CITY OF MENIFEE

MEMORANDUM

PUBLIC WORKS/ENGINEERING DEPARTMENT

DATE: **November 17, 2021**

TO: **Russell Brown, Senior Planner, Community Development Department**

FROM: **Chet Robinson, PE, GE, Associate Engineer**

CC: **Raquel Castro, Office Specialist II**

RE: **Ethanac and Barnett Warehouse – Drainage Report, RPT21-047, PC1**

The comments noted herein are for review of the following:

- Preliminary Drainage Study for Phelan – Barnett (Preliminary Engineering), Prepared by SDH & Associates, Inc., Job Number 2113, dated August 17, 2021.

The attached comments are provided by the City's Public Works / Engineering Department following review of the referenced Drainage Report. Please see attached redlines for additional comments.

Any questions can be directed to Chet Robinson, at (951) 723-3879, or by email at crobinson@cityofmenifee.us.

IF REDLINES WERE ATTACHED TO THIS MEMO, PLEASE RETURN ALL REDLINED PLANS WITH RESUBMITTALS. NO RESUBMITTALS WILL BE ACCEPTED WITHOUT THE REDLINES.

November 15, 2021

Mr. Chet Robinson
Associate Engineer
City of Menifee
29714 Haun Road
Menifee, CA 92586

Re: Ethanac Business Park - Review of WQMP and Drainage Reports

Dear Mr. Robinson,

JLC Engineering & Consulting Inc. (JLC) has reviewed the Ethanac Business Park WQMPs and Drainage Reports. The project is located within the Romoland/Homeland ADP area. The design concept in general for a local drainage perspective addresses the onsite water quality and runoff issues. However, the major constraint with the project is the timing associated with the construction of the overall ADP facilities. The ADP Map indicates that the Line A-11 and Line A-13 front the project. The Line A-11 appears to be in place and is currently maintained by the City of Perris. At this time, Line A-13 is not in place. The project must demonstrate that the project does not require mitigation measures or exacerbate ponding or flooding issues to adjacent property owners. The report claim that impacts are not anticipated; however, more discussion and qualitative evidence must be provided.

PRELIMINARY DRAINAGE REPORT

The onsite report has addressed onsite flooding and drainage issues. The report needs to provide further quantitative evidence on how the offsite areas function in the existing condition and how the project will either impact or not impact existing drainage patterns. The comments below provide comments based on the review of the drainage report.

1. Provide an overview of existing storm drain infrastructure, proposed storm drainage infrastructure and ultimate storm drain infrastructure.
2. Provide a discussion where existing flow direction from parcels adjacent to project and east of Barnett. This should include a discussion and perhaps an exhibit how the project would not adversely impact or obstruct drainage patterns.
3. If any drainage patterns are impeded provide a mitigation measure to resolve upstream ponding or blockage of runoff.
4. Provide a discussion how project meets the street design criteria for street flooding.
5. Provide a discussion on where APN 331-060-032 & 331-060-033 are tabled to flow. Doe these flows go to Line A-13 or Line A. If Line A, project must provide a storm drain connection or an easement in order for this property owner to connect to Line A.

6. Project is currently proposing storm drain to solve onsite runoff issues. Project is not proposing any ADP storm drain facilities along the project frontage. This is acceptable since project will be required to pay an ADP Fee for the area. However, the project must demonstrate that these facilities are not required to solve any drainage issues that are created by the project, improvements required as part of street infrastructure, or improvements required to meet City ordinance, such as street capacity requirements for 100 year and 10 year storm event.
7. Please address additional comments provided within the report.

PRELIMINARY WQMP

The WQMP address the minimum requirements to meet water quality measures required for the project. Based on a phone call with the engineer, it is understood that another BMP solution will be submitted to address water quality. The following comments have been provided that require resolution before approval:

1. How will the project treat runoff from any proposed offsite street improvements. Additional discussion to this issue must be provided. The resolution to the offsite roadway water quality issue may be a challenge. As a result, through discussion and arguments must be provided how this area will be addressed.
2. Please address additional comments provided within the WQMP.

Please make corrections to the Preliminary Drainage Report and Preliminary WQMP and resubmit for review. If you have any questions, please call me at (951) 304-9552

Sincerely,

Joseph L. Castaneda, P.E.
JLC Engineering & Consulting, Inc.
41660 Ivy Street, Suite A
Murrieta, CA 92562
Phone: (951) 304-9552
Fax: (951) 304-3568

PRELIMINARY DRAINAGE STUDY
FOR
PHELAN – BARNETT

(PRELIMINARY ENGINEERING)

Job Number 2113

August 17, 2021

Comment overview:

1. Provide an overview of existing storm drain infrastructure, proposed storm drain infrastructure and ultimate storm drain infrastructure.

2. Provide a discussion where existing flow direction from parcels adjacent to project and east of Barnett. This should include a discussion and perhaps an exhibit how the project would not adversely impact or obstruct drainage patterns

3. If any drainage patterns are impeded provide a mitigation measure to resolve upstream ponding or blockage of runoff.

4. Provide a discussion how project meets the street design criteria for street flooding.

5. Provide a discussion on where APN 331-060-032 & 331-060-033 are tabled to flow. Doe these flows go to Line A-13 or Line A. If Line A, project must provide a storm drain connection or an easement in order for this property owner to connect to Line A.

6. Project is currently proposing storm drain to solve onsite runoff issues. Project is not proposing any ADP storm drain facilities along the project frontage. This is acceptable since project will be required to pay an ADP Fee for the area. However, the project must demonstrate that these facilities are not required to solve any drainage issues that are created by the project, improvements required as part of street infrastructure, or improvements required to meet City ordinance, such as street capacity requirements for 100 year and 10 year storm event.

PRELIMINARY DRAINAGE STUDY

FOR

PHELAN – BARNETT

(PRELIMINARY ENGINEERING)

Job Number 2113

Nobu Murakami, P.E.
R.C.E. #78149
Exp. 09/30/2021

Prepared for:
Phelan Development Company
450 Newport Center Drive, Suite 405
Newport Beach, CA 92660
Telephone: (949) 720-8050

Prepared by:

SDH & Associates, Inc.
27363 Via Industria
Temecula, California 92590
Telephone: (951) 683-3691

August 17, 2021

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1.0 INTRODUCTION

1.1 Project Description

This drainage study presents preliminary engineering hydrologic and hydraulic analyses for the proposed Phelan – Barnett project (herein referred to as "the project"). The project is located in the City of Menifee, bounded by Ethanac Road to the north, Barnett Road to the east, Master Drainage Plan (MDP) Romoland Line A flood control channel to the west, and an undeveloped parcel to the south. Refer to Figure 1.0 for a Vicinity Map of the project.

1.2 Project Features

The overall project parcel (gross lot area) consists of approximately 13.9 acres while the overall drainage area is approximately 14.0 acres in the post-project condition. The proposed improvements will consist of a tilt-up warehouse building and associated parking areas, sidewalks, and landscape areas. This also includes minor improvement for the easterly frontage Barnett Road. In order to comply with the Riverside County drainage and water quality management requirements, the project also includes construction of permanent stormwater BMPs along the westerly edge of the project.

Discuss where this runoff parcel is supposed drain per Line A Hydrology Workmap prepared by RCFC&WCD

1.3 Drainage Characteristics

In the existing condition, the site consists of open, undeveloped space and runoff from the site generally drains in a northwesterly direction towards an existing Master Drainage Plan (MDP) Romoland Line A flood control channel. Regarding offsite drainage, there is a sliver of area from a portion of Barnett Road that appears to contribute to the northeasterly parcel (PM 37289 – not a part of this project) via a break in the existing berm/dike along Barnett Road. However, this area is located outside of the project boundary. A part of this parcel appears to drain onto the project and sheet-flows towards the existing MDP Romoland Line A flood control channel. Separately, a portion of the area from the existing southeasterly parcel (Por. Lot 1255 / MB 16/77-79) appears to run-on to the project site and sheet-flows towards the existing MDP Romoland Line A flood control channel. Runoff in the MDP Romoland Line A eventually discharges into the existing San Jacinto River, which ultimately discharges to Canyon Lake and then Lake Elsinore.

Discuss where this runoff parcel is supposed drain per Line A Hydrology Workmap prepared by RCFC&WCD

May be revised to Modular Wetlands per phone call with Engineer

In the post-project condition, the drainage characteristics compared to the pre-project condition. Runoff from the site will be captured via proposed catch basins and conveyed via proposed storm drain pipes towards two (2) proposed bioretention facilities (basins) along the westerly edge of the project for the purpose of storm water quality treatment, prior to discharging into the MDP Romoland Line A. A frontage street along Barnett Road is anticipated to be improved as part of this project and the drainage characteristic will be maintained as similar to the existing condition. This area is expected to drain towards the northeasterly parcel (PM 37289) as it does in the existing condition. It is anticipated that future development on this parcel (PM 37289) will address the run-on from Barnett Road. Also, it is our current understanding that there will be no run-on to the project from the future development on the northeasterly parcel. Separately, it is unknown at this time as to when the southeasterly parcel (Por. Lot 1255 / MB 15/77-79) may be developed. At this time, it is anticipated that runoff from the southeasterly parcel (when developed) will provide its own connection and discharge directly into the existing MDP Romoland Line A flood control channel outside of the project.

1.4 FEMA Flood Hazard Zone Information

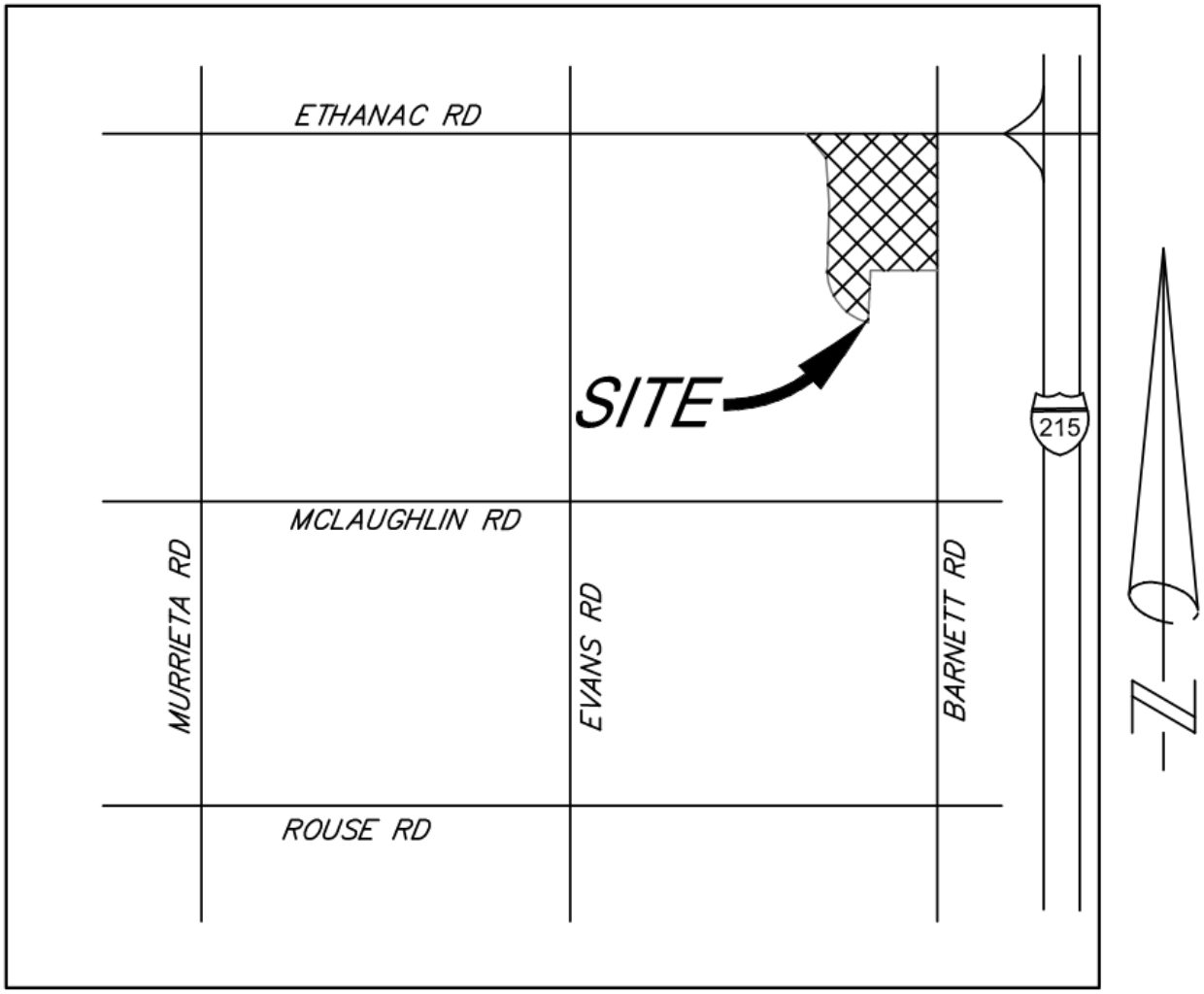
The project is shown on the FEMA Flood Insurance Rate Map (FIRM) number 06065C2055H, effective August 18, 2014. Based on the FIRM (latest version available from the FEMA website as of July 2021), the project including the water courses around the project have been identified to be within "Zone A". However, based on our recent coordination with the Riverside County Flood Control and Water Conservation District (RCFC & WCD), it is understood that the project site has been removed from the Zone A floodplain based on the LOMR the District is currently has in for review with FEMA for the dredging of Line A to the ultimate depth. Therefore, no FEMA submittals/processing are anticipated to be required for this project. For reference purpose, a copy of the FIRMette (reduced size) is included at the end of Appendix A.

1.6 Water Quality Management

In support of the preliminary site plan, a preliminary Water Quality Management Plan (WQMP) has been prepared for the project. The report is titled, "Preliminary Water Quality Management Plan for Phelan – Barnett," dated August 17, 2021, prepared by SDH & Associates, Inc. (Job Number 2113). The preliminary WQMP documents how the project addresses the requirements regarding

permanent stormwater quality management, in accordance with the stormwater guidance document titled, “2010 Water Quality Management Plan for the Santa Ana Region of Riverside County.”

Figure 1: Vicinity Map



2.0 HYDROLOGY

Preliminary hydrologic calculations were prepared in accordance with the Riverside County Flood Control and Water Conservation District - Hydrology Manual, dated April 1978 (manual) for preliminary on-site storm drain sizing purpose. The Hydrowin Advanced Engineering Software (AES) 2016 Rational Method Analysis (Version 23.0) program was used to perform the hydrologic analysis in this study.

The AES hydrologic model is developed by creating independent node-link models of each interior drainage basin and linking these sub-models together at confluence points. The program has the capability to perform calculations for 15 hydrologic processes. These processes are assigned code numbers that appear in the results. The code numbers and their significances are as follows:

Subarea Hydrologic Processes (Codes)

Code 1: Confluence analysis at a node
Code 2: Initial subarea analysis
Code 3: Pipe flow travel time (computer-estimated pipe sizes)
Code 4: Pipe flow travel time (user-specified pipe size)
Code 5: Trapezoidal channel travel time
Code 6: Street flow analysis through a subarea
Code 7: User-specified information at a node
Code 8: Addition of the subarea runoff to mainline
Code 9: V-Gutter flow through a subarea
Code 10: Copy main-stream data onto a memory bank
Code 11: Confluence a memory bank with the main-stream memory
Code 12: Clear a memory bank
Code 13: Clear the main-stream memory
Code 14: Copy a memory bank onto the main-stream memory
Code 15: Hydrologic data bank storage functions

In order to perform the hydrologic analysis; base information for the study area is required. This information includes the drainage facility locations and sizes, land uses, flow patterns, drainage basin boundaries, and topographic elevations. Compiled Hydrologic backup is included as Appendix A to this report.

Area

Drainage boundaries were delineated to distinguish areas with similar flow characteristics and hydrologic properties as well as to determine peak flows at confluence points, proposed storm drain facilities, and to facilitate hydraulic analyses. Drainage basin boundaries, flow patterns, and topographic elevations are shown on the hydrologic workmap for the site, included in Appendix B.

Time of Concentration/Intensity

The time of concentration was calculated using the AES to determine the intensity for the 100-year storm events. The rainfall intensity was calculated in AES using the 10 and 60-minute intensity values for the project area using NOAA Atlas 14 Point Precipitation Frequency Estimates. A supporting annotated chart has been included in Appendix A.

Runoff Coefficient

The runoff coefficients used for each minor basin were calculated by the AES software based on the user-entered information of the hydrologic soil group and the land use for each basin. The percentage of impervious area (i.e. land use) in each subdrainage area was used to determine the land use entered within AES per Plate D-5.6 of the Hydrology Manual. Supporting information for parameters assigned to AES calculations is included with Appendix A of this report.

Hydrologic soil group data is available for the site through the Natural Resource Conservation Service (NRCS) Web Soil Survey, showing the site consisting primarily of type "C" soils. For the purpose of hydrologic calculations for the proposed condition, soil type C has been applied.

Topography

The onsite project specific topography consists of 1-foot contours on the NAVD-88 vertical datum, provided by Arrowhead Mapping Corp.

2.1 Hydrologic Results

The hydrologic results at key points of interest for the project can be found in Table 2.1. The summary shows the hydrologic results at the proposed on-site catch basin locations (major catch basin locations) and overall on-site peak flow at the project outlet points of interest along the westerly edge of the project. The detailed hydrologic calculation results are located in Appendix B of this report.

Table 2.1 – Peak 100-yr, 1-hour Flow Rate

Key Drainage Node ID[3]	Post-project[1]	
	Total Area (Acres)	Peak Flow Rate, Q_{100} (cfs)[2]
110 (On-site Catch Basin - Surface)	2.1	5.6
115 (On-site Catch Basin - Surface)	0.2	0.5
130 (On-site Catch Basin - Surface)	6.1	17.7 *
145 (On-site Catch Basin - Surface)	0.6	2.0
147 (On-site Catch Basin - Surface)	0.3	1.0
180 (On-site – Outlet from Proposed BMP)	9.7	26.8
210 (On-site Catch Basin - Surface)	1.3	5.2
215 (On-site Catch Basin - Surface)	0.6	1.7
280 (On-site – Outlet from Proposed BMP)	4.3	15.3

Note:

1: Refer to Appendix A for supporting information.

2: "cfs"= cubic feet per second.

3: Refer to Appendix B for Drainage Study Map

4: Flows at Node 130 may be too large for a typical catch basin. During final engineering, the drainage area to this location may be subdivided further to capture at one or two more locations to provide adequate capacity.

General comment: I recommend developing an exhibit showing existing infrastructure and the proposed facilities that need to be constructed to address the following:
1. Meet Street Flooding design criteria
2. Ensure impacts to upstream property owners are not exacerbated.

3.0 HYDRAULICS

3.1 Hydraulic Methodology and Criteria

The 100-year, 1-hour proposed peak flow rates determined using the Modified Rational Method (AES Rational Method) outputs are used to determine preliminary sizes for the on-site storm drain system.

3.2 Inlet Sizing

Inlet design calculation specific to the proposed surface catch basin and BMP overflow catch basin will be conducted during final engineering and calculation output will be incorporated in Appendix C. In the post-project condition, the proposed inlets will be designed to intercept the 100-year, 1-hour peak flow rates.

For the proposed half width frontage street improvement within the public right-of-way, a hydraulic calculation (normal depth calculation) is anticipated to be provided (if applicable) during final engineering to check for the anticipated normal depth within the gutter and its spread width.

3.3 Storm Drain Sizing

Preliminary storm drain sizing calculations were conducted in order to size the proposed on-site private storm drain pipes. The calculations were prepared using the 100-year, 1-hour peak flow rate output from the AES Rational Method and the Manning's equation along with a sizing bump-up (typically 15 to 30%) to account for potential hydraulic losses. Typically, this calculation approach is adequate for on-site private storm drain sizing. If necessary, a more detailed hydraulic calculation may be provided during final engineering to validate the required storm drain sizes. A summary of relevant on-site storm drain sizing calculations is provided in Appendix D.

4.0 FLOOD CONTROL

The project is expected to increase the peak flow rate as a result of the proposed improvements. However, based on our coordination with Riverside County Flood Control and Water Conservation District (RCFC & WCD) in June 2021, this project (APN 331-060-036) was previously included within the watershed tributary to the Master Drainage Plan (MDP) Romoland Line A, which was constructed. It is understood from our coordination with RCFC staff that the MDP hydrology was based on the ultimate (build-out) land use condition for the project; therefore, the project would not be required to mitigate for increased runoff. Additionally, the project drains into the MDP Romoland Line A flood control channel (engineered channel) and San Jacinto River, which eventually drains to adequate sump/lake, including Canyon Lake and Lake Elsinore. Therefore, the project is anticipated to be exempt from the HCOC requirements (based on the "HCOC Exemption 3" condition in the WQMP guidance document). The project will be required to provide water quality treatment prior to discharging the project runoff into Romoland Line A and this requirement is being addressed in a separate Water Quality Management Plan (report).

Include the Line A Hydrology Calculation or workmap showing that RCFC&WCD used an industrial or commercial land use and include in Appendix A. Other option can be to obtain land use/general plan reference used in study and include in Appendix A.

Add discussion on need for an encroachment permit

5.0 CONCLUSION

This drainage study presents preliminary hydrologic and hydraulic analyses for the proposed Phelan – Barnett project. Hydrologic calculations were computed in accordance with the Riverside County Flood Control and Water Conservation District - Hydrology Manual, dated April 1978 (manual). The Advanced Engineering Software (AES) 2016 Rational Method Analysis (Version 23.0) program was used for the rational method modeling in this study. The peak discharge rates for the 100-year, 1-hour storm event have been determined for the project in order to determine the preliminary onsite storm drain sizes. In regards to flood control, the project is situated with the watershed tributary to MDP Romoland Line A flood control channel and the hydrology was based on the ultimate land use for the project site; therefore, the project would not be required to mitigate for the increased runoff. In summary, no adverse impacts are anticipated to the downstream drainage facilities as a result of the proposed project.

Appendix A

Hydrologic Backup Information

Includes:

1. Web Soil Survey Hydrologic Soil Group
2. NOAA Atlas 14 Annotated Rainfall Intensity Chart
3. FEMA FIRMette

4. Include the Line A Hydrology land use assumptions that way closure on land use consistency can be validated.

Map Scale: 1:2,980 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 40 80 160 240

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

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 1:15,800.

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:
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: Western Riverside Area, California
Survey Area Data: Version 13, May 27, 2020

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

Date(s) aerial images were photographed: May 25, 2019—Jun 25, 2019

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
EnA	Exeter sandy loam, 0 to 2 percent slopes	C	15.8	82.6%
MmB	Monserate sandy loam, 0 to 5 percent slopes	C	3.3	17.4%
Totals for Area of Interest			**19.1**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOAA Atlas 14, Volume 6, Version 2
Location name: Menifee, California, USA*
Latitude: 33.7415°, Longitude: -117.1945°
Elevation: 1422.48 ft**
* source: ESRI Maps
** source: USGS

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/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**1.03** (0.864-1.25)	**1.49** (1.25-1.80)	**2.11** (1.76-2.56)	**2.64** (2.18-3.23)	**3.41** (2.71-4.31)	**4.02** (3.13-5.20)	**4.67** (3.55-6.20)	**5.38** (3.97-7.36)	**6.38** (4.51-9.11)	**7.20** (4.91-10.7)
10-min	**0.744** (0.624-0.894)	**1.07** (0.894-1.29)	**1.51** (1.26-1.84)	**1.90** (1.57-2.32)	**2.44** (1.94-3.09)	**2.88** (2.25-3.73)	**3.35** (2.55-4.45)	**3.85** (2.84-5.27)	**4.57** (3.23-6.53)	**5.16** (3.52-7.64)
15-min	**0.600** (0.500-0.724)	**0.860** (0.720-1.04)	**1.22** (1.02-1.48)	**1.53** (1.26-1.87)	**1.97** (1.57-2.49)	**2.32** (1.81-3.00)	**2.70** (2.05-3.58)	**3.10** (2.30-4.25)	**3.69** (2.61-5.26)	**4.16** (2.84-6.16)
30-min	**0.486** (0.408-0.588)	**0.700** (0.584-0.844)	**0.992** (0.826-1.20)	**1.24** (1.03-1.52)	**1.60** (1.28-2.02)	**1.89** (1.47-2.44)	**2.20** (1.67-2.91)	**2.53** (1.87-3.45)	**3.00** (2.12-4.28)	**3.38** (2.31-5.01)
60-min	**0.351** (0.294-0.423)	**0.504** (0.421-0.609)	**0.715** (0.596-0.866)	**0.895** (0.740-1.09)	**1.15** (0.919-1.46)	**1.36** (1.06-1.76)	**1.58** (1.20-2.10)	**1.82** (1.34-2.49)	**2.16** (1.53-3.09)	**2.44** (1.66-3.61)
2-hr	**0.260** (0.218-0.314)	**0.353** (0.295-0.426)	**0.478** (0.399-0.580)	**0.584** (0.482-0.714)	**0.731** (0.583-0.925)	**0.848** (0.662-1.10)	**0.970** (0.738-1.29)	**1.10** (0.811-1.50)	**1.28** (0.904-1.83)	**1.42** (0.970-2.11)
3-hr	**0.212** (0.178-0.256)	**0.282** (0.236-0.341)	**0.377** (0.314-0.457)	**0.455** (0.376-0.556)	**0.564** (0.450-0.714)	**0.649** (0.507-0.840)	**0.738** (0.561-0.980)	**0.832** (0.614-1.14)	**0.961** (0.679-1.37)	**1.06** (0.725-1.57)
6-hr	**0.150** (0.126-0.181)	**0.197** (0.164-0.237)	**0.258** (0.215-0.313)	**0.309** (0.255-0.377)	**0.379** (0.302-0.479)	**0.433** (0.338-0.561)	**0.489** (0.372-0.650)	**0.548** (0.405-0.749)	**0.629** (0.445-0.898)	**0.692** (0.472-1.02)
12-hr	**0.099** (0.083-0.119)	**0.129** (0.108-0.156)	**0.169** (0.141-0.205)	**0.203** (0.168-0.248)	**0.249** (0.199-0.315)	**0.285** (0.223-0.369)	**0.323** (0.245-0.428)	**0.361** (0.267-0.494)	**0.415** (0.294-0.593)	**0.458** (0.312-0.678)
24-hr	**0.064** (0.057-0.074)	**0.085** (0.075-0.098)	**0.113** (0.100-0.131)	**0.137** (0.119-0.160)	**0.169** (0.143-0.204)	**0.195** (0.162-0.240)	**0.222** (0.180-0.279)	**0.250** (0.197-0.324)	**0.289** (0.219-0.390)	**0.321** (0.235-0.447)
2-day	**0.038** (0.033-0.044)	**0.051** (0.045-0.059)	**0.069** (0.061-0.080)	**0.084** (0.074-0.098)	**0.106** (0.090-0.127)	**0.123** (0.102-0.151)	**0.141** (0.114-0.177)	**0.160** (0.126-0.207)	**0.186** (0.141-0.251)	**0.208** (0.152-0.290)
3-day	**0.027** (0.024-0.031)	**0.037** (0.033-0.043)	**0.050** (0.044-0.058)	**0.062** (0.054-0.072)	**0.078** (0.066-0.095)	**0.092** (0.076-0.113)	**0.105** (0.085-0.133)	**0.120** (0.095-0.156)	**0.141** (0.107-0.190)	**0.158** (0.116-0.221)
4-day	**0.022** (0.019-0.025)	**0.030** (0.026-0.035)	**0.041** (0.037-0.048)	**0.051** (0.045-0.060)	**0.065** (0.055-0.079)	**0.076** (0.063-0.094)	**0.088** (0.072-0.111)	**0.101** (0.080-0.131)	**0.119** (0.090-0.161)	**0.134** (0.098-0.187)
7-day	**0.014** (0.012-0.016)	**0.020** (0.017-0.023)	**0.028** (0.024-0.032)	**0.035** (0.030-0.040)	**0.044** (0.038-0.054)	**0.052** (0.044-0.065)	**0.061** (0.049-0.077)	**0.070** (0.055-0.091)	**0.084** (0.063-0.113)	**0.095** (0.069-0.132)
10-day	**0.010** (0.009-0.012)	**0.015** (0.013-0.017)	**0.021** (0.018-0.024)	**0.026** (0.023-0.031)	**0.034** (0.029-0.041)	**0.040** (0.033-0.049)	**0.047** (0.038-0.059)	**0.054** (0.043-0.070)	**0.065** (0.049-0.088)	**0.074** (0.054-0.103)
20-day	**0.006** (0.005-0.007)	**0.009** (0.008-0.010)	**0.013** (0.011-0.015)	**0.016** (0.014-0.019)	**0.021** (0.018-0.025)	**0.025** (0.021-0.031)	**0.030** (0.024-0.037)	**0.035** (0.027-0.045)	**0.042** (0.032-0.057)	**0.048** (0.035-0.067)
30-day	**0.005** (0.004-0.006)	**0.007** (0.006-0.008)	**0.010** (0.009-0.012)	**0.013** (0.011-0.015)	**0.017** (0.014-0.020)	**0.020** (0.017-0.025)	**0.024** (0.020-0.030)	**0.028** (0.022-0.037)	**0.034** (0.026-0.046)	**0.040** (0.029-0.055)
45-day	**0.004** (0.003-0.004)	**0.005** (0.005-0.006)	**0.008** (0.007-0.009)	**0.010** (0.009-0.011)	**0.013** (0.011-0.016)	**0.016** (0.013-0.019)	**0.019** (0.015-0.024)	**0.022** (0.017-0.029)	**0.027** (0.021-0.036)	**0.031** (0.023-0.044)
60-day	**0.003** (0.003-0.004)	**0.005** (0.004-0.005)	**0.007** (0.006-0.008)	**0.008** (0.007-0.010)	**0.011** (0.009-0.013)	**0.013** (0.011-0.016)	**0.016** (0.013-0.020)	**0.019** (0.015-0.024)	**0.023** (0.018-0.031)	**0.027** (0.020-0.038)

[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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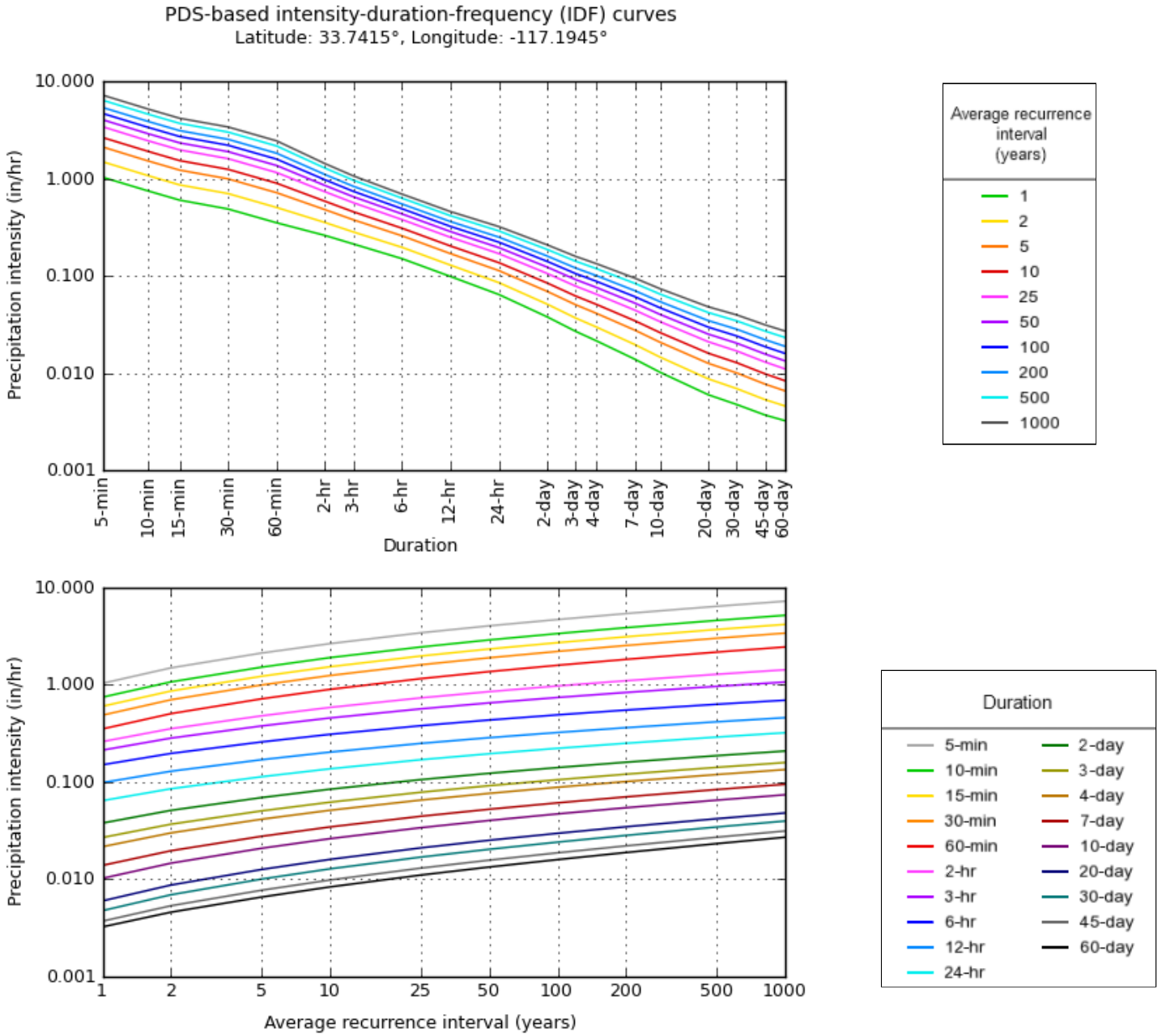
PF graphical



NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Thu Jul 8 18:19:29 2021

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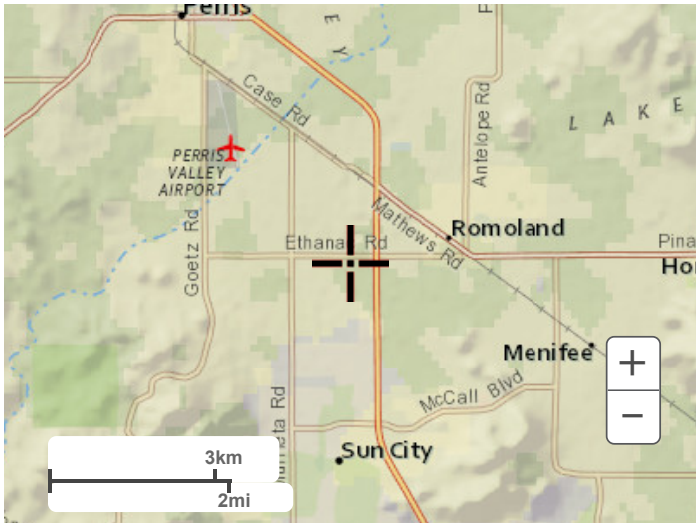
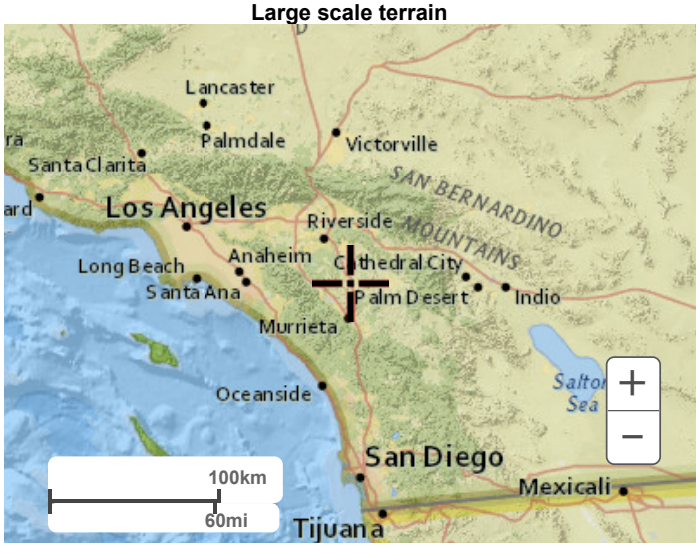
Maps & aerials

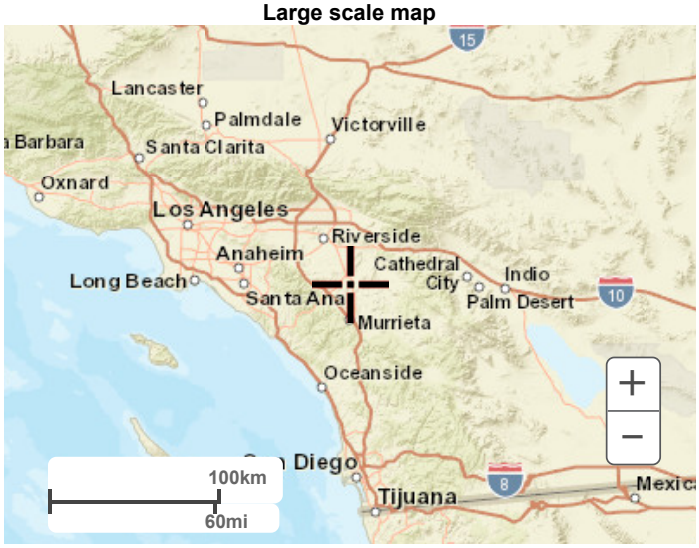
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

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

Disclaimer

NOTES TO USERS

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 (BFEs) 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 table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table 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 NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane 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:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

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 multiple sources including the Riverside County, CA effective database, and the National Geodetic Survey. Base map imagery for Riverside County, CA is a mosaic of the NAIP 2009 images, 1 meter resolution.

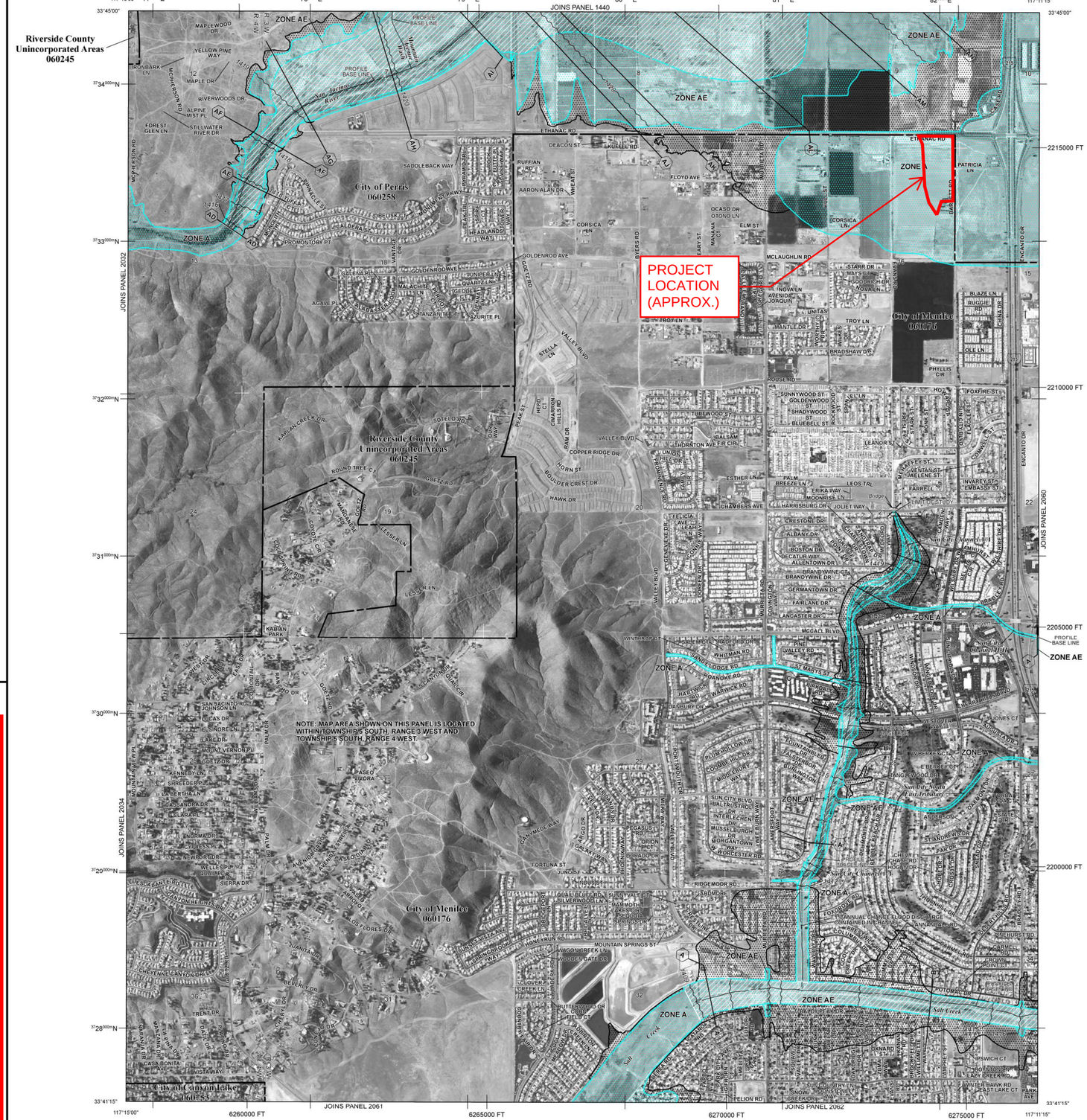
The **"profile base lines"** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the "profile base line", in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

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.

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

NOTE:
THE FLOODPLAIN MAPPING SHOWN ON THIS FIRM (OBTAINED FROM THE FEMA WEBSITE) MAY NOT BE UP-TO-DATE. BASED ON OUR COORDINATION WITH RCFC, IT IS UNDERSTOOD THAT THE PROJECT SITE HAS BEEN REMOVED FROM THE FLOODPLAIN BASED ON THE RECENT LOMR IN THIS AREA. THE DISTRICT IS CURRNETLY IN REVIEW WITH FEMA FOR THE DREDGING OF ROMOLAND LINE A TO THE ULTIMATE DEPTH. THEREFORE, NO FURTHER PROCESSING WITH FEMA SHOULD BE REQUIRED BY THE PROEJCT IN REGARDS TO THE FLOODPLAIN.



LEGEND

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

The 1% annual chance 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	Areas to be protected from 1% annual chance flood event 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 (EL 987) — Base Flood Elevation line and value; elevation in feet*
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
97°07'30", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4°75000mE — 1000-meter Universal Transverse Mercator grid ticks, zone 11
6000000 FT — 5000-foot grid values: California State Plane coordinate system, Zone VI (FIPSZONE = 406), Lambert projection
DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories List on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
August 28, 2008

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
August 18, 2014: for a description of revisions, see Notice to Users page in the Flood Insurance Study report.

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 0 500 1,000 1,500 2,000 FEET
300 0 300 600 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2055H

FIRM
FLOOD INSURANCE RATE MAP
RIVERSIDE COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 2055 OF 3805
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CANYON LAKE, CITY OF	060753	2055	H
MENIFEE, CITY OF	060176	2055	H
PERRIS, CITY OF	060258	2055	H
RIVERSIDE COUNTY UNINCORPORATED AREAS	060245	2055	H

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06065C2055H

MAP REVISED
AUGUST 18, 2014

Federal Emergency Management Agency

Appendix B

Modified Rational Method Results

Includes:

1. Post-project Drainage Study Map
2. Post-project AES Rational Method Output

General comment: I recommend developing an exhibit showing existing infrastructure and the proposed facilities that need to be constructed to address the following:
1. Meet Street Flooding design criteria
2. Ensure impacts to upstream property owners are not exacerbated.

An existing catch basin is located here.

Identify Line A-11 and discuss the MDP tributary area. This is a frontage improvement. However, the channel system exist and the Line A-11 is in place along Case Road. The system is maintained by City of Perris. Provide a discussion representing current condition

Discuss where runoff that accumulates in this area goes.

When project better understands Frontage Improvements along Ethanac and Barnett provide discuss is storm drain required to treat area to meet WQMP.

There is an existing culvert crossing Barnett Road. Please identify.

Discuss what flooding and inundation occur at intersection and if this will impact the project, street capacity requirements, and traffic circulation.

Also add where the direction of the current flows

Discuss what happens to the runoff from this parcel. Runoff appear to flow along the edge of Ethanac. Will your project block flows? Discuss how project will not create a ponded condition or worsen flooding due to backwater

A = 9.7 ACRES
Q100 = 26.8 CFS

Identify Line A-13 and discuss the MDP tributary area. This is a frontage improvement. Provide a discussion and an argument why this facility is not required by your project.

Discuss what happens to the runoff from the east of Barnett and the impacts to intersection at Ethanac and Barnett?

Do flows stay to the east of Barnett?

A = 4.3 ACRES
Q100 = 15.3 CFS

When project better understands Frontage Improvements along Ethanac and Barnett provide discuss is storm drain required to treat area to meet WQMP.

Discuss what happens to the runoff from this parcel and show flow arrows to better understand drainage issues.

Discuss how project will not create a ponded condition or worsen flooding due to backwater.

Please validate where this area was supposed to drain in the ultimate condition. Was this runoff supposed to drain to Line A or Line A-13.

If this area is to go to Line A, provide an easement or a path to ensure this project is not obstructed from draining to Line A.

NOTES:

1. *THIS DRAINAGE STUDY EXHIBIT IS PREPARED IN SUPPORT OF THE ON-SITE PRELIMINARY HYDROLOGIC CALCULATIONS AND STORM DRAIN SIZING.*

LEGEND

- *TRACT BOUNDARY*
- *MAJOR DRAINAGE BOUNDARY*
- *SUB BASIN BOUNDARY*
- *FLOW PATH*
- *DRAINAGE ACREAGE* (X.X AC.)
- *BASIN NODE ID* (XXX)
- *DISCHARGE LOCATION*

N

0 30 60 120 180 240

SCALE 1"=60'

DRAINAGE STUDY MAP FOR PHELAN - BARNETT (POST-PROJECT)

JN 2113 DATE: 8/17/2021

NOT FOR CONSTRUCTION - EXHIBIT FOR PRELIMINARY DRAINAGE STUDY ONLY

```
**************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
        RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                    (RCFC&WCD)  1978 HYDROLOGY MANUAL
         (c) Copyright 1982-2016 Advanced Engineering Software (aes)
                    (Rational Tabling Version 23.0)
                Release Date: 07/01/2016  License ID 1717

                          Analysis prepared by:

                          SDH & ASSOCIATES, INC.
                           27363 VIA INDUSTRIA
                            TEMECULA, CA 92590
                              (951) 683-3691

 ************************* DESCRIPTION OF STUDY *************************
* PHELAN - BARNETT (JN 2113)                                             *
* POST-PROJECT CONDITION - 100-YEAR, 1-HOUR STORM EVENT                  *
* BASIN 100                                                              *
 **************************************************************************

  FILE NAME: PB1HP00.RAT
  TIME/DATE OF STUDY: 13:53 08/14/2021
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  1.900
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.895
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  3.350
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.580
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.4201374
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.4194398
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =  100.00   1-HOUR INTENSITY(INCH/HOUR) =   1.580
  SLOPE OF INTENSITY DURATION CURVE = 0.4194
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   20.0     15.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0160

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
```

```
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    110.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   800.00
  UPSTREAM ELEVATION(FEET) =     22.30
  DOWNSTREAM ELEVATION(FEET) =     18.32
  ELEVATION DIFFERENCE(FEET) =      3.98
  TC = 0.303*[(  800.00**3)/(     3.98)]**.2 =   12.690
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.031
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8851
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =      5.63
  TOTAL AREA(ACRES) =      2.10   TOTAL RUNOFF(CFS) =      5.63

****************************************************************************
  FLOW PROCESS FROM NODE    110.00 TO NODE    115.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    15.32  DOWNSTREAM(FEET) =    13.42
  FLOW LENGTH(FEET) =   190.00   MANNING'S N =  0.012
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   9.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.17
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.63
  PIPE TRAVEL TIME(MIN.) =   0.51    Tc(MIN.) =   13.20
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    115.00 =     990.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    115.00 TO NODE    115.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.981
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8849
  SOIL CLASSIFICATION IS "C"
  SUBAREA AREA(ACRES) =    0.20   SUBAREA RUNOFF(CFS) =    0.53
  TOTAL AREA(ACRES) =        2.3   TOTAL RUNOFF(CFS) =       6.16
```

```
  TC(MIN.) =   13.20

****************************************************************************
  FLOW PROCESS FROM NODE    115.00 TO NODE    140.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    13.42  DOWNSTREAM(FEET) =    12.40
  FLOW LENGTH(FEET) =    89.00   MANNING'S N =  0.012
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   9.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.64
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.16
  PIPE TRAVEL TIME(MIN.) =   0.22    Tc(MIN.) =   13.43
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    140.00 =    1079.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    140.00 TO NODE    150.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     12.40  DOWNSTREAM(FEET) =     12.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =    92.00   CHANNEL SLOPE =  0.0011
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.805
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8842
  SOIL CLASSIFICATION IS "C"
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.66
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.83
  AVERAGE FLOW DEPTH(FEET) =   0.38   TRAVEL TIME(MIN.) =   1.84
  Tc(MIN.) =   15.26
  SUBAREA AREA(ACRES) =     0.40       SUBAREA RUNOFF(CFS) =    0.99
  TOTAL AREA(ACRES) =        2.7         PEAK FLOW RATE(CFS) =       7.15

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.40   FLOW VELOCITY(FEET/SEC.) =   0.86
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    150.00 =    1171.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    150.00 TO NODE    150.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    121.00 TO NODE    130.00 IS CODE =  21
----------------------------------------------------------------------------
```

```
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
================================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   496.00
  UPSTREAM ELEVATION(FEET) =     18.17
  DOWNSTREAM ELEVATION(FEET) =     15.75
  ELEVATION DIFFERENCE(FEET) =      2.42
  TC = 0.303*[(  496.00**3)/(     2.42)]**.2 =   10.522
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.279
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8861
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =     17.72
  TOTAL AREA(ACRES) =      6.10   TOTAL RUNOFF(CFS) =     17.72

****************************************************************************
  FLOW PROCESS FROM NODE    130.00 TO NODE    135.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
================================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    12.75  DOWNSTREAM(FEET) =    12.40
  FLOW LENGTH(FEET) =    56.00   MANNING'S N =  0.012
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  19.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.66
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      17.72
  PIPE TRAVEL TIME(MIN.) =   0.14    Tc(MIN.) =   10.66
  LONGEST FLOWPATH FROM NODE    121.00 TO NODE    135.00 =     552.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    135.00 TO NODE    150.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
================================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     12.40  DOWNSTREAM(FEET) =     12.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =   210.00   CHANNEL SLOPE =  0.0005
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   5.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      17.72
  FLOW VELOCITY(FEET/SEC.) =   0.93   FLOW DEPTH(FEET) =   0.87
  TRAVEL TIME(MIN.) =   3.76   Tc(MIN.) =   14.42
  LONGEST FLOWPATH FROM NODE    121.00 TO NODE    150.00 =     762.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    150.00 TO NODE    150.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
```

```
==========================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1       17.72    14.42       2.873        6.10
  LONGEST FLOWPATH FROM NODE    121.00 TO NODE    150.00 =     762.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        7.15    15.26       2.805        2.70
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    150.00 =    1171.00 FEET.

 ****************************WARNING*****************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 ****************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1      24.48      14.42        2.873
      2      24.46      15.26        2.805

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      24.48   Tc(MIN.) =   14.42
  TOTAL AREA(ACRES) =        8.8

****************************************************************************
  FLOW PROCESS FROM NODE    150.00 TO NODE    150.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    150.00 TO NODE    150.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   14.42
  RAINFALL INTENSITY(INCH/HR) =   2.87
  TOTAL STREAM AREA(ACRES) =     8.80
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     24.48

****************************************************************************
  FLOW PROCESS FROM NODE    141.00 TO NODE    145.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   304.00
  UPSTREAM ELEVATION(FEET) =     21.79
  DOWNSTREAM ELEVATION(FEET) =     18.70
  ELEVATION DIFFERENCE(FEET) =      3.09
  TC = 0.303*[(  304.00**3)/(     3.09)]**.2 =    7.470
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.786
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8877
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =      2.02
  TOTAL AREA(ACRES) =      0.60   TOTAL RUNOFF(CFS) =      2.02

****************************************************************************
  FLOW PROCESS FROM NODE    145.00 TO NODE    148.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    15.76  DOWNSTREAM(FEET) =    15.26
  FLOW LENGTH(FEET) =    50.00   MANNING'S N =  0.012
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.76
  GIVEN PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.02
  PIPE TRAVEL TIME(MIN.) =   0.17    Tc(MIN.) =    7.64
  LONGEST FLOWPATH FROM NODE    141.00 TO NODE    148.00 =     354.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    147.00 TO NODE    148.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.749
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8876
  SOIL CLASSIFICATION IS "C"
  SUBAREA AREA(ACRES) =    0.30   SUBAREA RUNOFF(CFS) =    1.00
  TOTAL AREA(ACRES) =        0.9   TOTAL RUNOFF(CFS) =       3.01
  TC(MIN.) =    7.64

****************************************************************************
  FLOW PROCESS FROM NODE    148.00 TO NODE    150.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
```

```
 ELEVATION DATA: UPSTREAM(FEET) =    15.26  DOWNSTREAM(FEET) =     8.50
 FLOW LENGTH(FEET) =    29.00   MANNING'S N =  0.012
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   2.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  16.04
 GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       3.01
 PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =    7.68
 LONGEST FLOWPATH FROM NODE    141.00 TO NODE    150.00 =     383.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    150.00 TO NODE    150.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =    7.68
 RAINFALL INTENSITY(INCH/HR) =   3.74
 TOTAL STREAM AREA(ACRES) =     0.90
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.01

 ** CONFLUENCE DATA **
 STREAM     RUNOFF       Tc      INTENSITY      AREA
 NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
     1       24.48    14.42        2.873          8.80
     2        3.01     7.68        3.743          0.90

***********************************WARNING**********************************
 IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
 ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
 WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
****************************************************************************

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM     RUNOFF      Tc      INTENSITY
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
     1       16.05     7.68       3.743
     2       26.80    14.42       2.873

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      26.80   Tc(MIN.) =   14.42
 TOTAL AREA(ACRES) =        9.7
 LONGEST FLOWPATH FROM NODE    101.00 TO NODE    150.00 =    1171.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    150.00 TO NODE    180.00 IS CODE =  41
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     8.10  DOWNSTREAM(FEET) =     6.00
  FLOW LENGTH(FEET) =    81.00   MANNING'S N =  0.012
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  12.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  12.87
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      26.80
  PIPE TRAVEL TIME(MIN.) =   0.10    Tc(MIN.) =   14.52
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    180.00 =    1252.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =         9.7  TC(MIN.) =     14.52
  PEAK FLOW RATE(CFS)   =      26.80
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
        RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                    (RCFC&WCD)  1978 HYDROLOGY MANUAL
         (c) Copyright 1982-2016 Advanced Engineering Software (aes)
                    (Rational Tabling Version 23.0)
                Release Date: 07/01/2016  License ID 1717

                          Analysis prepared by:

                          SDH & ASSOCIATES, INC.
                           27363 VIA INDUSTRIA
                            TEMECULA, CA 92590
                              (951) 683-3691

 ************************* DESCRIPTION OF STUDY *************************
* PHELAN - BARNETT (JN 2113)                                             *
* POST-PROJECT CONDITION - 100-YEAR, 1-HOUR STORM EVENT                  *
* BASIN 200                                                              *
 **************************************************************************

  FILE NAME: PB2HP00.RAT
  TIME/DATE OF STUDY: 13:27 08/14/2021
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  1.900
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.895
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  3.350
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.580
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.4201374
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.4194398
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =  100.00   1-HOUR INTENSITY(INCH/HOUR) =   1.580
  SLOPE OF INTENSITY DURATION CURVE = 0.4194
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   20.0     15.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0160

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
```

```
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    210.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   165.00
  UPSTREAM ELEVATION(FEET) =     22.58
  DOWNSTREAM ELEVATION(FEET) =     17.97
  ELEVATION DIFFERENCE(FEET) =      4.61
  TC = 0.303*[(  165.00**3)/(     4.61)]**.2 =    4.779
  COMPUTED TIME OF CONCENTRATION INCREASED TO 5 MIN.
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.480
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8894
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =      5.18
  TOTAL AREA(ACRES) =      1.30   TOTAL RUNOFF(CFS) =      5.18

****************************************************************************
  FLOW PROCESS FROM NODE    210.00 TO NODE    215.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    15.97  DOWNSTREAM(FEET) =    13.60
  FLOW LENGTH(FEET) =    30.00   MANNING'S N =  0.012
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   5.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  12.81
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.18
  PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =    5.04
  LONGEST FLOWPATH FROM NODE    201.00 TO NODE    215.00 =     195.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    215.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.466
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8894
  SOIL CLASSIFICATION IS "C"
  SUBAREA AREA(ACRES) =    2.20   SUBAREA RUNOFF(CFS) =    8.74
```

```
  TOTAL AREA(ACRES) =        3.5   TOTAL RUNOFF(CFS) =      13.92
  TC(MIN.) =    5.04

****************************************************************************
  FLOW PROCESS FROM NODE    215.00 TO NODE    220.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    13.60  DOWNSTREAM(FEET) =    13.40
  FLOW LENGTH(FEET) =    12.00   MANNING'S N =  0.012
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  14.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.99
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      13.92
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =    5.06
  LONGEST FLOWPATH FROM NODE    201.00 TO NODE    220.00 =     207.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    220.00 TO NODE    240.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     13.40  DOWNSTREAM(FEET) =     13.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =    28.00   CHANNEL SLOPE =  0.0036
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.355
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8891
  SOIL CLASSIFICATION IS "C"
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      14.30
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.62
  AVERAGE FLOW DEPTH(FEET) =   0.42   TRAVEL TIME(MIN.) =   0.29
  Tc(MIN.) =    5.35
  SUBAREA AREA(ACRES) =     0.20       SUBAREA RUNOFF(CFS) =    0.77
  TOTAL AREA(ACRES) =        3.7         PEAK FLOW RATE(CFS) =      14.69

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.43   FLOW VELOCITY(FEET/SEC.) =   1.64
  LONGEST FLOWPATH FROM NODE    201.00 TO NODE    240.00 =     235.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    240.00 TO NODE    240.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.35
```

```
  RAINFALL INTENSITY(INCH/HR) =   4.35
  TOTAL STREAM AREA(ACRES) =     3.70
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     14.69

****************************************************************************
  FLOW PROCESS FROM NODE    211.00 TO NODE    215.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   419.00
  UPSTREAM ELEVATION(FEET) =     21.20
  DOWNSTREAM ELEVATION(FEET) =     20.00
  ELEVATION DIFFERENCE(FEET) =      1.20
  TC = 0.303*[(  419.00**3)/(     1.20)]**.2 =   10.942
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.226
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8859
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =      1.71
  TOTAL AREA(ACRES) =      0.60   TOTAL RUNOFF(CFS) =      1.71

****************************************************************************
  FLOW PROCESS FROM NODE    215.00 TO NODE    225.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    17.00  DOWNSTREAM(FEET) =    13.44
  FLOW LENGTH(FEET) =    39.00   MANNING'S N =  0.012
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   2.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.76
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.71
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =   11.01
  LONGEST FLOWPATH FROM NODE    211.00 TO NODE    225.00 =     458.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    225.00 TO NODE    230.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    13.44  DOWNSTREAM(FEET) =    13.40
  FLOW LENGTH(FEET) =     4.00   MANNING'S N =  0.012
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.46
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.71
```

```
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =   11.02
  LONGEST FLOWPATH FROM NODE    211.00 TO NODE    230.00 =     462.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    230.00 TO NODE    240.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     13.40  DOWNSTREAM(FEET) =     13.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =    98.00   CHANNEL SLOPE =  0.0010
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   5.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.71
  FLOW VELOCITY(FEET/SEC.) =   0.49   FLOW DEPTH(FEET) =   0.17
  TRAVEL TIME(MIN.) =   3.35   Tc(MIN.) =   14.37
  LONGEST FLOWPATH FROM NODE    211.00 TO NODE    240.00 =     560.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    240.00 TO NODE    240.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   14.37
  RAINFALL INTENSITY(INCH/HR) =   2.88
  TOTAL STREAM AREA(ACRES) =     0.60
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.71

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       14.69     5.35        4.355          3.70
      2        1.71    14.37        2.878          0.60

 **********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 ***************************************************************************

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       15.33     5.35       4.355
```

```
      2       11.42    14.37       2.878

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      15.33   Tc(MIN.) =    5.35
  TOTAL AREA(ACRES) =        4.3
  LONGEST FLOWPATH FROM NODE    211.00 TO NODE    240.00 =     560.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    240.00 TO NODE    280.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     9.10  DOWNSTREAM(FEET) =     8.00
  FLOW LENGTH(FEET) =    93.00   MANNING'S N =  0.012
  DEPTH OF FLOW IN  30.0 INCH PIPE IS  12.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.40
  GIVEN PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      15.33
  PIPE TRAVEL TIME(MIN.) =   0.18    Tc(MIN.) =    5.53
  LONGEST FLOWPATH FROM NODE    211.00 TO NODE    280.00 =     653.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.3  TC(MIN.) =      5.53
  PEAK FLOW RATE(CFS)   =      15.33
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Appendix C

Inlet Sizing

Note: Detailed inlet calculations for on-site catch basins will be conducted during final engineering and will be incorporated in this Appendix.

Appendix D

Preliminary Storm Drain Sizing

Phelan-Barnett
Job # 2113
8/14/2021

Preliminary Storm Drain Size

The purpose of this table is to provide an estimated preliminary pipe sizes to convey the anticipated 100-year peak flow rates with a preliminary sizing bump-up factor to account for potential head losses through the pipe.

Manning's n: 0.012 HDPE or equivalent

Preliminary Sizing Bump-up (%): 30

			Preliminary Sizes per Varying Slopes						
		Slope at:	0.2%		0.5%		1.0%		
Node ID's:	**Q_{100} (cfs[1])**	**Q_{100} with Sizing Factor (cfs[1])**	**Minimum Pipe Size[2] (feet)**	**Suggested Pipe Size (inches)**	**Minimum Pipe Size[2] (feet)**	**Suggested Pipe Size (inches)**	**Minimum Pipe Size [2] (feet)**	**Suggested Pipe Size (inches)**	**PRELIMINARY RECOMMENDATIONS[3]**
110 - 115	5.6	7.3	1.71	24"	1.44	18"	1.27	18"	**Use 18" HDPE @ 0.5% MIN.**
115 - 140	6.2	8.1	1.78	24"	1.50	18"	1.32	18"	**Use 18" HDPE @ 0.5% MIN.**
130 - 135	17.7	23.0	2.64	36"	2.22	30"	1.95	24"	**Use 30" HDPE @ 0.5% MIN.**
145 - 148	2.0	2.6	1.16	18"	0.98	12"	0.86	12"	**Use 12" HDPE @ 0.5% MIN.**
148 - 150	3.0	3.9	1.36	18"	1.14	18"	1.00	12"	**Use 18" HDPE @ 0.5% MIN.**
150 - 180	26.8	34.8	3.08	42"	2.60	36"	2.28	30"	**Use 36" HDPE @ 0.5% MIN.**
210 - 215	5.2	6.8	1.67	24"	1.40	18"	1.23	18"	**Use 18" HDPE @ 0.5% MIN.**
215 - 220	13.9	18.1	2.41	30"	2.03	30"	1.78	24"	**Use 30" HDPE @ 0.5% MIN.**
215 - 225	1.7	2.2	1.10	18"	0.92	12"	0.81	10"	**Use 12" HDPE @ 0.5% MIN.**
225 - 230	1.7	2.2	1.10	18"	0.92	12"	0.81	10"	**Use 12" HDPE @ 0.5% MIN.**
240 - 280	15.3	19.9	2.50	30"	2.10	30"	1.85	24"	**Use 30" HDPE @ 0.5% MIN.**

Note:

1. "cfs" = cubic feet per second.
2. Minimum pipe sizes are calculated using the Manning's equation and are based on the flow rates with "bump up factor" to account for potential head losses through the storm drain pipes.
3. The on-site storm drain systems are private and the normal depth calculations should suffice for pipe sizing purpose.
   Detailed calculations may be performed on an as-needed basis during final engineering to validate the required sizes.