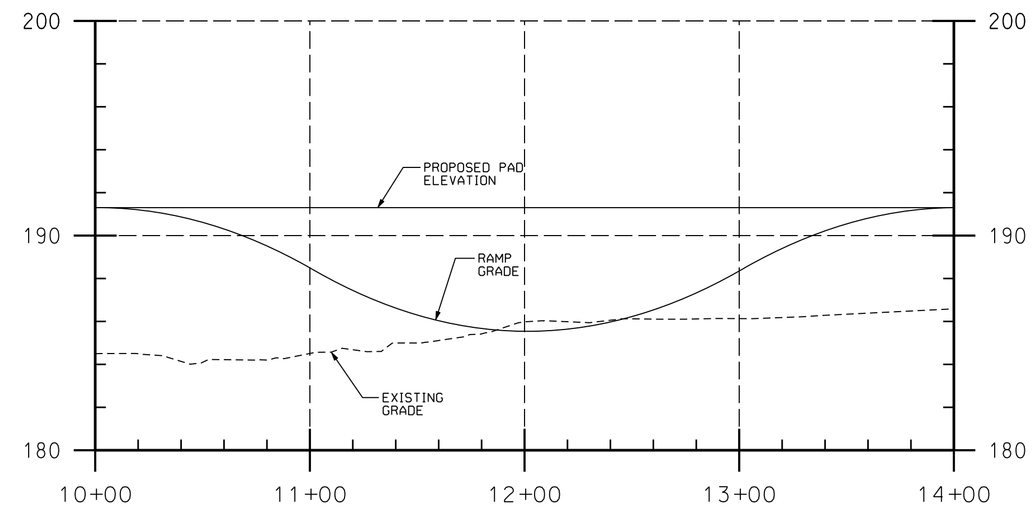


LINE	SURFACE	OFFSET
——	Mission Rock Pad 191.3	
——	Mission Rock Topo 082615	

Scaled 10.0000 Times Ver.
Scaled 1.0000 Times Hor.

Main Entrance Ramp Profile

NOT TO SCALE

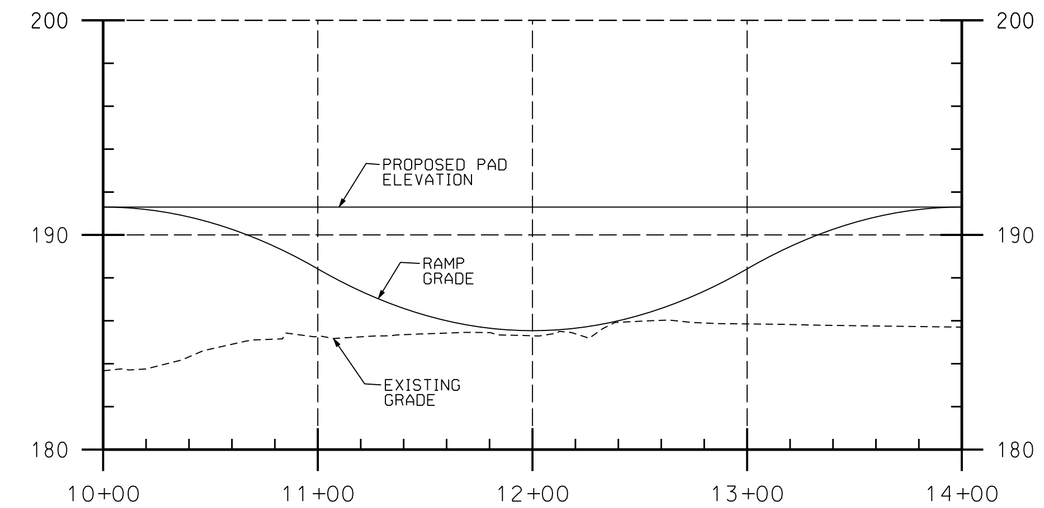


LINE	SURFACE	OFFSET
——	Mission Rock Pad 191.3	
——	Mission Rock Topo 082615	

Scaled 10.0000 Times Ver.
Scaled 1.0000 Times Hor.

North Ramp Wall Profile

NOT TO SCALE

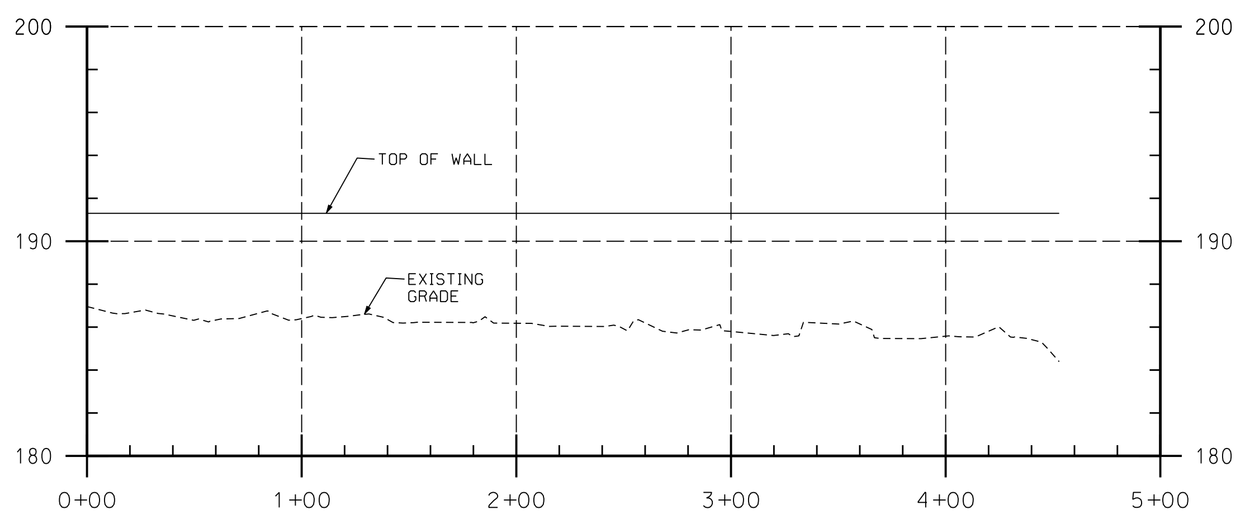


LINE	SURFACE	OFFSET
——	Mission Rock Pad 191.3	
——	Mission Rock Topo 082615	

Scaled 10.0000 Times Ver.
Scaled 1.0000 Times Hor.

South Ramp Wall Profile

NOT TO SCALE

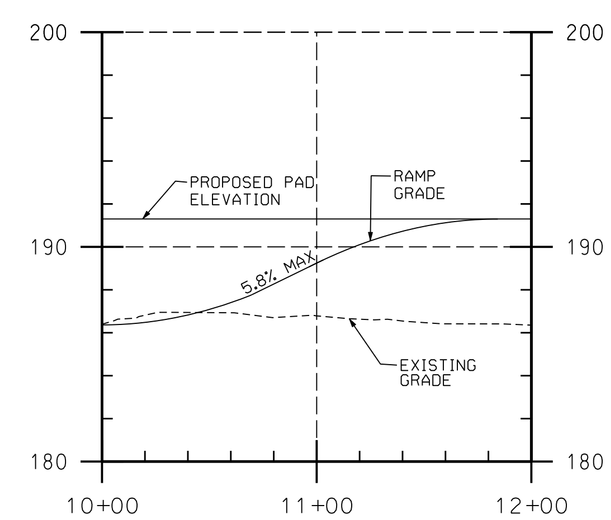


LINE	SURFACE	OFFSET
——	Mission Rock Pad 191.3	
——	Mission Rock Topo 082615	

Scaled 10.0000 Times Ver.
Scaled 1.0000 Times Hor.

North-West Boundary Wall Profile

NOT TO SCALE



LINE	SURFACE	OFFSET
——	Mission Rock Pad 191.3	
——	Mission Rock Topo 082615	

Scaled 10.0000 Times Ver.
Scaled 1.0000 Times Hor.

Emergency Access Wall Profile

NOT TO SCALE

WorleyParsons
resources & energy

CLIENT/PROJECT TITLE

CALPINE MISSION ROCK

GRADING PLAN EXHIBIT
RAMP PROFILES

SCALE 1"=50'
DRAWING SIZE 24x36
WORLEYPARSONS DWG. NO.
REV

$$DESIGN-FILE-NAME$$
$$$$DATE$$$$ $$$$TIME$$$$

...\Grading Exhibit 092915 sheet 2.dgn 9/29/2015 2:58:39 PM