Appendix 8.0

Preliminary Drainage Study

PRELIMINARY DRAINAGE STUDY

FAITH BIBLE CHURCH WILDOMAR
APN # 376-410-002, 376-410-024

Wildomar, Riverside County, California
January 22, 2019 (rev.2)

Prepared for:

Faith Bible Church
23811 Washington Ave. #C110-313
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Tel. 951-200-3173
Contact: Mr. John Pleasnick

Report Prepared By:

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Engineer of Work/ Contact Person:
Francisco Martinez Jr., PE, QSD

JN 2017-002

This report has been prepared by or under the direction of the following registered civil engineer who attests to the technical information contained herein. The registered civil engineer has also judged the qualifications of any technical specialists providing engineering data upon which recommendations, conclusions, and decisions are based.

1/22/2019

Francisco Martinez RCE Registered Civil Engineer	Date	Seal

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I. PURPOSE AND SCOPE

The purpose of this study is to support the entitlement phase and determine minimum drainage improvements required for Faith Bible Church Wildomar (Project), a religious institution development in the City of Wildomar, County of Riverside.

The scope of the preliminary study includes the following:

1. Determination of points of flow concentration and watershed subareas for onsite and offsite areas.
2. Determination of the 100-year peak storm flows based upon the post-project onsite and existing condition offsite areas utilizing the Rational Method as outlined in the Riverside County Flood Control & Conservation District Manual (ref 1).
3. Determine the required storm drain infrastructure to flood protect the project site for the 100-year storm event.
4. Preparation of a hydrology report, which consist of hydrological and analytical results and exhibits.

II. PROJECT SITE AND DRAINAGE AREA OVERVIEW

The property is proposed for a religious institution/Community Church development with parking lots and landscaped areas, a turf ball field that'll be used for overflow parking, tot-lot and an outdoor room, athletic facility (gymnasium), three residential units, frontage street improvements (1/2 width), a storm drain infrastructure system and two infiltration type basins.

The property is currently vacant and undeveloped but has been subject to a variety of man-mad disturbances which includes illegal off-road vehicle activities, weed abatement activities, and dirt trails for recreational use. The project site is comprised of two Assessor Parcel Numbers (APNs) 376-410-024 and 376-410-002 of approximately 24 acres located in the City of Wildomar, County of Riverside. The site is located within the Wildomar and Murrieta quadrangles of the United States Geological Survey's (USGS) 7.5-minute topographic map series in Section 36, Township 6 south, Range 4 west; more specifically the property is located east of Interstate 15, south of Peggy Lane, and north of Glazebrook Road, nearest cross street is Depasquale Road.

The on-site topography ranges from approximately 1,328 to 1,368 feet above mean sea level and consists of rolling terrain with steeper topography on the eastern portion of the site. The site is comprised and traversed by three (3) major offsite drainage areas. Existing off-site flows enter the property at various locations along the northerly boundary line and the easterly boundary where they travel south west towards the westerly property line and Caltrans Right-of-way. The off-site drainage watercourse that enters from the east is currently being collected by Line E, an existing 78-inch storm drain pipe part of the Murrieta Valley Glazebrook Storm Drain (RCFCD DWG No. 7-404). These flows are conveyed via Line E storm drain line where it terminates with a headwall west of

Depasquale Road at the south end of the property.

Developed flows are then collected by two (2) separate existing culverts with concrete headwalls which are located on near the easterly Caltrans ROW, and east of the westerly property line. The two culverts are located within Caltrans right-of-way. The northerly culvert is a 72-inch pipe, and the southerly culvert is an 84-inch storm drain pipe, is understood that they are owned and maintained by Caltrans. The storm drain culverts, however have been extended through development and as part of the Wildomar Valley Twinflower Storm Drain & Trillium Lateral (RCFCD DWG No. 7-141). Both storm drain culverts/ pipe extension confluence at 650 feet west of the westerly property line at Twinflower Avenue, and continues southwest for approximately 4000 feet through residential development to Palomar Street, here it enters an open channel (Trapezoidal) traveling west for 1,400 feet where it ultimately discharges to Murrieta Creek; see offsite drainage exhibit.

III. HYDROLOGY

The Riverside County Flood Control and Water Conservation District Hydrology Manual (Reference 1), was used to develop the hydrological parameters for the hydrology analyses. The rational method was used for the analyses and the computations were performed using the computer program developed by Civil CADD/Civil Design.

The intensity (in/hour) for the 10-year and 100-year storm frequency and the 10-minute and 60-minute duration was obtained using Plate D-4.1 (4 of 6) of the Hydrology Manual and summarized in the table below; a copy of the District's table is included in this report.

Rainfall Intensity table:

Storm Event & Duration	Intensity (in/hour)
10-Year, 10 minute	2.320
10-Year, 60-minute	0.980
100-Year, 10 minute	3.540
100-Year, 60-minute	1.500

The project site is underlain by A, C, D type soils, as shown in the Onsite Hydrologic Soil Unit Exhibit; this GIS exhibit is based on the U.S. Department of Agriculture Natural Resources Conservation Service Web Soil Survey. A Web Soil map was generated for the project site and included in Appendix C.

For 10-year storm events, Antecedent Moisture Condition (AMC) II was utilized and for 100-year storm events an AMC III.

The hydrology utilized the following land use covers for onsite and offsite analysis:

Land Use Cover	Pervious Ratio
Commercial	0.1
Condominium	0.35
Single Family (1/4 Acre)	0.5
Single Family (1 Acre)	0.8
Undeveloped (good cover)	1.0
Undeveloped (poor cover)	1.0

The proposed project condition for the ball field areas was analyzed as Undeveloped with good cover. Parking lot areas and offsite street area was analyzed as Commercial. The rational method analysis used multiple watershed areas and designated as Area "A through "D" with numerical sub-designations.

The existing onsite and off-site project and onsite proposed project rational method hydrology calculations have been included in Appendix A and B. The existing project rational method hydrology map has been included as figure 2, the proposed project rational method hydrology map as figure 3; and the offsite drainage hydrology map is included as figure 4.

Here below is a summary flow rate Table between existing and proposed conditions:

Description	Q100 Peak Flow Rates (cfs)				Net Q100 (cfs)
Watershed Area	A	B&C	A, B & C	D	
Proposed Conditions	15.8	179.3	195.1	212.3	
Existing Conditions	22.1	171.2	193.3	213.6	
Q100 Delta	-6.3	8.1	1.80	-1.3	0.5

Per hydrology flow rates results shown in summary table above, there is a net increase of 1.8 cfs between watershed areas A, B &C. However, the difference between existing and proposed conditions for both major watersheds tributary to the existing 72-inch and 84-inch storm drain pipes crossing interstate highway 15, the results yield a net increase of 0.5 cfs and considered negligible; moreover, basin infiltration will help reduce the outflows to near existing conditions.

IV. HYDRAULICS

The project will utilize a subsurface storm drain, drainage inlets, to convey peak flows and utilize two onsite (2) infiltration basins to mitigate for water quality and hydromodification requirements and located within the open ball field/overflow parking area.

All onsite surface storm flows will be directed to onsite drop curb and street inlets and conveyed via the storm drain pipe system where they will discharge to two (2) infiltration basins; an emergency overflow (weir) will be utilized to by-pass the 100 year storm flow where they will be collected and conveyed by street storm drain system and ultimately by the existing culverts crossing below interstate 15.

The proposed storm drain systems was preliminarily sized based on normal depth calculations as part of the rational method calculations analyzed with the CivilDesign engineering software (ref. 2). The computer program incorporates the hydrological parameters outlined in the RCFC&WCD Hydrology Manual (ref.1).

V. WATER QUALITY AND HYDROMODIFICATION MITIGATION

The project site will utilize two (2) infiltration basins to mitigate and address hydromodification requirements. This system will also serve as the water quality treatment facility for the project site. The Hydromodification Analysis Report and water quality calculations and discussion have been provided in the Water Quality Management Plan.

VI. FINDINGS

The hydrology analyses evaluated the proposed development to determine the necessary drainage improvements required to mitigate flows for increased runoff. It has been concluded that:

1. The proposed drainage facilities will safely convey the 100-year flows and provide flood protection to the project site.
2. The proposed infiltration basin system will adequately mitigate for hydromodifications and water quality.

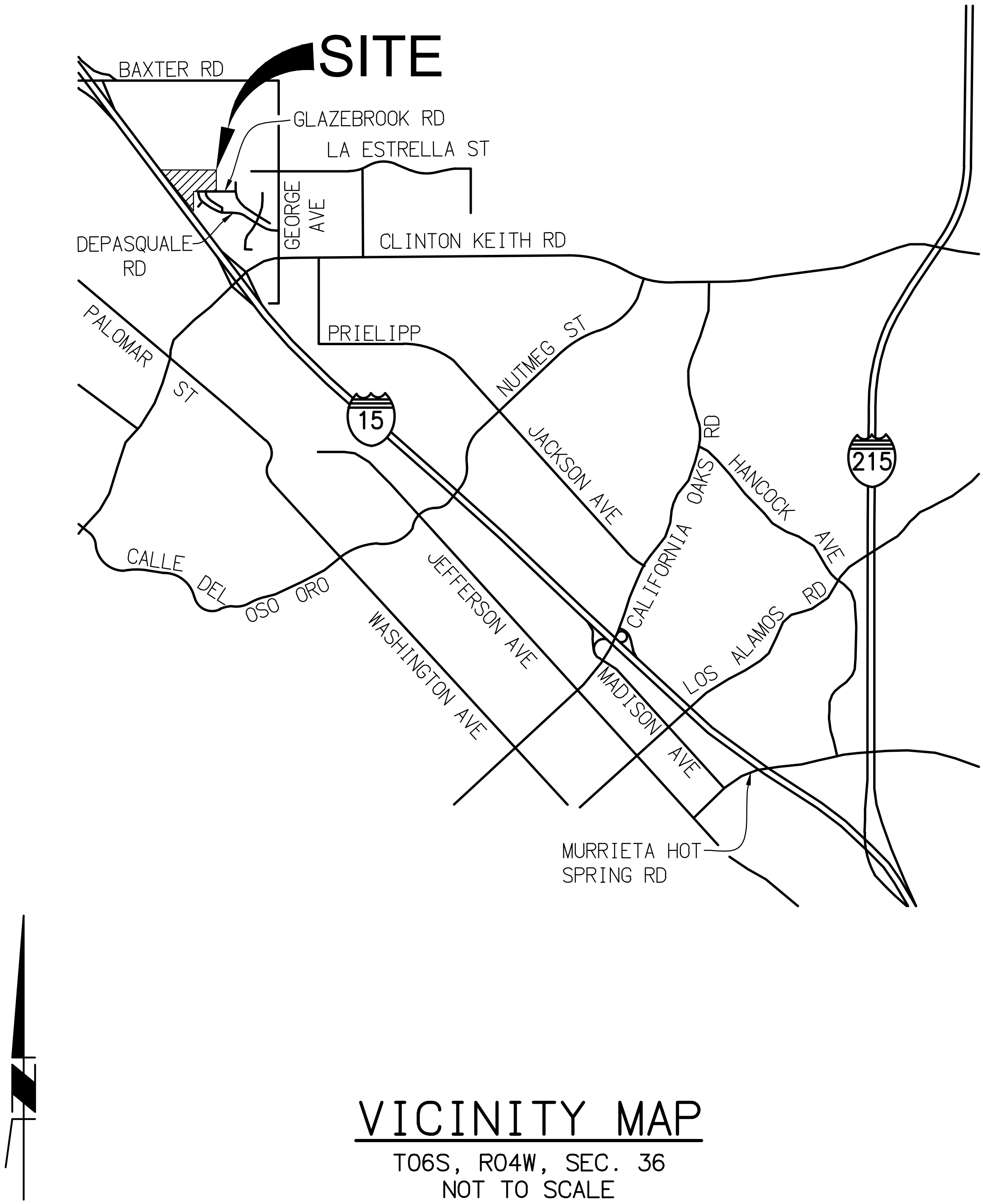
VII. REFERENCES

1. Riverside County Rational Method from RCFC & WCD Hydrology Manual, dated April 1978.

2. CIVILDESIGN ® Engineering Software, 1989-2014; Riverside County Rational Method Module, version 9.0.

FIGURE 1:

VICINITY MAP



VICINITY MAP

T06S, R04W, SEC. 36
NOT TO SCALE

FMCIVIL ENGINEERS INC.
29995 TECHNOLOGY DRIVE, SUITE 306
MURRIETA, CA 92563
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FAITH BIBLE CHURCH

VICINITY MAP

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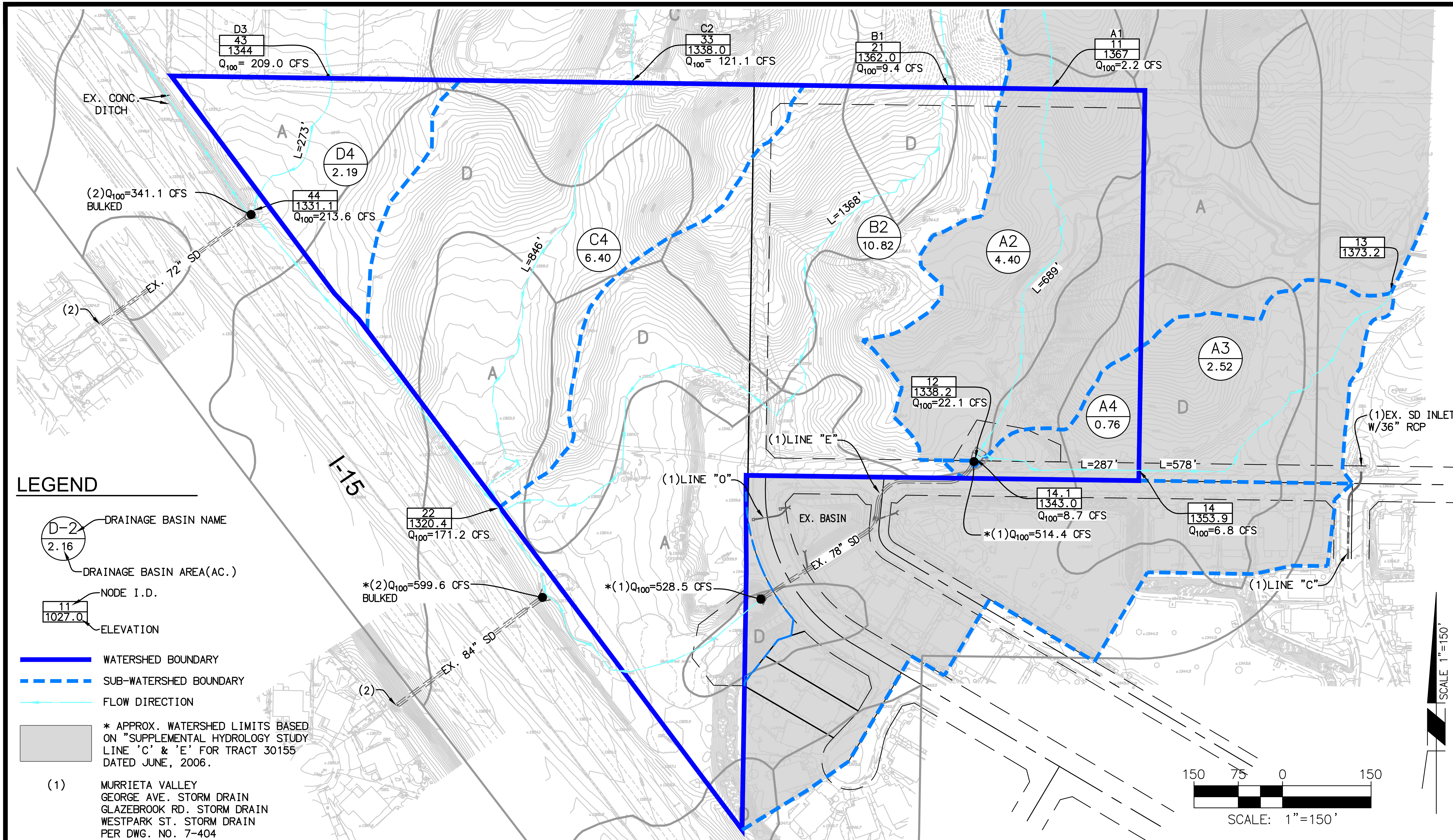
FIGURE 2:

EXISTING CONDITION HYDROLOGY MAP



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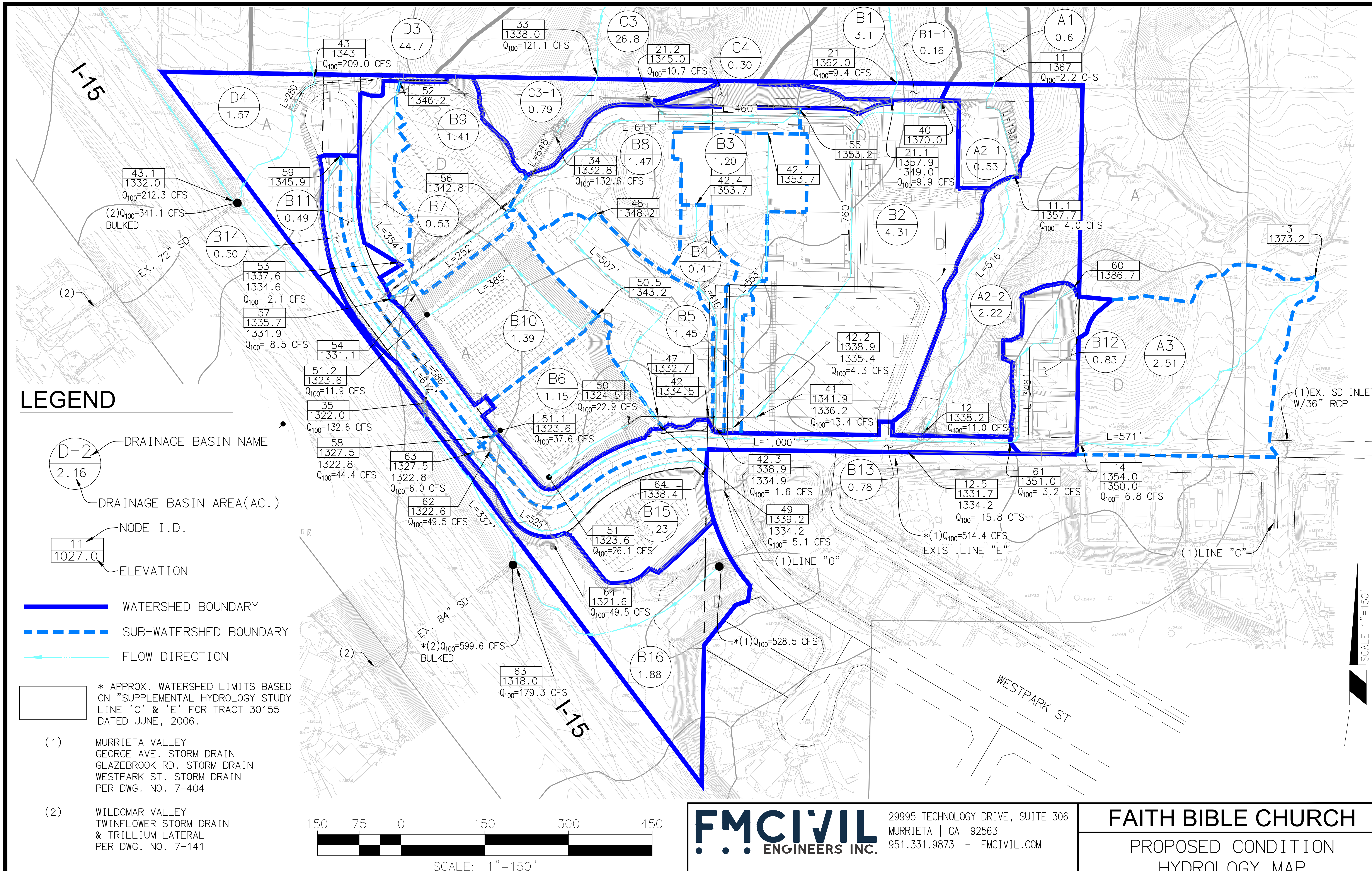
FAITH BIBLE CHURCH

EXISTING CONDITION HYDROLOGY MAP

FIGURE 3:

PROPOSED CONDITION HYDROLOGY MAP



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PROPOSED CONDITION HYDROLOGY MAP

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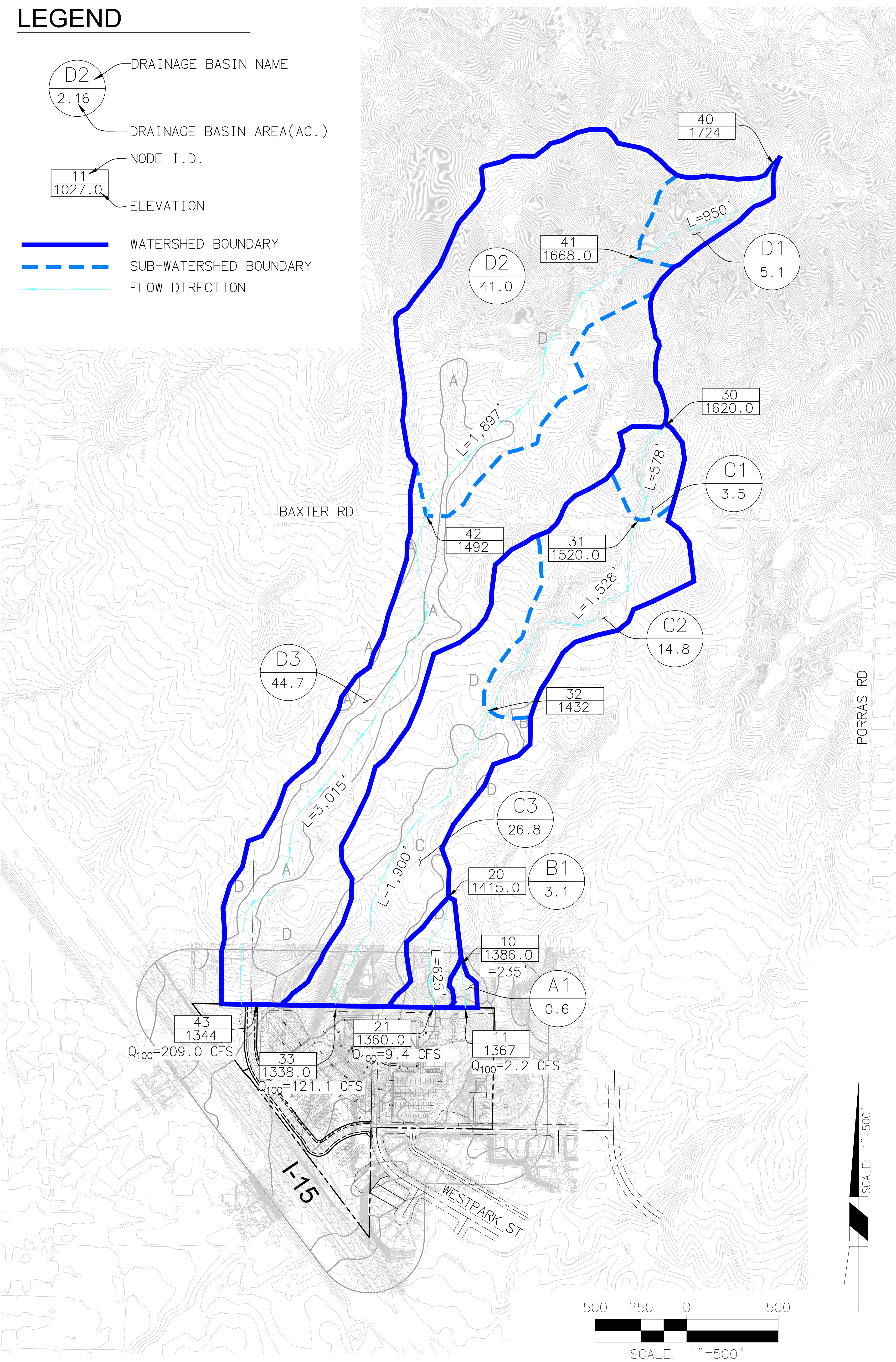
FIGURE 4:

OFFSITE HYDROLOGY MAP



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FAITH BIBLE CHURCH

OFFSITE HYDROLOGY MAP

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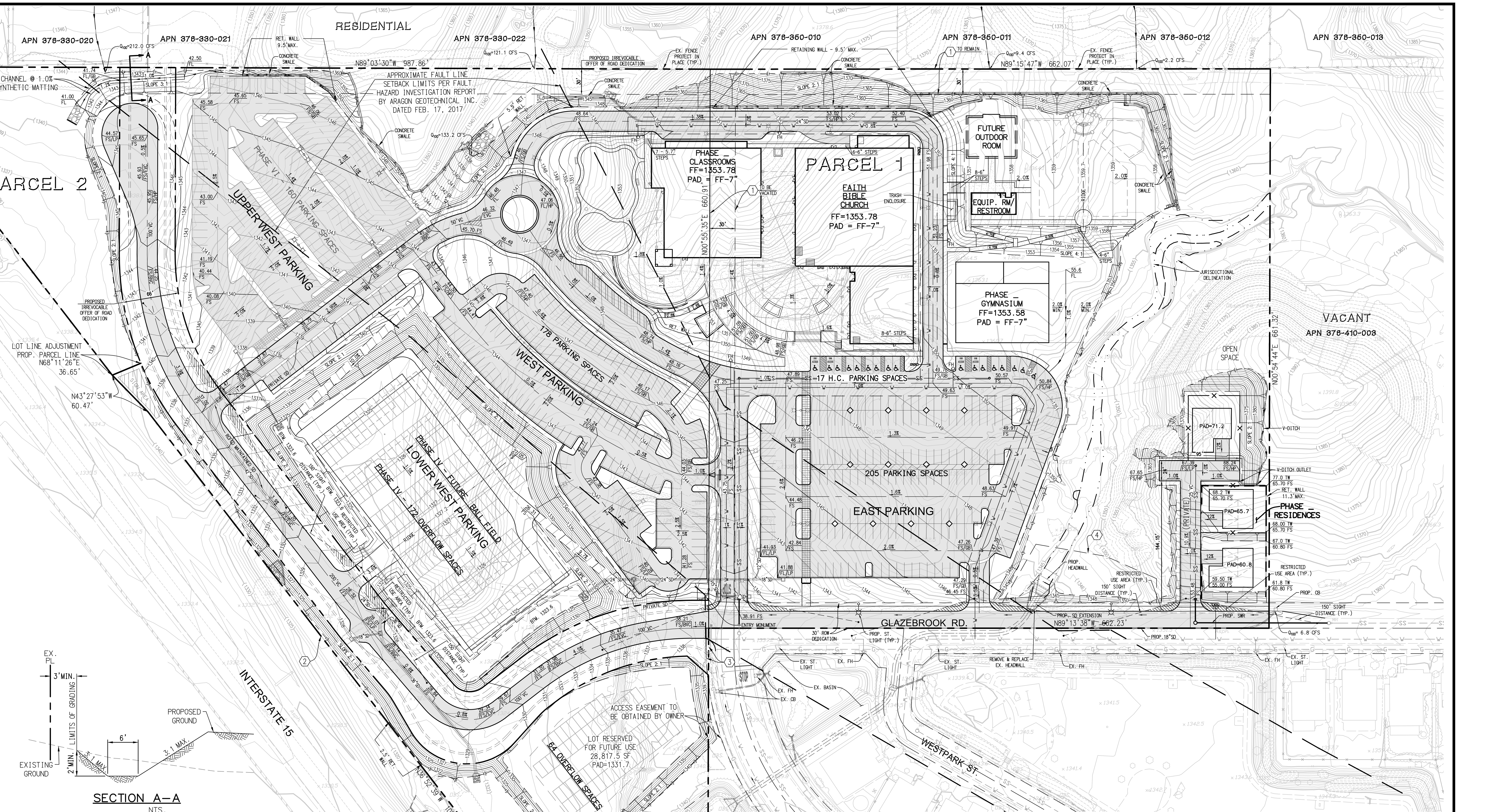
FIGURE 5:

CONCEPTUAL GRADING PLAN



GENERAL INFORMATION

1. DATE OF PREPARATION: OCTOBER 29, 2018
2. GROSS ACREAGE: 24.31 ACRES
3. NET ACREAGE: - 23.85 ACRES
4. EXISTING SITE USE: VACANT
5. EXISTING ZONING: C-1/C-P (GENERAL COMMERCIAL)
6. GENERAL PLAN LAND USE: CO (COMMERCIAL OFFICE), MDR
7. PROPOSED SITE USE: RELIGIOUS INSTITUTION
8. ALL DIMENSIONS ARE APPROXIMATE
9. ALL IMPROVEMENTS REQUIRED TO BE MADE OR INSTALLED BY THE SUBDIVIDER SHALL BE IN ACCORDANCE WITH THE DESIGN STANDARDS AND SPECIFICATIONS OF THE CITY OF WILDOMAR AND THE REQUIREMENTS OF THE STATE SUBDIVISION MAP ACT.
10. ON-SITE UTILITIES SHALL BE LOCATED UNDERGROUND.
11. NO OUTDOOR STORAGE OF MATERIALS OR EQUIPMENT WILL BE ALLOWED.
12. THE PROPERTY IS LOCATED WITHIN AN OFFICIAL RIVERSIDE COUNTY FAULT HAZARD MANAGEMENT ZONE FOR A MAPPED TRACE OF THE GLEN IVY NORTH FAULT.
13. THE PROPERTY IS LOCATED WITHIN ZONE "X" AS PER FEMA FIRM COMMUNITY PANEL NUMBER 06065C2682G AND 06065C2705G, DATED AUGUST 28, 2008. ZONE "X" BEING DEFINED AS "AREAS DETERMINED TO BE OUTSIDE OF 0.2% ANNUAL CHANCE FLOOD.

LEGAL DESCRIPTION

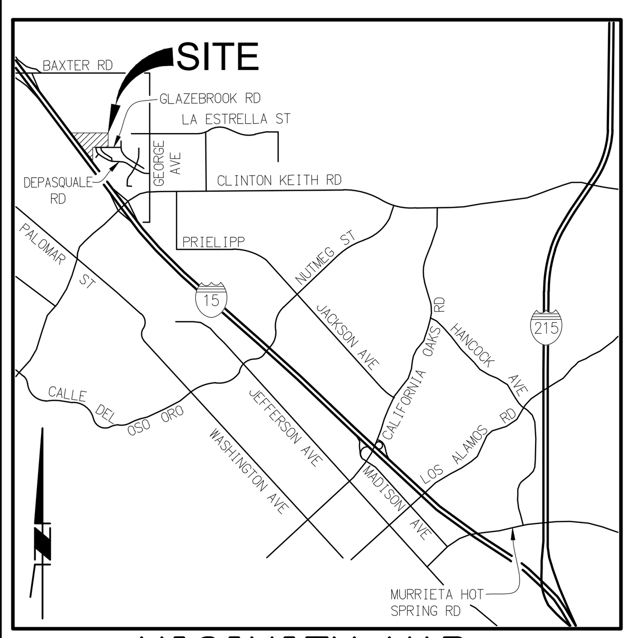
PARCEL(S) 1 AND LOTS A, C AND D OF PARCEL MAP NO. 9789, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS PER PLAT RECORDED IN BOOK 44 OF PARCEL MAPS, PAGE(S) 51, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY. TOGETHER WITH THAT PORTION OF FRACTIONAL SECTION 36, TOWNSHIP 6 SOUTH, RANGE 4 WEST, SAN BERNARDINO BASE AND MERIDIAN AS SHOWN BY UNITED STATES GOVERNMENT SURVEY.

ASSESSOR'S PARCEL NUMBER(S)

APN 376-410-002
APN 376-410-024

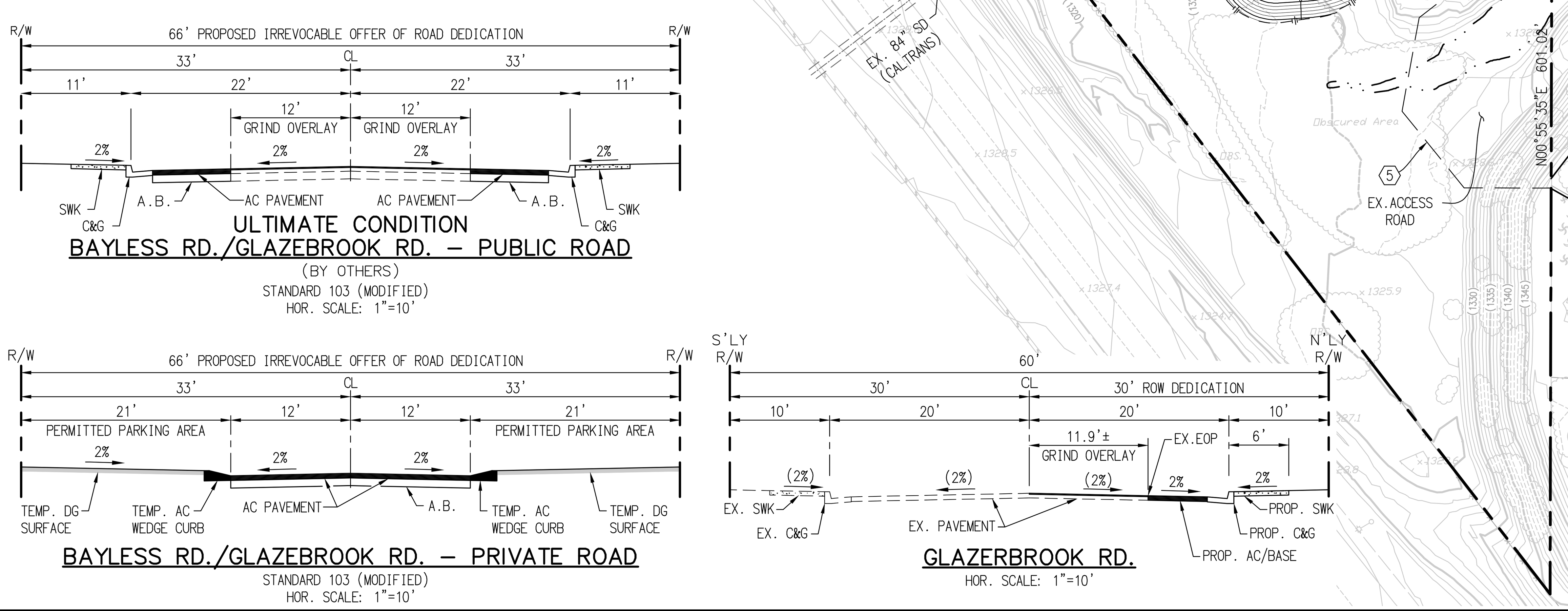
EASEMENT NOTES

1. EASEMENT FOR ROADS AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT RECORDED DECEMBER 22, 1970 AS INSTRUMENT NO. 128099, 128100, 128101 AND 128102, INCLUSIVE OF OFFICIAL RECORDS.
2. THE FACT THAT THE OWNERSHIP OF SAID LAND DOES NOT INCLUDE RIGHTS OF ACCESS TO OR FROM THE STREET, HIGHWAY OR FREEWAY ABUTTING SAID LAND, SUCH RIGHTS HAVING BEEN SEVERED FROM SAID LAND BY THE DOCUMENT RECORDED APRIL 11, 1957 AS INSTRUMENT NO. 26586 OF OFFICIAL RECORDS.
3. AN EASEMENT FOR PUBLIC ROAD AND DRAINAGE AND RIGHTS INCIDENTAL, THERETO AS SET FORTH IN DOCUMENT RECORDED MARCH 15, 2007 AS INSTRUMENT NO. 2007-176623 OF OFFICIAL RECORDS.
4. AN IRREVOCABLE OFFER TO DEDICATE A PORTION OF SAID LAND FOR STORM DRAIN EASEMENT FOR FLOOD CONTROL AND DRAINAGE PURPOSES RECORDED MARCH 13, 2007 AS INSTRUMENT NO. 2007-0170125.
5. AN IRREVOCABLE OFFER TO DEDICATE A PORTION OF SAID LAND FOR STORM DRAIN EASEMENT FOR FLOOD CONTROL AND DRAINAGE PURPOSES RECORDED MARCH 13, 2007 AS INSTRUMENT NO. 2007-0170126.



VICINITY MAP

T06S, R04W, SEC. 36
NOT TO SCALE



OWNER/APPLICANT

FAITH BIBLE CHURCH
23811 WASHINGTON AVE.,#C110-313
MURRIETA, CA. 92562
PHONE: 951.200.3173
CONTACT: JOHN PLEASNICK

CIVIL ENGINEER

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PHONE: 951.331.9873
CONTACT: FRANCISCO MARTINEZ JR., P.E.

ARCHITECT

VISIONEERING STUDIOS ARCHITECTURE, INC.
106 WEST 4TH ST, SUITE 600
SANTA ANA, CA 927011
PHONE: 949.417.5882
CONTACT: TONY TORRES

TOPOGRAPHY

INLAND AERIAL SURVEYS INC.
7117 ARLINGTON AVE., SUITE A
RIVERSIDE, CA. 92503
PHONE: 951.687.4252
AERIAL DATE: DECEMBER 2, 2015

GEOTECHNICAL ENGINEER

ARAGON GEOTECHNICAL INC.
16801 VAN BUREN BLVD.
RIVERSIDE, CA. 92504
PHONE: 951.776.0345
CONTACT: FERNANDO ARAGON, P.E., G.E.

LANDSCAPE ARCHITECT

DAVID NEAULT ASSOCIATES INC.
41877 ENTERPRISE CIRCLE NORTH, SUITE 140
TEMECULA, CA 92590
PHONE: 951.296.3430
CONTACT: DAVID S. NEAULT

UTILITIES

WATER AND SEWER
ELSINORE VALLEY MUNICIPAL WATER DISTRICT
PHONE: 951.674.3146

ELECTRIC
SOUTHERN CALIFORNIA EDISON
PHONE: 800.655.4555

GAS
SOUTHERN CALIFORNIA GAS COMPANY
PHONE: 800.427.2200

TELEPHONE
VERIZON COMMUNICATIONS
PHONE: 855.820.4924

NO.	DATE	REVISION

REGISTERED PROFESSIONAL ENGINEER FRANCISCO MARTINEZ JR C-84640 CIVIL STATE OF CALIFORNIA

PREPARED BY:
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FRANCISCO MARTINEZ JR. DATE: R.C.E. #84640

FAITH BIBLE CHURCH

CONCEPTUAL GRADING
EXHIBIT
CITY OF WILDOMAR

DATE: 10/29/2018

1

OF 1 SHEETS

PROJECT NO. 17-0111

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FIGURE 6:
ONSITE HYDROLOGY SOIL UNIT EXHIBIT

Planning Application No. 17 - _______

APPLICANT / LANDOWNER:
FAITH BIBLE CHURCH
2381 Washington Ave. #C110-313, Murietta, CA 92562
(951) 200-3173

Hydrologic Soil Group

- A
- D
- ND - Not Designated Assumed D

- Project Boundary
- Interstate
- Parcel Line

FMCIVIL ENGINEERS INC.

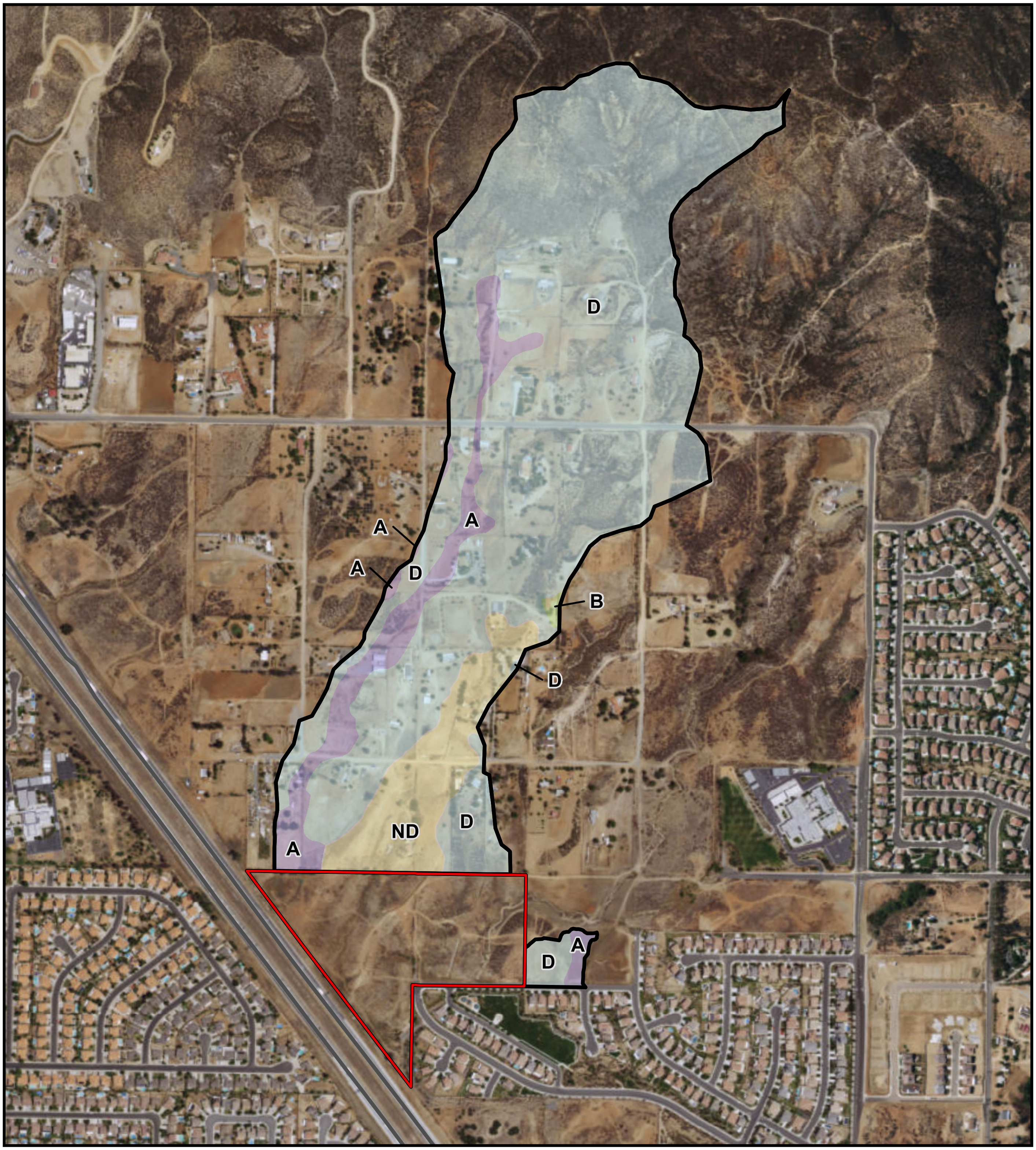
0 150 300 Feet

Onsite Hydrologic Soil Unit Exhibit

Source: Riverside County, 2017.

FIGURE 7:

HYDROLOGIC SOIL UNIT EXHIBIT (OFFSITE)



Planning Application No. 17 - _______

APPLICANT / LANDOWNER:
FAITH BIBLE CHURCH

2381 Washington Ave. #C110-313, Murietta, CA 92562
(951) 200-3173

Hydrologic Soil Group

- A
- B
- D
- ND - Not Designated Assumed D

- Project Boundary
- Offsite Drainage
- Interstate

Hydrologic Soil Unit Exhibit (Offsite)

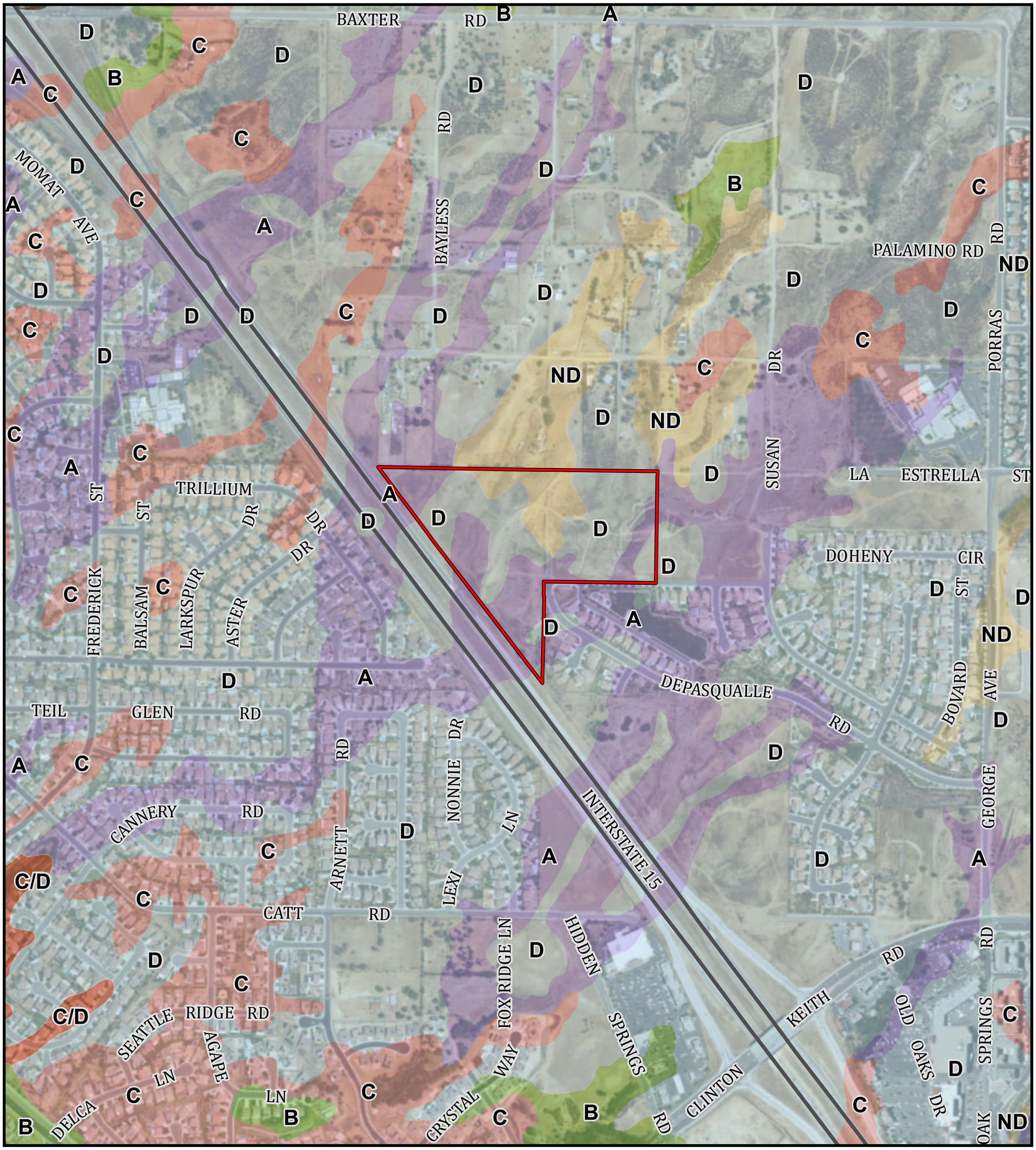
0 500 1,000
Feet

FMCIVIL ENGINEERS INC.

Source: Riverside County, 2017.

FIGURE 8:

HYDROLOGIC SOIL UNIT EXHIBIT (AREA WIDE)



Planning Application No. 17 - _______

APPLICANT / LANDOWNER:
FAITH BIBLE CHURCH
2381 Washington Ave. #C110-313, Murietta, CA 92562
(951) 200-3173

Hydrologic Soil Group

- A
- B
- C
- C/D
- D
- ND - Not Designated Assumed D

- Project Boundary
- Offsite Drainage
- Interstate

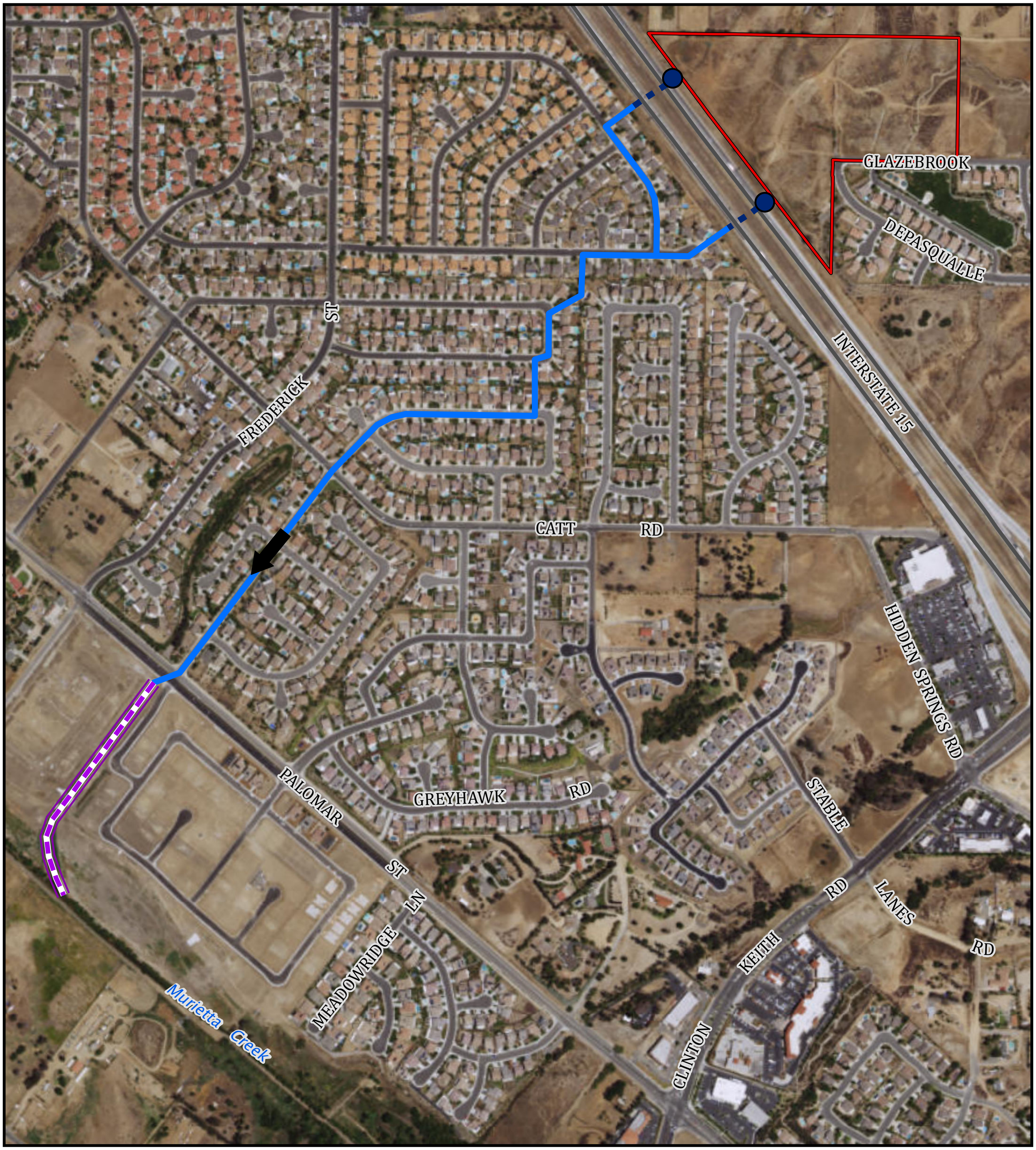
Hydrologic Soil Unit Exhibit (Area Wide)

0 500 1,000 Feet

Source: Riverside County, 2017.

FMCIVIL ENGINEERS INC.

FIGURE 9:
OFFSITE DRAINAGE



Planning Application No. 17 - _______

APPLICANT / LANDOWNER:
FAITH BIBLE CHURCH
2381 Washington Ave. #C110-313, Murietta, CA 92562
(951) 200-3173

Drain Channel
Storm Drain
Storm Drain Culvert With Headwall
Flow Path
Project Boundary

Offsite Drainage

0 460 920
Feet

FMCIVIL ENGINEERS INC.

Source: Riverside County, 2017.

APPENDIX A

EXIST PROJECT CONDITION RATIONAL METHOD HYDROLOGY (ONSITE AND OFFSITE)

```
            Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0
      Rational Hydrology Study       Date: 10/29/18  File:FBCX100A.out
------------------------------------------------------------------------
FBC EXISTING OFF/ONSITE FLOWS
100-YR STORM
WATERSHED A

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

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

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


Program License Serial Number 6405

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

Storm event (year) =  100.00 Antecedent Moisture Condition = 3

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

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




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       11.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   235.000(Ft.)
Top (of initial area) elevation =  1386.000(Ft.)
Bottom (of initial area) elevation =  1367.000(Ft.)
Difference in elevation =    19.000(Ft.)
Slope =    0.08085  s(percent)=       8.09
TC = k(0.480)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.049 min.
Rainfall intensity =      4.193(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1 Acre Lot)
Runoff Coefficient = 0.870
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3)  =  88.00
Pervious area fraction =  0.800; Impervious fraction =  0.200
Initial subarea runoff =      2.189(CFS)
Total initial stream area =        0.600(Ac.)
Pervious area fraction = 0.800
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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1367.000(Ft.)
End of natural channel elevation =   1338.200(Ft.)
Length of natural channel  =   689.000(Ft.)
Estimated mean flow rate at midpoint of channel =     10.214(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   5.14(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0418
Corrected/adjusted channel slope =  0.0418
Travel time =    2.24 min.     TC =    9.28  min.


 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.878
Decimal fraction soil group A = 0.207
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.793
RI index for soil(AMC 3)  =  93.67
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      3.674(In/Hr) for a   100.0 year storm
Subarea runoff =     14.199(CFS) for      4.400(Ac.)
Total runoff =     16.388(CFS)      Total area =       5.000(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      5.000(Ac.)
Runoff from this stream =     16.388(CFS)
Time of concentration =    9.28 min.
Rainfall intensity =     3.674(In/Hr)
Summary of stream data:

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


1       16.388      9.28              3.674
Largest stream flow has longer time of concentration
Qp =     16.388 + sum of
Qp =     16.388

Total of 1 main streams to confluence:
Flow rates before confluence point:
      16.388
Area of streams before confluence:
        5.000


Results of confluence:
Total flow rate =     16.388(CFS)
```

```
Time of concentration =     9.284 min.
Effective stream area after confluence  =      5.000(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       14.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   578.000(Ft.)
Top (of initial area) elevation =  1373.200(Ft.)
Bottom (of initial area) elevation =  1353.900(Ft.)
Difference in elevation =    19.300(Ft.)
Slope =    0.03339  s(percent)=       3.34
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   13.314 min.
Rainfall intensity =      3.090(In/Hr) for a   100.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.868
Decimal fraction soil group A = 0.326
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.674
RI index for soil(AMC 3)  =  92.10
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      6.757(CFS)
Total initial stream area =        2.520(Ac.)
Pervious area fraction = 1.000



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       12.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1353.900(Ft.)
End of natural channel elevation =   1338.200(Ft.)
Length of natural channel  =   287.000(Ft.)
Estimated mean flow rate at midpoint of channel =      7.776(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   5.49(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0547
Corrected/adjusted channel slope =  0.0547
Travel time =    0.87 min.     TC =   14.19  min.


 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.866
Decimal fraction soil group A = 0.338
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.662
RI index for soil(AMC 3)  =  91.94
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      2.997(In/Hr) for a   100.0 year storm
Subarea runoff =      1.973(CFS) for      0.760(Ac.)
Total runoff =      8.731(CFS)      Total area =       3.280(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

Process from Point/Station 14.000 to Point/Station 12.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 3.280(Ac.)
Runoff from this stream = 8.731(CFS)
Time of concentration = 14.19 min.
Rainfall intensity = 2.997(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	16.388	9.28	3.674
2	8.731	14.19	2.997

Largest stream flow has longer or shorter time of concentration
Qp = 16.388 + sum of
Qa Tb/Ta
8.731 * 0.654 = 5.714
Qp = 22.102

Total of 2 main streams to confluence:
Flow rates before confluence point:
16.388 8.731
Area of streams before confluence:
5.000 3.280

Results of confluence:
Total flow rate = 22.102(CFS)
Time of concentration = 9.284 min.
Effective stream area after confluence = 8.280(Ac.)
End of computations, total study area = 8.28 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.986
Area averaged RI index number = 82.7

```
            Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0
      Rational Hydrology Study       Date: 10/29/18  File:FBCX100BC.out
------------------------------------------------------------------------
FBC EXISTING OFF/ONSITE FLOWS
100-YR STORM EVENT
WATERSHED B & C

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

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

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


Program License Serial Number 6405

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

Storm event (year) =  100.00 Antecedent Moisture Condition = 3

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

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




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station       21.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   625.000(Ft.)
Top (of initial area) elevation =  1415.000(Ft.)
Bottom (of initial area) elevation =  1360.000(Ft.)
Difference in elevation =    55.000(Ft.)
Slope =    0.08800  s(percent)=       8.80
TC = k(0.480)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.249 min.
Rainfall intensity =      3.503(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1 Acre Lot)
Runoff Coefficient = 0.864
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3)  =  88.00
Pervious area fraction =  0.800; Impervious fraction =  0.200
Initial subarea runoff =      9.388(CFS)
Total initial stream area =        3.100(Ac.)
Pervious area fraction = 0.800
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.000 to Point/Station       22.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1362.000(Ft.)
End of natural channel elevation =   1320.400(Ft.)
Length of natural channel  =  1368.000(Ft.)
Estimated mean flow rate at midpoint of channel =     25.772(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   5.60(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0304
Corrected/adjusted channel slope =  0.0304
Travel time =    4.07 min.     TC =   14.32  min.


 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.865
Decimal fraction soil group A = 0.350
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.650
RI index for soil(AMC 3)  =  91.78
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      2.984(In/Hr) for a   100.0 year storm
Subarea runoff =     27.935(CFS) for     10.820(Ac.)
Total runoff =     37.324(CFS)      Total area =      13.920(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.000 to Point/Station       22.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     13.920(Ac.)
Runoff from this stream =     37.324(CFS)
Time of concentration =   14.32 min.
Rainfall intensity =     2.984(In/Hr)
Program is now starting with Main Stream No. 2



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       30.000 to Point/Station       31.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   578.000(Ft.)
Top (of initial area) elevation =  1620.000(Ft.)
Bottom (of initial area) elevation =  1520.000(Ft.)
Difference in elevation =   100.000(Ft.)
Slope =    0.17301  s(percent)=      17.30
TC = k(0.480)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.678 min.
Rainfall intensity =      3.795(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1 Acre Lot)
Runoff Coefficient = 0.867
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
```

```
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3)  =  88.00
Pervious area fraction =  0.800; Impervious fraction =  0.200
Initial subarea runoff =     11.516(CFS)
Total initial stream area =        3.500(Ac.)
Pervious area fraction = 0.800



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       31.000 to Point/Station       32.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1520.000(Ft.)
End of natural channel elevation =   1432.000(Ft.)
Length of natural channel  =  1528.000(Ft.)
Estimated mean flow rate at midpoint of channel =     35.864(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   8.45(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0576
Corrected/adjusted channel slope =  0.0576
Travel time =    3.01 min.     TC =   11.69  min.


 Adding area flow to channel
SINGLE FAMILY (1 Acre Lot)
Runoff Coefficient = 0.862
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.011
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.989
RI index for soil(AMC 3)  =  87.87
Pervious area fraction =  0.800; Impervious fraction =  0.200
Rainfall intensity =      3.289(In/Hr) for a   100.0 year storm
Subarea runoff =     41.948(CFS) for     14.800(Ac.)
Total runoff =     53.464(CFS)      Total area =      18.300(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       32.000 to Point/Station       33.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1432.000(Ft.)
End of natural channel elevation =   1338.000(Ft.)
Length of natural channel  =  1900.000(Ft.)
Estimated mean flow rate at midpoint of channel =     92.613(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =  10.32(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0495
Corrected/adjusted channel slope =  0.0495
Travel time =    3.07 min.     TC =   14.76  min.


 Adding area flow to channel
```

```
SINGLE FAMILY (1 Acre Lot)
Runoff Coefficient = 0.858
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.008
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.992
RI index for soil(AMC 3)  =  87.91
Pervious area fraction =  0.800; Impervious fraction =  0.200
Rainfall intensity =      2.941(In/Hr) for a   100.0 year storm
Subarea runoff =     67.595(CFS) for     26.800(Ac.)
Total runoff =    121.059(CFS)      Total area =      45.100(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       33.000 to Point/Station       22.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1338.000(Ft.)
End of natural channel elevation =   1320.400(Ft.)
Length of natural channel  =   846.000(Ft.)
Estimated mean flow rate at midpoint of channel =    129.649(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   7.40(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0208
Corrected/adjusted channel slope =  0.0208
Travel time =    1.90 min.     TC =   16.67  min.


 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.868
Decimal fraction soil group A = 0.274
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.726
RI index for soil(AMC 3)  =  92.78
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      2.774(In/Hr) for a   100.0 year storm
Subarea runoff =     15.403(CFS) for      6.400(Ac.)
Total runoff =    136.463(CFS)      Total area =      51.500(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       33.000 to Point/Station       22.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =     51.500(Ac.)
Runoff from this stream =    136.463(CFS)
Time of concentration =   16.67 min.
Rainfall intensity =     2.774(In/Hr)
Summary of stream data:

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


1       37.324     14.32               2.984
2      136.463     16.67               2.774
```

```
Largest stream flow has longer time of concentration
Qp =    136.463 + sum of
        Qb          Ia/Ib
        37.324 *    0.930 =     34.705
Qp =    171.168

Total of 2 main streams to confluence:
Flow rates before confluence point:
      37.324     136.463
Area of streams before confluence:
       13.920       51.500


Results of confluence:
Total flow rate =    171.168(CFS)
Time of concentration =    16.665 min.
Effective stream area after confluence  =     65.420(Ac.)
End of computations, total study area =           65.42 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.853
Area averaged RI index number =  76.7
```

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            Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0
      Rational Hydrology Study        Date: 10/29/18  File:FBCX100D.out
------------------------------------------------------------------------
FBC EXISTING OFFSITE/ONSITE FLOWS
100-YR STORM EVENT
WATERSHED D

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

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

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


Program License Serial Number 6405

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

Storm event (year) =  100.00 Antecedent Moisture Condition = 3

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

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




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       40.000 to Point/Station       41.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   950.000(Ft.)
Top (of initial area) elevation =  1724.000(Ft.)
Bottom (of initial area) elevation =  1668.000(Ft.)
Difference in elevation =    56.000(Ft.)
Slope =    0.05895  s(percent)=      5.89
TC = k(0.480)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   13.129 min.
Rainfall intensity =      3.111(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1 Acre Lot)
Runoff Coefficient = 0.860
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3)  =  88.00
Pervious area fraction =  0.800; Impervious fraction =  0.200
Initial subarea runoff =     13.647(CFS)
Total initial stream area =        5.100(Ac.)
Pervious area fraction = 0.800
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       41.000 to Point/Station       42.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1668.000(Ft.)
End of natural channel elevation =   1492.000(Ft.)
Length of natural channel  =  1897.000(Ft.)
Estimated mean flow rate at midpoint of channel =     68.503(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =  12.92(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0928
Corrected/adjusted channel slope =  0.0928
Travel time =    2.45 min.     TC =   15.58  min.


 Adding area flow to channel
SINGLE FAMILY (1 Acre Lot)
Runoff Coefficient = 0.851
Decimal fraction soil group A = 0.063
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.937
RI index for soil(AMC 3)  =  86.37
Pervious area fraction =  0.800; Impervious fraction =  0.200
Rainfall intensity =      2.866(In/Hr) for a   100.0 year storm
Subarea runoff =     99.958(CFS) for     41.000(Ac.)
Total runoff =    113.605(CFS)      Total area =      46.100(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       42.000 to Point/Station       43.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1492.000(Ft.)
End of natural channel elevation =   1344.000(Ft.)
Length of natural channel  =  3015.000(Ft.)
Estimated mean flow rate at midpoint of channel =    168.683(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =  12.33(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0491
Corrected/adjusted channel slope =  0.0491
Travel time =    4.08 min.     TC =   19.65  min.


 Adding area flow to channel
SINGLE FAMILY (1 Acre Lot)
Runoff Coefficient = 0.832
Decimal fraction soil group A = 0.178
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.822
RI index for soil(AMC 3)  =  83.41
Pervious area fraction =  0.800; Impervious fraction =  0.200
```

```
Rainfall intensity =      2.563(In/Hr) for a   100.0 year storm
Subarea runoff =     95.378(CFS) for     44.700(Ac.)
Total runoff =    208.983(CFS)      Total area =      90.800(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       43.000 to Point/Station       44.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1344.000(Ft.)
End of natural channel elevation =   1331.100(Ft.)
Length of natural channel  =   273.000(Ft.)
Estimated mean flow rate at midpoint of channel =    211.504(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =  12.97(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0473
Corrected/adjusted channel slope =  0.0473
Travel time =    0.35 min.     TC =   20.00  min.


 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.837
Decimal fraction soil group A = 0.683
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.317
RI index for soil(AMC 3)  =  87.38
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      2.541(In/Hr) for a   100.0 year storm
Subarea runoff =      4.656(CFS) for      2.190(Ac.)
Total runoff =    213.640(CFS)      Total area =      92.990(Ac.)
End of computations, total study area =          92.99 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.805
Area averaged RI index number =  70.1
```

APPENDIX B

PROPOSED PROJECT CONDITION RATIONAL METHOD HYDROLOGY (ONSITE W/EXISTING OFFSITES)

B.1: RATIONAL METHOD ANALYSIS, AREA "A" W/EXISTING OFFSITES

B.2: RATIONAL METHOD ANALYSIS, AREA "B" ONSITE

B.3: RATIONAL METHOD ANALYSIS, AREA "B-C" OFFSITE BY-PASS

B.4: RATIONAL METHOD ANALYSIS, AREA "D" W/EXISTING OFFSITES

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            Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0
      Rational Hydrology Study       Date: 10/28/18  File:FBCXP100A.out
------------------------------------------------------------------------
FBC OFF/ONSITE FLOWS
100-YR STORM
WATERSHED A UNDER DEVELOPED AND EXISTING CONDITIONS

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

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

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


Program License Serial Number 6405

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

Storm event (year) =  100.00 Antecedent Moisture Condition = 3

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

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




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Process from Point/Station       10.000 to Point/Station       11.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   235.000(Ft.)
Top (of initial area) elevation =  1386.000(Ft.)
Bottom (of initial area) elevation =  1367.000(Ft.)
Difference in elevation =    19.000(Ft.)
Slope =    0.08085  s(percent)=       8.09
TC = k(0.480)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.049 min.
Rainfall intensity =      4.193(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1 Acre Lot)
Runoff Coefficient = 0.870
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3)  =  88.00
Pervious area fraction =  0.800; Impervious fraction =  0.200
Initial subarea runoff =      2.189(CFS)
Total initial stream area =        0.600(Ac.)
Pervious area fraction = 0.800
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       11.100
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1367.000(Ft.)
End of natural channel elevation =   1357.700(Ft.)
Length of natural channel  =   195.000(Ft.)
Estimated mean flow rate at midpoint of channel =      3.156(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   4.15(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0477
Corrected/adjusted channel slope =  0.0477
Travel time =    0.78 min.     TC =    7.83  min.


 Adding area flow to channel
UNDEVELOPED (good cover) subarea
Runoff Coefficient = 0.871
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3)  =  91.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      3.986(In/Hr) for a   100.0 year storm
Subarea runoff =      1.840(CFS) for      0.530(Ac.)
Total runoff =      4.029(CFS)      Total area =       1.130(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.100 to Point/Station       12.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1357.700(Ft.)
End of natural channel elevation =   1338.200(Ft.)
Length of natural channel  =   516.000(Ft.)
Estimated mean flow rate at midpoint of channel =      7.987(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   4.59(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0378
Corrected/adjusted channel slope =  0.0378
Travel time =    1.87 min.     TC =    9.71  min.


 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.868
Decimal fraction soil group A = 0.414
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.586
RI index for soil(AMC 3)  =  90.94
Pervious area fraction =  1.000; Impervious fraction =  0.000
```

```
Rainfall intensity =      3.596(In/Hr) for a   100.0 year storm
Subarea runoff =      6.929(CFS) for      2.220(Ac.)
Total runoff =     10.958(CFS)      Total area =       3.350(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      12.000 to Point/Station      12.500
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =  1338.200(Ft.)
Downstream point/station elevation =  1331.700(Ft.)
Pipe length  =    31.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    10.958(CFS)
Given pipe size =     78.00(In.)
Calculated individual pipe flow  =    10.958(CFS)
Normal flow depth in pipe =    3.81(In.)
Flow top width inside pipe =   33.62(In.)
Critical depth could not be calculated.
Pipe flow velocity =     18.30(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     9.73 min.



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      12.000 to Point/Station      12.500
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      3.350(Ac.)
Runoff from this stream =     10.958(CFS)
Time of concentration =    9.73 min.
Rainfall intensity =     3.591(In/Hr)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      13.000 to Point/Station      14.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   571.000(Ft.)
Top (of initial area) elevation =  1373.200(Ft.)
Bottom (of initial area) elevation =  1354.000(Ft.)
Difference in elevation =    19.200(Ft.)
Slope =    0.03363  s(percent)=       3.36
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   13.231 min.
Rainfall intensity =      3.099(In/Hr) for a   100.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.868
Decimal fraction soil group A = 0.327
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.673
RI index for soil(AMC 3)  =  92.08
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      6.751(CFS)
Total initial stream area =       2.510(Ac.)
Pervious area fraction = 1.000



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      14.000 to Point/Station      12.500
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =  1350.000(Ft.)
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Downstream point/station elevation =  1334.200(Ft.)
Pipe length  =   317.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.751(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     6.751(CFS)
Normal flow depth in pipe =    6.61(In.)
Flow top width inside pipe =   17.35(In.)
Critical Depth =   12.07(In.)
Pipe flow velocity =     11.47(Ft/s)
Travel time through pipe =    0.46 min.
Time of concentration (TC) =    13.69 min.



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Process from Point/Station       14.000 to Point/Station       12.500
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.510(Ac.)
Runoff from this stream =      6.751(CFS)
Time of concentration =   13.69 min.
Rainfall intensity =     3.049(In/Hr)
Summary of stream data:

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


1       10.958      9.73                 3.591
2        6.751     13.69                 3.049
Largest stream flow has longer or shorter time of concentration
Qp =     10.958 + sum of
        Qa          Tb/Ta
         6.751 *    0.711 =      4.799
Qp =     15.758

Total of 2 streams to confluence:
Flow rates before confluence point:
      10.958       6.751
Area of streams before confluence:
        3.350        2.510
Results of confluence:
Total flow rate =     15.758(CFS)
Time of concentration =     9.734 min.
Effective stream area after confluence =      5.860(Ac.)
End of computations, total study area =           5.86 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.980
Area averaged RI index number =  80.2
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            Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0
      Rational Hydrology Study       Date: 10/29/18  File:FBCP100B.out
------------------------------------------------------------------------
FBC ONSITE FLOWS
100-YEAR STORM
WATERSHED B

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

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

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


Program License Serial Number 6405

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

Storm event (year) =  100.00 Antecedent Moisture Condition = 3

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

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





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Process from Point/Station       40.000 to Point/Station       41.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   760.000(Ft.)
Top (of initial area) elevation =  1370.000(Ft.)
Bottom (of initial area) elevation =  1341.900(Ft.)
Difference in elevation =    28.100(Ft.)
Slope =    0.03697  s(percent)=      3.70
TC = k(0.370)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.161 min.
Rainfall intensity =      3.518(In/Hr) for a   100.0 year storm
CONDOMINIUM subarea type
Runoff Coefficient = 0.882
Decimal fraction soil group A = 0.070
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.930
RI index for soil(AMC 3)  =  86.19
Pervious area fraction =  0.350; Impervious fraction =  0.650
Initial subarea runoff =     13.372(CFS)
Total initial stream area =        4.310(Ac.)
Pervious area fraction = 0.350
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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       41.000 to Point/Station       42.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =  1336.200(Ft.)
Downstream point/station elevation =  1334.500(Ft.)
Pipe length  =    86.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    13.372(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =    13.372(CFS)
Normal flow depth in pipe =   13.43(In.)
Flow top width inside pipe =   15.67(In.)
Critical Depth =   16.35(In.)
Pipe flow velocity =      9.47(Ft/s)
Travel time through pipe =    0.15 min.
Time of concentration (TC) =    10.31 min.



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Process from Point/Station       41.000 to Point/Station       42.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      4.310(Ac.)
Runoff from this stream =     13.372(CFS)
Time of concentration =   10.31 min.
Rainfall intensity =     3.493(In/Hr)
Program is now starting with Main Stream No. 2



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       42.100 to Point/Station       42.200
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   553.000(Ft.)
Top (of initial area) elevation =  1353.700(Ft.)
Bottom (of initial area) elevation =  1338.900(Ft.)
Difference in elevation =    14.800(Ft.)
Slope =    0.02676  s(percent)=       2.68
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.739 min.
Rainfall intensity =      4.009(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.896
Decimal fraction soil group A = 0.064
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.937
RI index for soil(AMC 3)  =  86.39
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      4.308(CFS)
Total initial stream area =        1.200(Ac.)
Pervious area fraction = 0.100



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Process from Point/Station       42.200 to Point/Station       42.300
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =  1335.400(Ft.)
Downstream point/station elevation =  1334.900(Ft.)
Pipe length  =    32.00(Ft.)   Manning's N = 0.013
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```
No. of pipes = 1  Required pipe flow  =     4.308(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     4.308(CFS)
Normal flow depth in pipe =    9.49(In.)
Flow top width inside pipe =    9.76(In.)
Critical Depth =   10.47(In.)
Pipe flow velocity =      6.46(Ft/s)
Travel time through pipe =    0.08 min.
Time of concentration (TC) =     7.82 min.



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Process from Point/Station       42.200 to Point/Station       42.300
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      1.200(Ac.)
Runoff from this stream =      4.308(CFS)
Time of concentration =    7.82 min.
Rainfall intensity =     3.989(In/Hr)



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Process from Point/Station       42.400 to Point/Station       42.300
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   416.000(Ft.)
Top (of initial area) elevation =  1353.700(Ft.)
Bottom (of initial area) elevation =  1338.900(Ft.)
Difference in elevation =    14.800(Ft.)
Slope =    0.03558  s(percent)=       3.56
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.524 min.
Rainfall intensity =      4.351(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.896
Decimal fraction soil group A = 0.101
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.899
RI index for soil(AMC 3)  =  85.39
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      1.598(CFS)
Total initial stream area =       0.410(Ac.)
Pervious area fraction = 0.100



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Process from Point/Station       42.400 to Point/Station       42.300
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      0.410(Ac.)
Runoff from this stream =      1.598(CFS)
Time of concentration =    6.52 min.
Rainfall intensity =     4.351(In/Hr)
Summary of stream data:

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


1        4.308      7.82                 3.989
2        1.598      6.52                 4.351
Largest stream flow has longer time of concentration
```

```
Qp =      4.308 + sum of
        Qb         Ia/Ib
         1.598 *    0.917 =      1.464
Qp =      5.773

Total of 2 streams to confluence:
Flow rates before confluence point:
       4.308       1.598
Area of streams before confluence:
        1.200        0.410
Results of confluence:
Total flow rate =      5.773(CFS)
Time of concentration =     7.822 min.
Effective stream area after confluence =      1.610(Ac.)



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Process from Point/Station       42.300 to Point/Station       42.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =  1334.900(Ft.)
Downstream point/station elevation =  1334.500(Ft.)
Pipe length  =    20.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.773(CFS)
Given pipe size =     15.00(In.)
Calculated individual pipe flow  =     5.773(CFS)
Normal flow depth in pipe =    8.65(In.)
Flow top width inside pipe =   14.82(In.)
Critical Depth =   11.67(In.)
Pipe flow velocity =      7.87(Ft/s)
Travel time through pipe =    0.04 min.
Time of concentration (TC) =     7.86 min.



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Process from Point/Station       42.300 to Point/Station       42.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      1.610(Ac.)
Runoff from this stream =      5.773(CFS)
Time of concentration =    7.86 min.
Rainfall intensity =     3.978(In/Hr)
Summary of stream data:

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


1       13.372     10.31               3.493
2        5.773      7.86               3.978
Largest stream flow has longer time of concentration
Qp =     13.372 + sum of
        Qb         Ia/Ib
         5.773 *    0.878 =      5.068
Qp =     18.440

Total of 2 main streams to confluence:
Flow rates before confluence point:
      13.372       5.773
Area of streams before confluence:
        4.310        1.610


Results of confluence:
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Total flow rate =     18.440(CFS)
Time of concentration =    10.313 min.
Effective stream area after confluence  =      5.920(Ac.)



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Process from Point/Station       42.000 to Point/Station       47.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =  1334.500(Ft.)
Downstream point/station elevation =  1332.700(Ft.)
Pipe length  =    91.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    18.440(CFS)
Given pipe size =     24.00(In.)
Calculated individual pipe flow  =    18.440(CFS)
Normal flow depth in pipe =   13.11(In.)
Flow top width inside pipe =   23.90(In.)
Critical Depth =   18.54(In.)
Pipe flow velocity =     10.50(Ft/s)
Travel time through pipe =    0.14 min.
Time of concentration (TC) =    10.46 min.



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Process from Point/Station       42.000 to Point/Station       47.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      5.920(Ac.)
Runoff from this stream =     18.440(CFS)
Time of concentration =   10.46 min.
Rainfall intensity =     3.470(In/Hr)



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Process from Point/Station       48.000 to Point/Station       49.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   507.000(Ft.)
Top (of initial area) elevation =  1348.200(Ft.)
Bottom (of initial area) elevation =  1339.200(Ft.)
Difference in elevation =     9.000(Ft.)
Slope =    0.01775  s(percent)=       1.78
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.115 min.
Rainfall intensity =      3.919(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.895
Decimal fraction soil group A = 0.145
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.855
RI index for soil(AMC 3)  =  84.26
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      5.083(CFS)
Total initial stream area =        1.450(Ac.)
Pervious area fraction = 0.100



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Process from Point/Station       49.000 to Point/Station       47.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =  1334.200(Ft.)
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Downstream point/station elevation =  1332.700(Ft.)
Pipe length  =    12.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.083(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     5.083(CFS)
Normal flow depth in pipe =    5.30(In.)
Flow top width inside pipe =   11.92(In.)
Critical Depth =   11.05(In.)
Pipe flow velocity =     15.18(Ft/s)
Travel time through pipe =    0.01 min.
Time of concentration (TC) =     8.13 min.



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Process from Point/Station       49.000 to Point/Station       47.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.450(Ac.)
Runoff from this stream =      5.083(CFS)
Time of concentration =    8.13 min.
Rainfall intensity =     3.916(In/Hr)
Summary of stream data:

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


1       18.440     10.46                3.470
2        5.083      8.13                3.916
Largest stream flow has longer time of concentration
Qp =     18.440 + sum of
        Qb         Ia/Ib
         5.083 *    0.886 =      4.504
Qp =     22.945

Total of 2 streams to confluence:
Flow rates before confluence point:
      18.440       5.083
Area of streams before confluence:
        5.920        1.450
Results of confluence:
Total flow rate =     22.945(CFS)
Time of concentration =    10.457 min.
Effective stream area after confluence =      7.370(Ac.)



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Process from Point/Station       47.000 to Point/Station       50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =  1334.500(Ft.)
Downstream point/station elevation =  1324.500(Ft.)
Pipe length  =    60.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    22.945(CFS)
Given pipe size =     24.00(In.)
Calculated individual pipe flow  =    22.945(CFS)
Normal flow depth in pipe =    8.15(In.)
Flow top width inside pipe =   22.73(In.)
Critical Depth =   20.46(In.)
Pipe flow velocity =     24.39(Ft/s)
Travel time through pipe =    0.04 min.
Time of concentration (TC) =    10.50 min.
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Process from Point/Station      50.000 to Point/Station      51.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1324.500(Ft.)
Downstream point elevation =  1323.600(Ft.)
Channel length thru subarea  =   169.000(Ft.)
Channel base width      =   15.000(Ft.)
Slope or 'Z' of left channel bank =   5.000
Slope or 'Z' of right channel bank =   5.000
Estimated mean flow rate at midpoint of channel =     24.539(CFS)
Manning's 'N'    = 0.025
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     24.539(CFS)
Depth of flow =   0.535(Ft.), Average velocity =   2.594(Ft/s)
Channel flow top width =   20.352(Ft.)
Flow Velocity =    2.59(Ft/s)
Travel time  =    1.09 min.
Time of concentration =   11.58 min.

Sub-Channel No. 1 Critical depth =      0.414(Ft.)
  '     '       '     Critical flow top width =     19.141(Ft.)
  '     '       '     Critical flow velocity=    3.472(Ft/s)
  '     '       '     Critical flow area =      7.068(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (good cover) subarea
Runoff Coefficient = 0.825
Decimal fraction soil group A = 0.370
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.630
RI index for soil(AMC 3)  =  81.57
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      3.303(In/Hr) for a   100.0 year storm
Subarea runoff =      3.133(CFS) for      1.150(Ac.)
Total runoff =     26.078(CFS)      Total area =       8.520(Ac.)
Depth of flow =   0.554(Ft.), Average velocity =   2.648(Ft/s)

Sub-Channel No. 1 Critical depth =      0.430(Ft.)
  '     '       '     Critical flow top width =     19.297(Ft.)
  '     '       '     Critical flow velocity=    3.539(Ft/s)
  '     '       '     Critical flow area =      7.368(Sq.Ft)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      50.000 to Point/Station      51.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      8.520(Ac.)
Runoff from this stream =     26.078(CFS)
Time of concentration =   11.58 min.
Rainfall intensity =     3.303(In/Hr)
Program is now starting with Main Stream No. 2



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      52.000 to Point/Station      53.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   354.000(Ft.)
Top (of initial area) elevation =  1346.200(Ft.)
Bottom (of initial area) elevation =  1337.600(Ft.)
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Difference in elevation =     8.600(Ft.)
Slope =    0.02429  s(percent)=       2.43
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.601 min.
Rainfall intensity =      4.327(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.895
Decimal fraction soil group A = 0.132
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.868
RI index for soil(AMC 3)  =  84.59
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      2.053(CFS)
Total initial stream area =        0.530(Ac.)
Pervious area fraction = 0.100


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Process from Point/Station       53.000 to Point/Station       54.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =  1334.600(Ft.)
Downstream point/station elevation =  1331.100(Ft.)
Pipe length  =    64.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.053(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     2.053(CFS)
Normal flow depth in pipe =    4.06(In.)
Flow top width inside pipe =   11.35(In.)
Critical Depth =    7.34(In.)
Pipe flow velocity =      8.78(Ft/s)
Travel time through pipe =    0.12 min.
Time of concentration (TC) =     6.72 min.


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Process from Point/Station       53.000 to Point/Station       54.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      0.530(Ac.)
Runoff from this stream =      2.053(CFS)
Time of concentration =    6.72 min.
Rainfall intensity =     4.289(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       55.000 to Point/Station       56.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   611.000(Ft.)
Top (of initial area) elevation =  1353.200(Ft.)
Bottom (of initial area) elevation =  1342.800(Ft.)
Difference in elevation =    10.400(Ft.)
Slope =    0.01702  s(percent)=       1.70
TC = k(0.370)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.875 min.
Rainfall intensity =      3.405(In/Hr) for a   100.0 year storm
CONDOMINIUM subarea type
Runoff Coefficient = 0.884
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
```

```
RI index for soil(AMC 3)  =  88.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Initial subarea runoff =      4.425(CFS)
Total initial stream area =        1.470(Ac.)
Pervious area fraction = 0.350



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       56.000 to Point/Station       57.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  1342.800(Ft.)
End of street segment elevation =  1335.700(Ft.)
Length of street segment  =   252.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  24.000(Ft.)
Distance from crown to crossfall grade break  =  22.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      6.514(CFS)
Depth of flow =   0.372(Ft.), Average velocity =   4.162(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  12.114(Ft.)
Flow velocity =   4.16(Ft/s)
Travel time =    1.01 min.     TC =   11.88  min.
 Adding area flow to street
COMMERCIAL subarea type
Runoff Coefficient = 0.893
Decimal fraction soil group A = 0.176
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.824
RI index for soil(AMC 3)  =  83.46
Pervious area fraction =  0.100; Impervious fraction =  0.900
Rainfall intensity =      3.263(In/Hr) for a   100.0 year storm
Subarea runoff =      4.110(CFS) for      1.410(Ac.)
Total runoff =      8.535(CFS)      Total area =       2.880(Ac.)
Street flow at end of street =      8.535(CFS)
Half street flow at end of street =      8.535(CFS)
Depth of flow =   0.400(Ft.), Average velocity =   4.442(Ft/s)
Flow width (from curb towards crown)=  13.505(Ft.)



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Process from Point/Station       57.000 to Point/Station       54.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =  1331.900(Ft.)
Downstream point/station elevation =  1331.100(Ft.)
Pipe length  =    37.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     8.535(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     8.535(CFS)
Normal flow depth in pipe =    9.55(In.)
Flow top width inside pipe =   17.97(In.)
Critical Depth =   13.57(In.)
Pipe flow velocity =      8.96(Ft/s)
Travel time through pipe =    0.07 min.
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Time of concentration (TC) =    11.95 min.



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       57.000 to Point/Station       54.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      2.880(Ac.)
Runoff from this stream =      8.535(CFS)
Time of concentration =   11.95 min.
Rainfall intensity =     3.254(In/Hr)
Summary of stream data:

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


1        2.053      6.72                 4.289
2        8.535     11.95                 3.254
Largest stream flow has longer time of concentration
Qp =      8.535 + sum of
        Qb         Ia/Ib
         2.053 *    0.759 =      1.557
Qp =     10.092

Total of 2 streams to confluence:
Flow rates before confluence point:
       2.053       8.535
Area of streams before confluence:
        0.530        2.880
Results of confluence:
Total flow rate =     10.092(CFS)
Time of concentration =    11.953 min.
Effective stream area after confluence =      3.410(Ac.)



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Process from Point/Station       54.000 to Point/Station       51.200
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =  1331.100(Ft.)
Downstream point/station elevation =  1323.600(Ft.)
Pipe length  =    34.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    10.092(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =    10.092(CFS)
Normal flow depth in pipe =    5.53(In.)
Flow top width inside pipe =   16.60(In.)
Critical Depth =   14.70(In.)
Pipe flow velocity =     21.94(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =    11.98 min.



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       54.000 to Point/Station       51.200
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      3.410(Ac.)
Runoff from this stream =     10.092(CFS)
Time of concentration =   11.98 min.
Rainfall intensity =     3.251(In/Hr)
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       50.500 to Point/Station       51.200
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   385.000(Ft.)
Top (of initial area) elevation =  1343.200(Ft.)
Bottom (of initial area) elevation =  1323.600(Ft.)
Difference in elevation =    19.600(Ft.)
Slope =    0.05091  s(percent)=       5.09
TC = k(0.940)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   18.448 min.
Rainfall intensity =      2.642(In/Hr) for a   100.0 year storm
UNDEVELOPED (good cover) subarea
Runoff Coefficient = 0.755
Decimal fraction soil group A = 0.644
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.356
RI index for soil(AMC 3)  =  72.36
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      2.771(CFS)
Total initial stream area =        1.390(Ac.)
Pervious area fraction = 1.000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       50.500 to Point/Station       51.200
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      1.390(Ac.)
Runoff from this stream =      2.771(CFS)
Time of concentration =   18.45 min.
Rainfall intensity =     2.642(In/Hr)
Summary of stream data:

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


1       10.092     11.98                 3.251
2        2.771     18.45                 2.642
Largest stream flow has longer or shorter time of concentration
Qp =     10.092 + sum of
        Qa           Tb/Ta
         2.771 *    0.649 =      1.799
Qp =     11.892

Total of 2 streams to confluence:
Flow rates before confluence point:
      10.092       2.771
Area of streams before confluence:
        3.410        1.390
Results of confluence:
Total flow rate =     11.892(CFS)
Time of concentration =    11.979 min.
Effective stream area after confluence =      4.800(Ac.)


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Process from Point/Station       51.200 to Point/Station       51.100
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
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In Main Stream number: 2
Stream flow area =      4.800(Ac.)
Runoff from this stream =     11.892(CFS)
Time of concentration =   11.98 min.
Rainfall intensity =     3.251(In/Hr)
Summary of stream data:

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


1       26.078     11.58               3.303
2       11.892     11.98               3.251
Largest stream flow has longer or shorter time of concentration
Qp =     26.078 + sum of
        Qa           Tb/Ta
        11.892 *    0.967 =     11.500
Qp =     37.578

Total of 2 main streams to confluence:
Flow rates before confluence point:
      26.078      11.892
Area of streams before confluence:
        8.520        4.800


Results of confluence:
Total flow rate =     37.578(CFS)
Time of concentration =    11.584 min.
Effective stream area after confluence  =     13.320(Ac.)



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Process from Point/Station       51.100 to Point/Station       58.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =  1323.600(Ft.)
Downstream point/station elevation =  1322.800(Ft.)
Pipe length  =    12.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    37.578(CFS)
Given pipe size =     24.00(In.)
Calculated individual pipe flow  =    37.578(CFS)
Normal flow depth in pipe =   14.00(In.)
Flow top width inside pipe =   23.66(In.)
Critical depth could not be calculated.
Pipe flow velocity =     19.75(Ft/s)
Travel time through pipe =    0.01 min.
Time of concentration (TC) =    11.59 min.



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       51.100 to Point/Station       58.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     13.320(Ac.)
Runoff from this stream =     37.578(CFS)
Time of concentration =   11.59 min.
Rainfall intensity =     3.302(In/Hr)
Program is now starting with Main Stream No. 2



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       59.000 to Point/Station       58.000
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**** INITIAL AREA EVALUATION ****
____________________________________________________________________
Initial area flow distance =   586.000(Ft.)
Top (of initial area) elevation =  1345.900(Ft.)
Bottom (of initial area) elevation =  1327.500(Ft.)
Difference in elevation =    18.400(Ft.)
Slope =    0.03140  s(percent)=       3.14
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.672 min.
Rainfall intensity =      4.026(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.891
Decimal fraction soil group A = 0.436
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.564
RI index for soil(AMC 3)  =  75.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      1.758(CFS)
Total initial stream area =        0.490(Ac.)
Pervious area fraction = 0.100


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Process from Point/Station      59.000 to Point/Station      58.000
**** CONFLUENCE OF MAIN STREAMS ****
____________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      0.490(Ac.)
Runoff from this stream =      1.758(CFS)
Time of concentration =    7.67 min.
Rainfall intensity =     4.026(In/Hr)
Program is now starting with Main Stream No. 3


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Process from Point/Station      60.000 to Point/Station      61.000
**** INITIAL AREA EVALUATION ****
____________________________________________________________________
Initial area flow distance =   346.000(Ft.)
Top (of initial area) elevation =  1386.700(Ft.)
Bottom (of initial area) elevation =  1351.000(Ft.)
Difference in elevation =    35.700(Ft.)
Slope =    0.10318  s(percent)=      10.32
TC = k(0.390)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.368 min.
Rainfall intensity =      4.402(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.876
Decimal fraction soil group A = 0.145
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.855
RI index for soil(AMC 3)  =  84.26
Pervious area fraction =  0.500; Impervious fraction =  0.500
Initial subarea runoff =      3.201(CFS)
Total initial stream area =        0.830(Ac.)
Pervious area fraction = 0.500


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Process from Point/Station      61.000 to Point/Station      58.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
____________________________________________________________________
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```
Top of street segment elevation =  1351.000(Ft.)
End of street segment elevation =  1327.500(Ft.)
Length of street segment  =  1000.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.875(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      4.408(CFS)
Depth of flow =   0.328(Ft.), Average velocity =   3.557(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  10.597(Ft.)
Flow velocity =   3.56(Ft/s)
Travel time =    4.69 min.     TC =   11.05  min.
 Adding area flow to street
COMMERCIAL subarea type
Runoff Coefficient = 0.883
Decimal fraction soil group A = 0.742
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.258
RI index for soil(AMC 3)  =  63.09
Pervious area fraction =  0.100; Impervious fraction =  0.900
Rainfall intensity =      3.379(In/Hr) for a   100.0 year storm
Subarea runoff =      2.327(CFS) for      0.780(Ac.)
Total runoff =      5.528(CFS)      Total area =       1.610(Ac.)
Street flow at end of street =      5.528(CFS)
Half street flow at end of street =      5.528(CFS)
Depth of flow =   0.349(Ft.), Average velocity =   3.751(Ft/s)
Flow width (from curb towards crown)=  11.652(Ft.)



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Process from Point/Station       61.000 to Point/Station       58.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 3
Stream flow area =      1.610(Ac.)
Runoff from this stream =      5.528(CFS)
Time of concentration =   11.05 min.
Rainfall intensity =     3.379(In/Hr)
Summary of stream data:

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


1       37.578     11.59              3.302
2        1.758      7.67              4.026
3        5.528     11.05              3.379
Largest stream flow has longer time of concentration
Qp =     37.578 + sum of
        Qb          Ia/Ib
         1.758 *    0.820 =      1.442
        Qb          Ia/Ib
         5.528 *    0.977 =      5.403
Qp =     44.422
```

```
Total of 3 main streams to confluence:
Flow rates before confluence point:
      37.578       1.758       5.528
Area of streams before confluence:
       13.320        0.490        1.610


Results of confluence:
Total flow rate =     44.422(CFS)
Time of concentration =    11.594 min.
Effective stream area after confluence  =     15.420(Ac.)



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Process from Point/Station       58.000 to Point/Station       62.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =  1322.800(Ft.)
Downstream point/station elevation =  1322.600(Ft.)
Pipe length  =    23.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    44.422(CFS)
Given pipe size =     36.00(In.)
Calculated individual pipe flow  =    44.422(CFS)
Normal flow depth in pipe =   22.50(In.)
Flow top width inside pipe =   34.86(In.)
Critical Depth =   26.07(In.)
Pipe flow velocity =      9.56(Ft/s)
Travel time through pipe =    0.04 min.
Time of concentration (TC) =    11.63 min.



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Process from Point/Station       58.000 to Point/Station       62.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     15.420(Ac.)
Runoff from this stream =     44.422(CFS)
Time of concentration =   11.63 min.
Rainfall intensity =     3.296(In/Hr)
Program is now starting with Main Stream No. 2



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       59.000 to Point/Station       63.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =    34.000(Ft.)
Top (of initial area) elevation =  1345.900(Ft.)
Bottom (of initial area) elevation =  1327.500(Ft.)
Difference in elevation =    18.400(Ft.)
Slope =    0.54118  s(percent)=      54.12
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Warning: TC computed to be less than 5 min.; program is assuming the
time of concentration is 5 minutes.
Initial area time of concentration =    5.000 min.
Rainfall intensity =      4.944(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.893
Decimal fraction soil group A = 0.349
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.650
Decimal fraction soil group D = 0.001
RI index for soil(AMC 3)  =  74.87
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```
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      2.206(CFS)
Total initial stream area =       0.500(Ac.)
Pervious area fraction = 0.100



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Process from Point/Station       59.000 to Point/Station       63.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      0.500(Ac.)
Runoff from this stream =      2.206(CFS)
Time of concentration =    5.00 min.
Rainfall intensity =     4.944(In/Hr)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       64.000 to Point/Station       63.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   525.000(Ft.)
Top (of initial area) elevation =  1338.400(Ft.)
Bottom (of initial area) elevation =  1327.500(Ft.)
Difference in elevation =    10.900(Ft.)
Slope =    0.02076  s(percent)=       2.08
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.975 min.
Rainfall intensity =      3.952(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.881
Decimal fraction soil group A = 0.928
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.072
RI index for soil(AMC 3)  =  55.10
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      4.280(CFS)
Total initial stream area =       1.230(Ac.)
Pervious area fraction = 0.100



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Process from Point/Station       64.000 to Point/Station       63.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      1.230(Ac.)
Runoff from this stream =      4.280(CFS)
Time of concentration =    7.98 min.
Rainfall intensity =     3.952(In/Hr)
Summary of stream data:

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


1        2.206      5.00                 4.944
2        4.280      7.98                 3.952
Largest stream flow has longer time of concentration
Qp =      4.280 + sum of
        Qb          Ia/Ib
         2.206 *    0.799 =      1.763
Qp =      6.044
```

```
Total of 2 streams to confluence:
Flow rates before confluence point:
       2.206       4.280
Area of streams before confluence:
        0.500        1.230
Results of confluence:
Total flow rate =      6.044(CFS)
Time of concentration =     7.975 min.
Effective stream area after confluence =      1.730(Ac.)



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Process from Point/Station       63.000 to Point/Station       62.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =  1322.800(Ft.)
Downstream point/station elevation =  1322.600(Ft.)
Pipe length  =    35.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.044(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     6.044(CFS)
Normal flow depth in pipe =   11.75(In.)
Flow top width inside pipe =   17.14(In.)
Critical Depth =   11.40(In.)
Pipe flow velocity =      4.95(Ft/s)
Travel time through pipe =    0.12 min.
Time of concentration (TC) =     8.09 min.



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Process from Point/Station       63.000 to Point/Station       62.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      1.730(Ac.)
Runoff from this stream =      6.044(CFS)
Time of concentration =    8.09 min.
Rainfall intensity =     3.924(In/Hr)
Summary of stream data:

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


1       44.422     11.63               3.296
2        6.044      8.09               3.924
Largest stream flow has longer time of concentration
Qp =     44.422 + sum of
        Qb          Ia/Ib
         6.044 *    0.840 =      5.077
Qp =     49.499

Total of 2 main streams to confluence:
Flow rates before confluence point:
      44.422       6.044
Area of streams before confluence:
       15.420        1.730


Results of confluence:
Total flow rate =     49.499(CFS)
Time of concentration =    11.634 min.
Effective stream area after confluence  =     17.150(Ac.)
```

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Process from Point/Station       62.000 to Point/Station       64.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =  1322.600(Ft.)
Downstream point/station elevation =  1321.600(Ft.)
Pipe length  =   202.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    49.499(CFS)
Given pipe size =     36.00(In.)
Calculated individual pipe flow  =    49.499(CFS)
Normal flow depth in pipe =   31.69(In.)
Flow top width inside pipe =   23.38(In.)
Critical Depth =   27.48(In.)
Pipe flow velocity =      7.51(Ft/s)
Travel time through pipe =    0.45 min.
Time of concentration (TC) =    12.08 min.
End of computations, total study area =           17.15 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.337
Area averaged RI index number =  64.4
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            Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0
      Rational Hydrology Study       Date: 10/29/18  File:FBCXP100CB.out
------------------------------------------------------------------------
FBC OFFSITE AREA C AND B (BY-PASS)
100-YR STORM EVENT
BY-PASS OFFSITE AREAS AND PARTIAL ONSITE AREA B

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

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

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


Program License Serial Number 6405

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

Storm event (year) =  100.00 Antecedent Moisture Condition = 3

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

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




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station       21.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   625.000(Ft.)
Top (of initial area) elevation =  1415.000(Ft.)
Bottom (of initial area) elevation =  1362.000(Ft.)
Difference in elevation =    53.000(Ft.)
Slope =    0.08480  s(percent)=      8.48
TC = k(0.480)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.326 min.
Rainfall intensity =      3.491(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1 Acre Lot)
Runoff Coefficient = 0.864
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3)  =  88.00
Pervious area fraction =  0.800; Impervious fraction =  0.200
Initial subarea runoff =      9.354(CFS)
Total initial stream area =        3.100(Ac.)
Pervious area fraction = 0.800
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.000 to Point/Station       21.100
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1362.000(Ft.)
End of natural channel elevation =   1357.900(Ft.)
Length of natural channel  =    37.500(Ft.)
Estimated mean flow rate at midpoint of channel =      9.595(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   8.07(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.1093
Corrected/adjusted channel slope =  0.1065
Travel time =    0.08 min.     TC =   10.40  min.


 Adding area flow to channel
USER INPUT of soil data for subarea
Runoff Coefficient = 0.891
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3)  =  97.32
Pervious area fraction =  0.950; Impervious fraction =  0.050
Rainfall intensity =      3.478(In/Hr) for a   100.0 year storm
Subarea runoff =      0.496(CFS) for      0.160(Ac.)
Total runoff =      9.850(CFS)      Total area =       3.260(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.100 to Point/Station       21.200
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1349.000(Ft.)
Downstream point/station elevation =  1345.000(Ft.)
Pipe length  =   460.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.850(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     9.850(CFS)
Normal flow depth in pipe =   14.86(In.)
Flow top width inside pipe =   13.66(In.)
Critical Depth =   14.53(In.)
Pipe flow velocity =      6.32(Ft/s)
Travel time through pipe =    1.21 min.
Time of concentration (TC) =    11.62 min.



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Process from Point/Station       21.100 to Point/Station       21.200
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
USER INPUT of soil data for subarea
Runoff Coefficient = 0.885
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3)  =  95.80
```

```
Pervious area fraction =  0.950; Impervious fraction =  0.050
Time of concentration =    11.62 min.
Rainfall intensity =      3.299(In/Hr) for a   100.0 year storm
Subarea runoff =      0.876(CFS) for      0.300(Ac.)
Total runoff =     10.725(CFS)      Total area =       3.560(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      21.100 to Point/Station      21.200
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      3.560(Ac.)
Runoff from this stream =     10.725(CFS)
Time of concentration =   11.62 min.
Rainfall intensity =     3.299(In/Hr)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      30.000 to Point/Station      31.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   578.000(Ft.)
Top (of initial area) elevation =  1620.000(Ft.)
Bottom (of initial area) elevation =  1520.000(Ft.)
Difference in elevation =   100.000(Ft.)
Slope =    0.17301  s(percent)=     17.30
TC = k(0.480)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.678 min.
Rainfall intensity =      3.795(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1 Acre Lot)
Runoff Coefficient = 0.867
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3)  =  88.00
Pervious area fraction =  0.800; Impervious fraction =  0.200
Initial subarea runoff =     11.516(CFS)
Total initial stream area =       3.500(Ac.)
Pervious area fraction = 0.800



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      31.000 to Point/Station      32.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1520.000(Ft.)
End of natural channel elevation =   1432.000(Ft.)
Length of natural channel  =  1528.000(Ft.)
Estimated mean flow rate at midpoint of channel =     35.864(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   8.45(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0576
Corrected/adjusted channel slope =  0.0576
Travel time =    3.01 min.     TC =   11.69  min.


 Adding area flow to channel
```

```
SINGLE FAMILY (1 Acre Lot)
Runoff Coefficient = 0.862
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.011
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.989
RI index for soil(AMC 3)  =  87.87
Pervious area fraction =  0.800; Impervious fraction =  0.200
Rainfall intensity =      3.289(In/Hr) for a   100.0 year storm
Subarea runoff =     41.948(CFS) for     14.800(Ac.)
Total runoff =     53.464(CFS)      Total area =      18.300(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       32.000 to Point/Station       33.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1432.000(Ft.)
End of natural channel elevation =   1338.000(Ft.)
Length of natural channel  =  1900.000(Ft.)
Estimated mean flow rate at midpoint of channel =     92.613(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =  10.32(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0495
Corrected/adjusted channel slope =  0.0495
Travel time =    3.07 min.     TC =   14.76  min.


 Adding area flow to channel
SINGLE FAMILY (1 Acre Lot)
Runoff Coefficient = 0.858
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.008
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.992
RI index for soil(AMC 3)  =  87.91
Pervious area fraction =  0.800; Impervious fraction =  0.200
Rainfall intensity =      2.941(In/Hr) for a   100.0 year storm
Subarea runoff =     67.595(CFS) for     26.800(Ac.)
Total runoff =    121.059(CFS)      Total area =      45.100(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       33.000 to Point/Station       34.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1338.000(Ft.)
End of natural channel elevation =   1332.800(Ft.)
Length of natural channel  =   132.000(Ft.)
Estimated mean flow rate at midpoint of channel =    122.120(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =  10.01(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0394
Corrected/adjusted channel slope =  0.0394
```

Travel time = 0.22 min. TC = 14.98 min.

Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.881
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3) = 95.60
Pervious area fraction = 1.000; Impervious fraction = 0.000
Rainfall intensity = 2.920(In/Hr) for a 100.0 year storm
Subarea runoff = 2.033(CFS) for 0.790(Ac.)
Total runoff = 123.093(CFS) Total area = 45.890(Ac.)

++
Process from Point/Station 33.000 to Point/Station 34.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 45.890(Ac.)
Runoff from this stream = 123.093(CFS)
Time of concentration = 14.98 min.
Rainfall intensity = 2.920(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	10.725	11.62	3.299
2	123.093	14.98	2.920

Largest stream flow has longer time of concentration
Qp = 123.093 + sum of
Qb Ia/Ib
10.725 * 0.885 = 9.493
Qp = 132.586

Total of 2 streams to confluence:
Flow rates before confluence point:
10.725 123.093
Area of streams before confluence:
3.560 45.890
Results of confluence:
Total flow rate = 132.586(CFS)
Time of concentration = 14.981 min.
Effective stream area after confluence = 49.450(Ac.)

++
Process from Point/Station 34.000 to Point/Station 35.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 1332.800(Ft.)
Downstream point/station elevation = 1322.000(Ft.)
Pipe length = 649.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 132.586(CFS)
Given pipe size = 42.00(In.)
Calculated individual pipe flow = 132.586(CFS)
Normal flow depth in pipe = 35.34(In.)
Flow top width inside pipe = 30.68(In.)
Critical Depth = 39.85(In.)
Pipe flow velocity = 15.36(Ft/s)
Travel time through pipe = 0.70 min.

```
Time of concentration (TC) =    15.69 min.



+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       35.000 to Point/Station      63.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1322.000(Ft.)
End of natural channel elevation =   1318.000(Ft.)
Length of natural channel  =   337.000(Ft.)
Estimated mean flow rate at midpoint of channel =    135.106(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   5.66(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0119
Corrected/adjusted channel slope =  0.0119
Travel time =    0.99 min.     TC =   16.68  min.


 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.835
Decimal fraction soil group A = 0.786
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.214
RI index for soil(AMC 3)  =  86.02
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      2.773(In/Hr) for a   100.0 year storm
Subarea runoff =      4.352(CFS) for      1.880(Ac.)
Total runoff =    136.938(CFS)      Total area =      51.330(Ac.)



+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       35.000 to Point/Station      63.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     51.330(Ac.)
Runoff from this stream =    136.938(CFS)
Time of concentration =   16.68 min.
Rainfall intensity =     2.773(In/Hr)
Program is now starting with Main Stream No. 2



+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       62.000 to Point/Station      64.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
Rainfall intensity =      3.238(In/Hr) for a   100.0 year storm
USER INPUT of soil data for subarea
Runoff Coefficient = 0.874
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3)  =  81.52
Pervious area fraction =  0.337; Impervious fraction =  0.663
User specified values are as follows:
```

```
TC =  12.08 min.  Rain intensity =       3.24(In/Hr)
Total area =        17.15(Ac.)  Total runoff =     49.50(CFS)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       62.000 to Point/Station       64.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =     17.150(Ac.)
Runoff from this stream =     49.499(CFS)
Time of concentration =   12.08 min.
Rainfall intensity =     3.238(In/Hr)
Summary of stream data:

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


1      136.938     16.68               2.773
2       49.499     12.08               3.238
Largest stream flow has longer time of concentration
Qp =    136.938 + sum of
        Qb          Ia/Ib
        49.499 *    0.857 =     42.401
Qp =    179.339

Total of 2 main streams to confluence:
Flow rates before confluence point:
     136.938      49.499
Area of streams before confluence:
       51.330       17.150


Results of confluence:
Total flow rate =    179.339(CFS)
Time of concentration =    16.677 min.
Effective stream area after confluence  =     68.480(Ac.)
End of computations, total study area =          68.48 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.693
Area averaged RI index number =  72.4
```

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            Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0
      Rational Hydrology Study       Date: 10/28/18  File:FBCXP100D.out
------------------------------------------------------------------------
FBC OFF/ONSITE FLOWS
100-YR STORM EVENT
WATERSHED D

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

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

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


Program License Serial Number 6405

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

Storm event (year) =  100.00 Antecedent Moisture Condition = 3

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

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





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Process from Point/Station       40.000 to Point/Station       41.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   950.000(Ft.)
Top (of initial area) elevation =  1724.000(Ft.)
Bottom (of initial area) elevation =  1668.000(Ft.)
Difference in elevation =    56.000(Ft.)
Slope =    0.05895  s(percent)=       5.89
TC = k(0.480)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   13.129 min.
Rainfall intensity =      3.111(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1 Acre Lot)
Runoff Coefficient = 0.860
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3)  =  88.00
Pervious area fraction =  0.800; Impervious fraction =  0.200
Initial subarea runoff =     13.647(CFS)
Total initial stream area =        5.100(Ac.)
Pervious area fraction = 0.800
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       41.000 to Point/Station       42.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1668.000(Ft.)
End of natural channel elevation =   1492.000(Ft.)
Length of natural channel  =  1897.000(Ft.)
Estimated mean flow rate at midpoint of channel =     68.503(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =  12.92(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0928
Corrected/adjusted channel slope =  0.0928
Travel time =    2.45 min.     TC =   15.58  min.


 Adding area flow to channel
SINGLE FAMILY (1 Acre Lot)
Runoff Coefficient = 0.851
Decimal fraction soil group A = 0.063
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.937
RI index for soil(AMC 3)  =  86.37
Pervious area fraction =  0.800; Impervious fraction =  0.200
Rainfall intensity =      2.866(In/Hr) for a   100.0 year storm
Subarea runoff =     99.958(CFS) for     41.000(Ac.)
Total runoff =    113.605(CFS)      Total area =      46.100(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       42.000 to Point/Station       43.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1492.000(Ft.)
End of natural channel elevation =   1344.000(Ft.)
Length of natural channel  =  3015.000(Ft.)
Estimated mean flow rate at midpoint of channel =    168.683(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =  12.33(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0491
Corrected/adjusted channel slope =  0.0491
Travel time =    4.08 min.     TC =   19.65  min.


 Adding area flow to channel
SINGLE FAMILY (1 Acre Lot)
Runoff Coefficient = 0.832
Decimal fraction soil group A = 0.178
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.822
RI index for soil(AMC 3)  =  83.41
Pervious area fraction =  0.800; Impervious fraction =  0.200
```

```
Rainfall intensity =      2.563(In/Hr) for a   100.0 year storm
Subarea runoff =     95.378(CFS) for     44.700(Ac.)
Total runoff =    208.983(CFS)      Total area =      90.800(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       43.000 to Point/Station       43.100
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of natural channel elevation =   1343.000(Ft.)
End of natural channel elevation =   1332.000(Ft.)
Length of natural channel  =   280.000(Ft.)
Estimated mean flow rate at midpoint of channel =    210.790(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =  11.82(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
      Normal channel slope =  0.0393
Corrected/adjusted channel slope =  0.0393
Travel time =    0.39 min.     TC =   20.05  min.


 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.821
Decimal fraction soil group A = 0.894
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.106
RI index for soil(AMC 3)  =  84.60
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      2.539(In/Hr) for a   100.0 year storm
Subarea runoff =      3.274(CFS) for      1.570(Ac.)
Total runoff =    212.258(CFS)      Total area =      92.370(Ac.)
End of computations, total study area =           92.37 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.803
Area averaged RI index number =  70.0
```

APPENDIX C

REFERENCE DATA

C1: HYDROLOGIC SOILS DATA BY NRCS WEBSOIL SURVEY

C2: Plate D-4.1

United States Department of Agriculture

NRCS

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 Western Riverside Area, California

FBC WILDOMAR

July 29, 2017

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 (https://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.

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Contents

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.

Soil Map

Map Scale: 1:3,300 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 45, 90, 180, 270

Feet: 0, 150, 300, 600, 900

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 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 1:15,800.

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 9, Sep 12, 2016

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

Date(s) aerial images were photographed: Feb 24, 2015—Feb 26, 2015

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

Western Riverside Area, California (CA679)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
ChD2	Cieneba sandy loam, 8 to 15 percent slopes, eroded	0.7	3.0%
HcC	Hanford coarse sandy loam, 2 to 8 percent slopes	8.2	33.9%
MnD2	Monserate sandy loam, shallow, 5 to 15 percent slopes, eroded	3.7	15.2%
MnE3	Monserate sandy loam, shallow, 15 to 25 percent slopes, severely eroded	2.2	8.8%
PlD	Placentia fine sandy loam, 5 to 15 percent slopes	5.7	23.3%
TeG	Terrace escarpments	3.8	15.7%
Totals for Area of Interest		**24.3**	**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.

Western Riverside Area, California

ChD2—Cieneba sandy loam, 8 to 15 percent slopes, eroded

Map Unit Setting

National map unit symbol: hcsb
Elevation: 500 to 4,000 feet
Mean annual precipitation: 12 to 35 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 200 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Cieneba

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Residuum weathered from igneous rock

Typical profile

H1 - 0 to 14 inches: sandy loam
H2 - 14 to 22 inches: weathered bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Natural drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: SHALLOW LOAMY (1975) (R019XD060CA)
Hydric soil rating: No

Minor Components

Friant

Percent of map unit: 5 percent
Hydric soil rating: No

Vista

Percent of map unit: 5 percent
Hydric soil rating: No

Fallbrook

Percent of map unit: 5 percent
Hydric soil rating: No

HcC—Hanford coarse sandy loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: hcw2
Elevation: 150 to 900 feet
Mean annual precipitation: 9 to 20 inches
Mean annual air temperature: 63 to 64 degrees F
Frost-free period: 250 to 280 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

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

Description of Hanford

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

H1 - 0 to 8 inches: coarse sandy loam
H2 - 8 to 40 inches: fine sandy loam
H3 - 40 to 60 inches: stratified loamy sand to coarse sandy loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: 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
Available water storage in profile: Moderate (about 7.0 inches)

Interpretive groups

Land capability classification (irrigated): 2e

Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Ecological site: SANDY (R020XD012CA)
Hydric soil rating: No

Minor Components

Greenfield

Percent of map unit: 5 percent
Hydric soil rating: No

Ramona

Percent of map unit: 5 percent
Hydric soil rating: No

Tujunga

Percent of map unit: 2 percent
Hydric soil rating: No

Unnamed

Percent of map unit: 2 percent
Hydric soil rating: No

Unnamed

Percent of map unit: 1 percent
Hydric soil rating: No

MnD2—Monserate sandy loam, shallow, 5 to 15 percent slopes, eroded

Map Unit Setting

National map unit symbol: hcx8
Elevation: 700 to 2,500 feet
Mean annual precipitation: 10 to 18 inches
Mean annual air temperature: 63 to 64 degrees F
Frost-free period: 220 to 280 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Monserate

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

H1 - 0 to 10 inches: sandy loam
H2 - 10 to 18 inches: sandy clay loam
H3 - 18 to 45 inches: indurated
H4 - 45 to 57 inches: cemented
H5 - 57 to 70 inches: loamy coarse sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: 10 to 20 inches to duripan
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: SHALLOW LOAMY (1975) (R019XD060CA)
Hydric soil rating: No

Minor Components

Greenfield

Percent of map unit: 5 percent
Hydric soil rating: No

Hanford

Percent of map unit: 5 percent
Hydric soil rating: No

Tujunga

Percent of map unit: 5 percent
Hydric soil rating: No

MnE3—Monserate sandy loam, shallow, 15 to 25 percent slopes, severely eroded

Map Unit Setting

National map unit symbol: hcx9
Elevation: 700 to 2,500 feet
Mean annual precipitation: 10 to 18 inches
Mean annual air temperature: 63 to 64 degrees F
Frost-free period: 220 to 280 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Monserate

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Alluvium derived from granite

Typical profile

H1 - 0 to 10 inches: sandy loam
H2 - 10 to 18 inches: sandy clay loam
H3 - 18 to 45 inches: indurated
H4 - 45 to 57 inches: cemented
H5 - 57 to 70 inches: loamy coarse sand

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 10 to 20 inches to duripan
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: SHALLOW LOAMY (1975) (R019XD060CA)
Hydric soil rating: No

Minor Components

Greenfield

Percent of map unit: 5 percent
Hydric soil rating: No

Hanford

Percent of map unit: 5 percent
Hydric soil rating: No

Tujunga

Percent of map unit: 5 percent
Hydric soil rating: No

PID—Placentia fine sandy loam, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: hcxw
Elevation: 50 to 2,500 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 200 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Placentia

Setting

Landform: Alluvial fans, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

H1 - 0 to 18 inches: fine sandy loam
H2 - 18 to 39 inches: clay
H3 - 39 to 57 inches: clay loam
H4 - 57 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 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: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 50.0
Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D

Ecological site: CLAYPAN (1975) (R019XD061CA)
Hydric soil rating: No

Minor Components

Greenfield

Percent of map unit: 5 percent
Hydric soil rating: No

Hanford

Percent of map unit: 5 percent
Hydric soil rating: No

Ramona

Percent of map unit: 4 percent
Hydric soil rating: No

Unnamed, ponded

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

TeG—Terrace escarpments

Map Unit Composition

Terrace escarpments: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Terrace Escarpments

Setting

Landform: Terraces
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Alluvium derived from mixed sources

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Ecological site: SHALLOW LOAMY (1975) (R019XD060CA)
Hydric soil rating: No

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Glossary

Many of the terms relating to landforms, geology, and geomorphology are defined in more detail in the “National Soil Survey Handbook.”

ABC soil

A soil having an A, a B, and a C horizon.

Ablation till

Loose, relatively permeable earthy material deposited during the downwasting of nearly static glacial ice, either contained within or accumulated on the surface of the glacier.

AC soil

A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil

The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil

Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil

A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvial cone

A semiconical type of alluvial fan having very steep slopes. It is higher, narrower, and steeper than a fan and is composed of coarser and thicker layers of material deposited by a combination of alluvial episodes and (to a much lesser degree) landslides (debris flow). The coarsest materials tend to be concentrated at the apex of the cone.

Alluvial fan

A low, outspread mass of loose materials and/or rock material, commonly with gentle slopes. It is shaped like an open fan or a segment of a cone. The material was deposited by a stream at the place where it issues from a narrow mountain valley or upland valley or where a tributary stream is near or at its junction with the main stream. The fan is steepest near its apex, which points upstream, and slopes gently and convexly outward (downstream) with a gradual decrease in gradient.

Alluvium

Unconsolidated material, such as gravel, sand, silt, clay, and various mixtures of these, deposited on land by running water.

Alpha,alpha-dipyridyl

A compound that when dissolved in ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction implies reducing conditions and the likely presence of redoximorphic features.

Animal unit month (AUM)

The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Aquic conditions

Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Argillic horizon

A subsoil horizon characterized by an accumulation of illuvial clay.

Arroyo

The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in unconsolidated material. It is usually dry but can be transformed into a temporary watercourse or short-lived torrent after heavy rain within the watershed.

Aspect

The direction toward which a slope faces. Also called slope aspect.

Association, soil

A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity)

The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low: 0 to 3
Low: 3 to 6
Moderate: 6 to 9
High: 9 to 12
Very high: More than 12

Backslope

The position that forms the steepest and generally linear, middle portion of a hillslope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below.

Backswamp

A flood-plain landform. Extensive, marshy or swampy, depressed areas of flood plains between natural levees and valley sides or terraces.

Badland

A landscape that is intricately dissected and characterized by a very fine drainage network with high drainage densities and short, steep slopes and narrow interfluves. Badlands develop on surfaces that have little or no vegetative cover overlying unconsolidated or poorly cemented materials (clays, silts, or sandstones) with, in some cases, soluble minerals, such as gypsum or halite.

Bajada

A broad, gently inclined alluvial piedmont slope extending from the base of a mountain range out into a basin and formed by the lateral coalescence of a series of alluvial fans. Typically, it has a broadly undulating transverse profile, parallel to the mountain front, resulting from the convexities of component fans. The term is generally restricted to constructional slopes of intermontane basins.

Basal area

The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

Base saturation

The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Base slope (geomorphology)

A geomorphic component of hills consisting of the concave to linear (perpendicular to the contour) slope that, regardless of the lateral shape, forms an apron or wedge at the bottom of a hillside dominated by colluvium and slope-wash sediments (for example, slope alluvium).

Bedding plane

A planar or nearly planar bedding surface that visibly separates each successive layer of stratified sediment or rock (of the same or different lithology) from the preceding or following layer; a plane of deposition. It commonly marks a change in the circumstances of deposition and may show a parting, a color difference, a change in particle size, or various combinations of these. The term is commonly applied to any bedding surface, even one that is conspicuously bent or deformed by folding.

Bedding system

A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock

The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography

A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bench terrace

A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum

Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout (map symbol)

A saucer-, cup-, or trough-shaped depression formed by wind erosion on a preexisting dune or other sand deposit, especially in an area of shifting sand or loose soil or where protective vegetation is disturbed or destroyed. The adjoining accumulation of sand derived from the depression, where recognizable, is commonly included. Blowouts are commonly small.

Borrow pit (map symbol)

An open excavation from which soil and underlying material have been removed, usually for construction purposes.

Bottom land

An informal term loosely applied to various portions of a flood plain.

Boulders

Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks

A landscape or tract of steep, rough or broken land dissected by ravines and gullies and marking a sudden change in topography.

Breast height

An average height of 4.5 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

Brush management

Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Butte

An isolated, generally flat-topped hill or mountain with relatively steep slopes and talus or precipitous cliffs and characterized by summit width that is less than the height of bounding escarpments; commonly topped by a caprock of resistant material and representing an erosion remnant carved from flat-lying rocks.

Cable yarding

A method of moving felled trees to a nearby central area for transport to a processing facility. Most cable yarding systems involve use of a drum, a pole, and wire cables in an arrangement similar to that of a rod and reel used for fishing. To reduce friction and soil disturbance, felled trees generally are reeled in while one end is lifted or the entire log is suspended.

Calcareous soil

A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche

A general term for a prominent zone of secondary carbonate accumulation in surficial materials in warm, subhumid to arid areas. Caliche is formed by both geologic and pedologic processes. Finely crystalline calcium carbonate forms a nearly continuous surface-coating and void-filling medium in geologic (parent) materials. Cementation ranges from weak in nonindurated forms to very strong in indurated forms. Other minerals (e.g., carbonates, silicate, and sulfate) may occur as accessory cements. Most petrocalcic horizons and some calcic horizons are caliche.

California bearing ratio (CBR)

The load-supporting capacity of a soil as compared to that of standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Canopy

The leafy crown of trees or shrubs. (See Crown.)

Canyon

A long, deep, narrow valley with high, precipitous walls in an area of high local relief.

Capillary water

Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena

A sequence, or “chain,” of soils on a landscape that formed in similar kinds of parent material and under similar climatic conditions but that have different characteristics as a result of differences in relief and drainage.

Cation

An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity

The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Catsteps

See Terracettes.

Cement rock

Shaly limestone used in the manufacture of cement.

Channery soil material

Soil material that has, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Chemical treatment

Control of unwanted vegetation through the use of chemicals.

Chiseling

Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Cirque

A steep-walled, semicircular or crescent-shaped, half-bowl-like recess or hollow, commonly situated at the head of a glaciated mountain valley or high on the side of a mountain. It was produced by the erosive activity of a mountain glacier. It commonly contains a small round lake (tarn).

Clay

As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions

See Redoximorphic features.

Clay film

A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Clay spot (map symbol)

A spot where the surface texture is silty clay or clay in areas where the surface layer of the soils in the surrounding map unit is sandy loam, loam, silt loam, or coarser.

Claypan

A dense, compact subsoil layer that contains much more clay than the overlying materials, from which it is separated by a sharply defined boundary. The layer restricts the downward movement of water through the soil. A claypan is commonly hard when dry and plastic and sticky when wet.

Climax plant community

The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil

Sand or loamy sand.

Cobble (or cobblestone)

A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material

Material that has 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

COLE (coefficient of linear extensibility)

See Linear extensibility.

Colluvium

Unconsolidated, unsorted earth material being transported or deposited on side slopes and/or at the base of slopes by mass movement (e.g., direct gravitational action) and by local, unconcentrated runoff.

Complex slope

Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil

A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Concretions

See Redoximorphic features.

Conglomerate

A coarse grained, clastic sedimentary rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system

Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage

A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil

Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the “Soil Survey Manual.”

Contour stripcropping

Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section

The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat)

A type of limnic layer composed predominantly of fecal material derived from aquatic animals.

Corrosion (geomorphology)

A process of erosion whereby rocks and soil are removed or worn away by natural chemical processes, especially by the solvent action of running water, but also by other reactions, such as hydrolysis, hydration, carbonation, and oxidation.

Corrosion (soil survey interpretations)

Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop

A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Crop residue management

Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cropping system

Growing crops according to a planned system of rotation and management practices.

Cross-slope farming

Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown

The upper part of a tree or shrub, including the living branches and their foliage.

Cryoturbate

A mass of soil or other unconsolidated earthy material moved or disturbed by frost action. It is typically coarser than the underlying material.

Cuesta

An asymmetric ridge capped by resistant rock layers of slight or moderate dip (commonly less than 15 percent slopes); a type of homocline produced by differential erosion of interbedded resistant and weak rocks. A cuesta has a long, gentle slope on one side (dip slope) that roughly parallels the inclined beds; on the other side, it has a relatively short and steep or clifflike slope (scarp) that cuts through the tilted rocks.

Culmination of the mean annual increment (CMAI)

The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age, the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

Cutbanks cave

The walls of excavations tend to cave in or slough.

Decreasers

The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing

Postponing grazing or resting grazing land for a prescribed period.

Delta

A body of alluvium having a surface that is fan shaped and nearly flat; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Dense layer

A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depression, closed (map symbol)

A shallow, saucer-shaped area that is slightly lower on the landscape than the surrounding area and that does not have a natural outlet for surface drainage.

Depth, soil

Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Desert pavement

A natural, residual concentration or layer of wind-polished, closely packed gravel, boulders, and other rock fragments mantling a desert surface. It forms where wind action and sheetwash have removed all smaller particles or where rock fragments have migrated upward through sediments to the surface. It typically protects the finer grained underlying material from further erosion.

Diatomaceous earth

A geologic deposit of fine, grayish siliceous material composed chiefly or entirely of the remains of diatoms.

Dip slope

A slope of the land surface, roughly determined by and approximately conforming to the dip of the underlying bedrock.

Diversion (or diversion terrace)

A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Divided-slope farming

A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Drainage class (natural)

Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained*. These classes are defined in the “Soil Survey Manual.”

Drainage, surface

Runoff, or surface flow of water, from an area.

Drainageway

A general term for a course or channel along which water moves in draining an area. A term restricted to relatively small, linear depressions that at some time move concentrated water and either do not have a defined channel or have only a small defined channel.

Draw

A small stream valley that generally is shallower and more open than a ravine or gulch and that has a broader bottom. The present stream channel may appear inadequate to have cut the drainageway that it occupies.

Drift

A general term applied to all mineral material (clay, silt, sand, gravel, and boulders) transported by a glacier and deposited directly by or from the ice or transported by running water emanating from a glacier. Drift includes unstratified material (till) that forms moraines and stratified deposits that form outwash plains, eskers, kames, varves, and glaciofluvial sediments. The term is generally applied to Pleistocene glacial deposits in areas that no longer contain glaciers.

Drumlin

A low, smooth, elongated oval hill, mound, or ridge of compact till that has a core of bedrock or drift. It commonly has a blunt nose facing the direction from which the ice approached and a gentler slope tapering in the other direction. The longer axis is parallel to the general direction of glacier flow. Drumlins are products of streamline (laminar) flow of glaciers, which molded the subglacial floor through a combination of erosion and deposition.

Duff

A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Dune

A low mound, ridge, bank, or hill of loose, windblown granular material (generally sand), either barren and capable of movement from place to place or covered and stabilized with vegetation but retaining its characteristic shape.

Earthy fill

See Mine spoil.

Ecological site

An area where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. An ecological site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other ecological sites in kind and/or proportion of species or in total production.

Eluviation

The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation

A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Eolian deposit

Sand-, silt-, or clay-sized clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sheet of sand or loess.

Ephemeral stream

A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation

A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion

The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (accelerated)

Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion (geologic)

Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion pavement

A surficial lag concentration or layer of gravel and other rock fragments that remains on the soil surface after sheet or rill erosion or wind has removed the finer soil particles and that tends to protect the underlying soil from further erosion.

Erosion surface

A land surface shaped by the action of erosion, especially by running water.

Escarpment

A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Most commonly applied to cliffs produced by differential erosion. Synonym: scarp.

Escarpment, bedrock (map symbol)

A relatively continuous and steep slope or cliff, produced by erosion or faulting, that breaks the general continuity of more gently sloping land surfaces. Exposed material is hard or soft bedrock.

Escarpment, nonbedrock (map symbol)

A relatively continuous and steep slope or cliff, generally produced by erosion but in some places produced by faulting, that breaks the continuity of more gently sloping land surfaces. Exposed earthy material is nonsoil or very shallow soil.

Esker

A long, narrow, sinuous, steep-sided ridge of stratified sand and gravel deposited as the bed of a stream flowing in an ice tunnel within or below the ice (subglacial) or between ice walls on top of the ice of a wasting glacier and left behind as high ground when the ice melted. Eskers range in length from less than a kilometer to more than 160 kilometers and in height from 3 to 30 meters.

Extrusive rock

Igneous rock derived from deep-seated molten matter (magma) deposited and cooled on the earth’s surface.

Fallow

Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fan remnant

A general term for landforms that are the remaining parts of older fan landforms, such as alluvial fans, that have been either dissected or partially buried.

Fertility, soil

The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat)

The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity

The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fill slope

A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil

Sandy clay, silty clay, or clay.

Firebreak

An area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom

An obsolete, informal term loosely applied to the lowest flood-plain steps that are subject to regular flooding.

Flaggy soil material

Material that has, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone

A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain

The nearly level plain that borders a stream and is subject to flooding unless protected artificially.

Flood-plain landforms

A variety of constructional and erosional features produced by stream channel migration and flooding. Examples include backswamps, flood-plain splays, meanders, meander belts, meander scrolls, oxbow lakes, and natural levees.

Flood-plain splay

A fan-shaped deposit or other outspread deposit formed where an overloaded stream breaks through a levee (natural or artificial) and deposits its material (commonly coarse grained) on the flood plain.

Flood-plain step

An essentially flat, terrace-like alluvial surface within a valley that is frequently covered by floodwater from the present stream; any approximately horizontal surface still actively modified by fluvial scour and/or deposition. May occur individually or as a series of steps.

Fluvial

Of or pertaining to rivers or streams; produced by stream or river action.

Foothills

A region of steeply sloping hills that fringes a mountain range or high-plateau escarpment. The hills have relief of as much as 1,000 feet (300 meters).

Footslope

The concave surface at the base of a hillslope. A footslope is a transition zone between upslope sites of erosion and transport (shoulders and backslopes) and downslope sites of deposition (toeslopes).

Forb

Any herbaceous plant not a grass or a sedge.

Forest cover

All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type

A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragipan

A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Genesis, soil

The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai

Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

Glaciofluvial deposits

Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur in the form of outwash plains, valley trains, deltas, kames, eskers, and kame terraces.

Glaciolacustrine deposits

Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are bedded or laminated.

Gleyed soil

Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Graded stripcropping

Growing crops in strips that grade toward a protected waterway.

Grassed waterway

A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel

Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravel pit (map symbol)

An open excavation from which soil and underlying material have been removed and used, without crushing, as a source of sand or gravel.

Gravelly soil material

Material that has 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Gravelly spot (map symbol)

A spot where the surface layer has more than 35 percent, by volume, rock fragments that are mostly less than 3 inches in diameter in an area that has less than 15 percent rock fragments.

Green manure crop (agronomy)

A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water

Water filling all the unblocked pores of the material below the water table.

Gully (map symbol)

A small, steep-sided channel caused by erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage whereas a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard bedrock

Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hard to reclaim

Reclamation is difficult after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Hardpan

A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Head slope (geomorphology)

A geomorphic component of hills consisting of a laterally concave area of a hillside, especially at the head of a drainageway. The overland waterflow is converging.

Hemic soil material (mucky peat)

Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-residue crops

Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill

A generic term for an elevated area of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline. Slopes are generally more than 15 percent. The distinction between a hill and a mountain is arbitrary and may depend on local usage.

Hillslope

A generic term for the steeper part of a hill between its summit and the drainage line, valley flat, or depression floor at the base of a hill.

Horizon, soil

A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the “Soil Survey Manual.” The major horizons of mineral soil are as follows:

O horizon: An organic layer of fresh and decaying plant residue.

L horizon: A layer of organic and mineral limnic materials, including coprogenous earth (sedimentary peat), diatomaceous earth, and marl.

A horizon: The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon: The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon: The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon: The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon: Soft, consolidated bedrock beneath the soil.

R layer: Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

M layer: A root-limiting subsoil layer consisting of nearly continuous, horizontally oriented, human-manufactured materials.

W layer: A layer of water within or beneath the soil.

Humus

The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups

Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties include depth to a seasonal high water table, the infiltration rate, and depth to a layer that significantly restricts the downward movement of water. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Igneous rock

Rock that was formed by cooling and solidification of magma and that has not been changed appreciably by weathering since its formation. Major varieties include plutonic and volcanic rock (e.g., andesite, basalt, and granite).

Illuviation

The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil

A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers

Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration

The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity

The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate

The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate

The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Very low: Less than 0.2
Low: 0.2 to 0.4
Moderately low: 0.4 to 0.75
Moderate: 0.75 to 1.25
Moderately high: 1.25 to 1.75
High: 1.75 to 2.5
Very high: More than 2.5

Interfluve

A landform composed of the relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction. An elevated area between two drainageways that sheds water to those drainageways.

Interfluve (geomorphology)

A geomorphic component of hills consisting of the uppermost, comparatively level or gently sloping area of a hill; shoulders of backwearing hillslopes can narrow the upland or can merge, resulting in a strongly convex shape.

Intermittent stream

A stream, or reach of a stream, that does not flow year-round but that is commonly dry for 3 or more months out of 12 and whose channel is generally below the local water table. It flows only during wet periods or when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders

On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Iron depletions

See Redoximorphic features.

Irrigation

Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin: Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border: Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding: Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation: Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle): Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow: Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler: Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation: Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding: Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame

A low mound, knob, hummock, or short irregular ridge composed of stratified sand and gravel deposited by a subglacial stream as a fan or delta at the margin of a melting glacier; by a supraglacial stream in a low place or hole on the surface of the glacier; or as a ponded deposit on the surface or at the margin of stagnant ice.

Karst (topography)

A kind of topography that formed in limestone, gypsum, or other soluble rocks by dissolution and that is characterized by closed depressions, sinkholes, caves, and underground drainage.

Knoll

A small, low, rounded hill rising above adjacent landforms.

Ksat

See Saturated hydraulic conductivity.

Lacustrine deposit

Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake plain

A nearly level surface marking the floor of an extinct lake filled by well sorted, generally fine textured, stratified deposits, commonly containing varves.

Lake terrace

A narrow shelf, partly cut and partly built, produced along a lakeshore in front of a scarp line of low cliffs and later exposed when the water level falls.

Landfill (map symbol)

An area of accumulated waste products of human habitation, either above or below natural ground level.

Landslide

A general, encompassing term for most types of mass movement landforms and processes involving the downslope transport and outward deposition of soil and rock materials caused by gravitational forces; the movement may or may not involve saturated materials. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones

Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Lava flow (map symbol)

A solidified, commonly lobate body of rock formed through lateral, surface outpouring of molten lava from a vent or fissure.

Leaching

The removal of soluble material from soil or other material by percolating water.

Levee (map symbol)

An embankment that confines or controls water, especially one built along the banks of a river to prevent overflow onto lowlands.

Linear extensibility

Refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. Linear extensibility is used to determine the shrink-swell potential of soils. It is an expression of the volume change between the water content of the clod at $^1/_3$- or $^1/_{10}$-bar tension (33kPa or 10kPa tension) and oven dryness. Volume change is influenced by the amount and type of clay minerals in the soil. The volume change is the percent change for the whole soil. If it is expressed as a fraction, the resulting value is COLE, coefficient of linear extensibility.

Liquid limit

The moisture content at which the soil passes from a plastic to a liquid state.

Loam

Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess

Material transported and deposited by wind and consisting dominantly of silt-sized particles.

Low strength

The soil is not strong enough to support loads.

Low-residue crops

Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Marl

An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal proportions; formed primarily under freshwater lacustrine conditions but also formed in more saline environments.

Marsh or swamp (map symbol)

A water-saturated, very poorly drained area that is intermittently or permanently covered by water. Sedges, cattails, and rushes are the dominant vegetation in marshes, and trees or shrubs are the dominant vegetation in swamps. Not used in map units where the named soils are poorly drained or very poorly drained.

Mass movement

A generic term for the dislodgment and downslope transport of soil and rock material as a unit under direct gravitational stress.

Masses

See Redoximorphic features.

Meander belt

The zone within which migration of a meandering channel occurs; the flood-plain area included between two imaginary lines drawn tangential to the outer bends of active channel loops.

Meander scar

A crescent-shaped, concave or linear mark on the face of a bluff or valley wall, produced by the lateral erosion of a meandering stream that impinged upon and undercut the bluff.

Meander scroll

One of a series of long, parallel, close-fitting, crescent-shaped ridges and troughs formed along the inner bank of a stream meander as the channel migrated laterally down-valley and toward the outer bank.

Mechanical treatment

Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil

Very fine sandy loam, loam, silt loam, or silt.

Mesa

A broad, nearly flat topped and commonly isolated landmass bounded by steep slopes or precipitous cliffs and capped by layers of resistant, nearly horizontal rocky material. The summit width is characteristically greater than the height of the bounding escarpments.

Metamorphic rock

Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement at depth in the earth's crust. Nearly all such rocks are crystalline.

Mine or quarry (map symbol)

An open excavation from which soil and underlying material have been removed and in which bedrock is exposed. Also denotes surface openings to underground mines.

Mine spoil

An accumulation of displaced earthy material, rock, or other waste material removed during mining or excavation. Also called earthy fill.

Mineral soil

Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage

Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area

A kind of map unit that has little or no natural soil and supports little or no vegetation.

Miscellaneous water (map symbol)

Small, constructed bodies of water that are used for industrial, sanitary, or mining applications and that contain water most of the year.

Moderately coarse textured soil

Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil

Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon

A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Moraine

In terms of glacial geology, a mound, ridge, or other topographically distinct accumulation of unsorted, unstratified drift, predominantly till, deposited primarily by the direct action of glacial ice in a variety of landforms. Also, a general term for a landform composed mainly of till (except for kame moraines, which are composed mainly of stratified outwash) that has been deposited by a glacier. Some types of moraines are disintegration, end, ground, kame, lateral, recessional, and terminal.

Morphology, soil

The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil

Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Mountain

A generic term for an elevated area of the land surface, rising more than 1,000 feet (300 meters) above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can occur as a single, isolated mass or in a group forming a chain or range. Mountains are formed primarily by tectonic activity and/or volcanic action but can also be formed by differential erosion.

Muck

Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mucky peat

See Hemic soil material.

Mudstone

A blocky or massive, fine grained sedimentary rock in which the proportions of clay and silt are approximately equal. Also, a general term for such material as clay, silt, claystone, siltstone, shale, and argillite and that should be used only when the amounts of clay and silt are not known or cannot be precisely identified.

Munsell notation

A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Natric horizon

A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

Neutral soil

A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nodules

See Redoximorphic features.

Nose slope (geomorphology)

A geomorphic component of hills consisting of the projecting end (laterally convex area) of a hillside. The overland waterflow is predominantly divergent. Nose slopes consist dominantly of colluvium and slope-wash sediments (for example, slope alluvium).

Nutrient, plant

Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter

Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low: Less than 0.5 percent
Low: 0.5 to 1.0 percent
Moderately low: 1.0 to 2.0 percent
Moderate: 2.0 to 4.0 percent
High: 4.0 to 8.0 percent
Very high: More than 8.0 percent

Outwash

Stratified and sorted sediments (chiefly sand and gravel) removed or “washed out” from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of a glacier. The coarser material is deposited nearer to the ice.

Outwash plain

An extensive lowland area of coarse textured glaciofluvial material. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

Paleoterrace

An erosional remnant of a terrace that retains the surface form and alluvial deposits of its origin but was not emplaced by, and commonly does not grade to, a present-day stream or drainage network.

Pan

A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material

The unconsolidated organic and mineral material in which soil forms.

Peat

Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped

An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment

A layer of sediment, eroded from the shoulder and backslope of an erosional slope, that lies on and is being (or was) transported across a gently sloping erosional surface at the foot of a receding hill or mountain slope.

Pedon

The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation

The movement of water through the soil.

Perennial water (map symbol)

Small, natural or constructed lakes, ponds, or pits that contain water most of the year.

Permafrost

Ground, soil, or rock that remains at or below 0 degrees C for at least 2 years. It is defined on the basis of temperature and is not necessarily frozen.

pH value

A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Phase, soil

A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

Piping

Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Pitting

Pits caused by melting around ice. They form on the soil after plant cover is removed.

Plastic limit

The moisture content at which a soil changes from semisolid to plastic.

Plasticity index

The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plateau (geomorphology)

A comparatively flat area of great extent and elevation; specifically, an extensive land region that is considerably elevated (more than 100 meters) above the adjacent lower lying terrain, is commonly limited on at least one side by an abrupt descent, and has a flat or nearly level surface. A comparatively large part of a plateau surface is near summit level.

Playa

The generally dry and nearly level lake plain that occupies the lowest parts of closed depressions, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff. Playa deposits are fine grained and may or may not have a high water table and saline conditions.

Plinthite

The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. It commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on repeated wetting and drying, especially if it is exposed also to heat from the sun. In a moist soil, plinthite can be cut with a spade. It is a form of laterite.

Plowpan

A compacted layer formed in the soil directly below the plowed layer.

Ponding

Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded

Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Pore linings

See Redoximorphic features.

Potential native plant community

See Climax plant community.

Potential rooting depth (effective rooting depth)

Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning

Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil

The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil

A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use

Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Rangeland

Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Reaction, soil

A measure of acidity or alkalinity of a soil, expressed as pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid: Less than 3.5
Extremely acid: 3.5 to 4.4
Very strongly acid: 4.5 to 5.0
Strongly acid: 5.1 to 5.5
Moderately acid: 5.6 to 6.0
Slightly acid: 6.1 to 6.5
Neutral: 6.6 to 7.3
Slightly alkaline: 7.4 to 7.8
Moderately alkaline: 7.9 to 8.4
Strongly alkaline: 8.5 to 9.0
Very strongly alkaline: 9.1 and higher

Red beds

Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

Redoximorphic concentrations

See Redoximorphic features.

Redoximorphic depletions

See Redoximorphic features.

Redoximorphic features

Redoximorphic features are associated with wetness and result from alternating periods of reduction and oxidation of iron and manganese compounds in the soil. Reduction occurs during saturation with water, and oxidation occurs when the soil is not saturated. Characteristic color patterns are created by these processes. The reduced iron and manganese ions may be removed from a soil if vertical or lateral fluxes of water occur, in which case there is no iron or manganese precipitation in that soil. Wherever the iron and manganese are oxidized and precipitated, they form either soft masses or hard concretions or nodules. Movement of iron and manganese as a result of redoximorphic processes in a soil may result in redoximorphic features that are defined as follows:

1. Redoximorphic concentrations.—These are zones of apparent accumulation of iron-manganese oxides, including:
   A. Nodules and concretions, which are cemented bodies that can be removed from the soil intact. Concretions are distinguished from nodules on the basis of internal organization. A concretion typically has concentric layers that are visible to the naked eye. Nodules do not have visible organized internal structure; *and*
   B. Masses, which are noncemented concentrations of substances within the soil matrix; *and*
   C. Pore linings, i.e., zones of accumulation along pores that may be either coatings on pore surfaces or impregnations from the matrix adjacent to the pores.
2. Redoximorphic depletions.—These are zones of low chroma (chromas less than those in the matrix) where either iron-manganese oxides alone or both iron-manganese oxides and clay have been stripped out, including:
   A. Iron depletions, i.e., zones that contain low amounts of iron and manganese oxides but have a clay content similar to that of the adjacent matrix; *and*
   B. Clay depletions, i.e., zones that contain low amounts of iron, manganese, and clay (often referred to as silt coatings or skeletans).
3. Reduced matrix.—This is a soil matrix that has low chroma *in situ* but undergoes a change in hue or chroma within 30 minutes after the soil material has been exposed to air.

Reduced matrix

See Redoximorphic features.

Regolith

All unconsolidated earth materials above the solid bedrock. It includes material weathered in place from all kinds of bedrock and alluvial, glacial, eolian, lacustrine, and pyroclastic deposits.

Relief

The relative difference in elevation between the upland summits and the lowlands or valleys of a given region.

Residuum (residual soil material)

Unconsolidated, weathered or partly weathered mineral material that accumulated as bedrock disintegrated in place.

Rill

A very small, steep-sided channel resulting from erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. A rill generally is not an obstacle to wheeled vehicles and is shallow enough to be smoothed over by ordinary tillage.

Riser

The vertical or steep side slope (e.g., escarpment) of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural, steplike landforms, such as successive stream terraces.

Road cut

A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments

Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rock outcrop (map symbol)

An exposure of bedrock at the surface of the earth. Not used where the named soils of the surrounding map unit are shallow over bedrock or where "Rock outcrop" is a named component of the map unit.

Root zone

The part of the soil that can be penetrated by plant roots.

Runoff

The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil

A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Saline spot (map symbol)

An area where the surface layer has an electrical conductivity of 8 mmhos/cm more than the surface layer of the named soils in the surrounding map unit. The surface layer of the surrounding soils has an electrical conductivity of 2 mmhos/cm or less.

Sand

As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone

Sedimentary rock containing dominantly sand-sized particles.

Sandy spot (map symbol)

A spot where the surface layer is loamy fine sand or coarser in areas where the surface layer of the named soils in the surrounding map unit is very fine sandy loam or finer.

Sapric soil material (muck)

The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saturated hydraulic conductivity (Ksat)

The ease with which pores of a saturated soil transmit water. Formally, the proportionality coefficient that expresses the relationship of the rate of water movement to hydraulic gradient in Darcy's Law, a law that describes the rate of water movement through porous media. Commonly abbreviated as "Ksat." Terms describing saturated hydraulic conductivity are:

Very high: 100 or more micrometers per second (14.17 or more inches per hour)

High: 10 to 100 micrometers per second (1.417 to 14.17 inches per hour)

Moderately high: 1 to 10 micrometers per second (0.1417 inch to 1.417 inches per hour)

Moderately low: 0.1 to 1 micrometer per second (0.01417 to 0.1417 inch per hour)

Low: 0.01 to 0.1 micrometer per second (0.001417 to 0.01417 inch per hour)

Very low: Less than 0.01 micrometer per second (less than 0.001417 inch per hour).

To convert inches per hour to micrometers per second, multiply inches per hour by 7.0572. To convert micrometers per second to inches per hour, multiply micrometers per second by 0.1417.

Saturation

Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Scarification

The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Sedimentary rock

A consolidated deposit of clastic particles, chemical precipitates, or organic remains accumulated at or near the surface of the earth under normal low temperature and pressure conditions. Sedimentary rocks include consolidated equivalents of alluvium, colluvium, drift, and eolian, lacustrine, and marine deposits. Examples are sandstone, siltstone, mudstone, claystone, shale, conglomerate, limestone, dolomite, and coal.

Sequum

A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil

A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Severely eroded spot (map symbol)

An area where, on the average, 75 percent or more of the original surface layer has been lost because of accelerated erosion. Not used in map units in which “severely eroded,” “very severely eroded,” or “gullied” is part of the map unit name.

Shale

Sedimentary rock that formed by the hardening of a deposit of clay, silty clay, or silty clay loam and that has a tendency to split into thin layers.

Sheet erosion

The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Short, steep slope (map symbol)

A narrow area of soil having slopes that are at least two slope classes steeper than the slope class of the surrounding map unit.

Shoulder

The convex, erosional surface near the top of a hillslope. A shoulder is a transition from summit to backslope.

Shrink-swell

The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Shrub-coppice dune

A small, streamlined dune that forms around brush and clump vegetation.

Side slope (geomorphology)

A geomorphic component of hills consisting of a laterally planar area of a hillside. The overland waterflow is predominantly parallel. Side slopes are dominantly colluvium and slope-wash sediments.

Silica

A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio

The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt

As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone

An indurated silt having the texture and composition of shale but lacking its fine lamination or fissility; a massive mudstone in which silt predominates over clay.

Similar soils

Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Sinkhole (map symbol)

A closed, circular or elliptical depression, commonly funnel shaped, characterized by subsurface drainage and formed either by dissolution of the surface of underlying bedrock (e.g., limestone, gypsum, or salt) or by collapse of underlying caves within bedrock. Complexes of sinkholes in carbonate-rock terrain are the main components of karst topography.

Site index

A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slickensides (pedogenic)

Grooved, striated, and/or glossy (shiny) slip faces on structural peds, such as wedges; produced by shrink-swell processes, most commonly in soils that have a high content of expansive clays.

Slide or slip (map symbol)

A prominent landform scar or ridge caused by fairly recent mass movement or descent of earthy material resulting from failure of earth or rock under shear stress along one or several surfaces.

Slope

The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope alluvium

Sediment gradually transported down the slopes of mountains or hills primarily by nonchannel alluvial processes (i.e., slope-wash processes) and characterized by particle sorting. Lateral particle sorting is evident on long slopes. In a profile sequence, sediments may be distinguished by differences in size and/or specific gravity of rock fragments and may be separated by stone lines. Burnished peds and sorting of rounded or subrounded pebbles or cobbles distinguish these materials from unsorted colluvial deposits.

Slow refill

The slow filling of ponds, resulting from restricted water transmission in the soil.

Slow water movement

Restricted downward movement of water through the soil. See Saturated hydraulic conductivity.

Sodic (alkali) soil

A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Sodic spot (map symbol)

An area where the surface layer has a sodium adsorption ratio that is at least 10 more than that of the surface layer of the named soils in the surrounding map unit. The surface layer of the surrounding soils has a sodium adsorption ratio of 5 or less.

Sodicity

The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^{+} to Ca^{++} + Mg^{++}. The degrees of sodicity and their respective ratios are:

Slight: Less than 13:1

Moderate: 13-30:1

Strong: More than 30:1

Sodium adsorption ratio (SAR)

A measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration.

Soft bedrock

Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil

A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief and by the passage of time.

Soil separates

Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand: 2.0 to 1.0
Coarse sand: 1.0 to 0.5
Medium sand: 0.5 to 0.25
Fine sand: 0.25 to 0.10
Very fine sand: 0.10 to 0.05
Silt: 0.05 to 0.002
Clay: Less than 0.002

Solum

The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Spoil area (map symbol)

A pile of earthy materials, either smoothed or uneven, resulting from human activity.

Stone line

In a vertical cross section, a line formed by scattered fragments or a discrete layer of angular and subangular rock fragments (commonly a gravel- or cobble-sized lag concentration) that formerly was draped across a topographic surface and was later buried by additional sediments. A stone line generally caps material that was subject to weathering, soil formation, and erosion before burial. Many stone lines seem to be buried erosion pavements, originally formed by sheet and rill erosion across the land surface.

Stones

Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony

Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stony spot (map symbol)

A spot where 0.01 to 0.1 percent of the soil surface is covered by rock fragments that are more than 10 inches in diameter in areas where the surrounding soil has no surface stones.

Strath terrace

A type of stream terrace; formed as an erosional surface cut on bedrock and thinly mantled with stream deposits (alluvium).

Stream terrace

One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream; represents the remnants of an abandoned flood plain, stream bed, or valley floor produced during a former state of fluvial erosion or deposition.

Stripcropping

Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

Structure, soil

The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are:

Platy: Flat and laminated
Prismatic: Vertically elongated and having flat tops
Columnar: Vertically elongated and having rounded tops
Angular blocky: Having faces that intersect at sharp angles (planes)
Subangular blocky: Having subrounded and planar faces (no sharp angles)
Granular: Small structural units with curved or very irregular faces

Structureless soil horizons are defined as follows:

Single grained: Entirely noncoherent (each grain by itself), as in loose sand
Massive: Occurring as a coherent mass

Stubble mulch

Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil

Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling

Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum

The part of the soil below the solum.

Subsurface layer

Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow

The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Summit

The topographically highest position of a hillslope. It has a nearly level (planar or only slightly convex) surface.

Surface layer

The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil

The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Talus

Rock fragments of any size or shape (commonly coarse and angular) derived from and lying at the base of a cliff or very steep rock slope. The accumulated mass of such loose broken rock formed chiefly by falling, rolling, or sliding.

Taxadjuncts

Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

Terminal moraine

An end moraine that marks the farthest advance of a glacier. It typically has the form of a massive arcuate or concentric ridge, or complex of ridges, and is underlain by till and other types of drift.

Terrace (conservation)

An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geomorphology)

A steplike surface, bordering a valley floor or shoreline, that represents the former position of a flood plain, lake, or seashore. The term is usually applied both to the relatively flat summit surface (tread) that was cut or built by stream or wave action and to the steeper descending slope (scarp or riser) that has graded to a lower base level of erosion.

Terracettes

Small, irregular steplike forms on steep hillslopes, especially in pasture, formed by creep or erosion of surficial materials that may be induced or enhanced by trampling of livestock, such as sheep or cattle.

Texture, soil

The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

Thin layer

Otherwise suitable soil material that is too thin for the specified use.

Till

Dominantly unsorted and nonstratified drift, generally unconsolidated and deposited directly by a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders; rock fragments of various lithologies are embedded within a finer matrix that can range from clay to sandy loam.

Till plain

An extensive area of level to gently undulating soils underlain predominantly by till and bounded at the distal end by subordinate recessional or end moraines.

Tilth, soil

The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toeslope

The gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear and are constructional surfaces forming the lower part of a hillslope continuum that grades to valley or closed-depression floors.

Topsoil

The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements

Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Tread

The flat to gently sloping, topmost, laterally extensive slope of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural steplike landforms, such as successive stream terraces.

Tuff

A generic term for any consolidated or cemented deposit that is 50 percent or more volcanic ash.

Upland

An informal, general term for the higher ground of a region, in contrast with a low-lying adjacent area, such as a valley or plain, or for land at a higher elevation than the flood plain or low stream terrace; land above the footslope zone of the hillslope continuum.

Valley fill

The unconsolidated sediment deposited by any agent (water, wind, ice, or mass wasting) so as to fill or partly fill a valley.

Variegation

Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve

A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Very stony spot (map symbol)

A spot where 0.1 to 3.0 percent of the soil surface is covered by rock fragments that are more than 10 inches in diameter in areas where the surface of the surrounding soil is covered by less than 0.01 percent stones.

Water bars

Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering

All physical disintegration, chemical decomposition, and biologically induced changes in rocks or other deposits at or near the earth’s surface by atmospheric or biologic agents or by circulating surface waters but involving essentially no transport of the altered material.

Well graded

Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wet spot (map symbol)

A somewhat poorly drained to very poorly drained area that is at least two drainage classes wetter than the named soils in the surrounding map unit.

Wilting point (or permanent wilting point)

The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow

The uprooting and tipping over of trees by the wind.