K &S ENGINEERING, INC.
Planning Engineering Surveying

DRAINAGE STUDY

FOR

HERMANNY HOUSE
PARCEL 3 OF PARCEL MAP 12357

PROJECT ADDRESS
2538 RUETTE NICOLE
LA JOLLA, CA 92037
APN#346-831-44-00

PROJECT APPLICANT
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CITY OF SAN DIEGO
PROJECT NO.: PRJ-1115175
DRAWING NO.: 101498-D

PREPARED BY:
K&S ENGINEERING, INC.
7801 MISSION CENTER COURT, SUITE 100
SAN DIEGO, CA 92108

REGISTERED PROFESSIONAL ENGINEER
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STATE OF CALIFORNIA

2/17/2025
Date

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K&S Job No. 22-025

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1. SITE DESCRIPTION

A. EXISTING CONDITION

The site consists of a 0.37 acre project located on Ruette Nicole in Montoro Subdivision in the City of San Diego. It comprises APN: 346-831-44-00.

The existing condition consists of an undeveloped residential lot within a fully developed subdivision.

Currently the off-site runoff from the easterly side is being captured by the existing concrete ditch that directs runoff to the existing underground storm drain system as shown on drawing number 23210-D.

The on-site runoff is divided into two basins; basin one from the existing pad sheet flows towards the street and basin two, which is the slope area sheet flows to the westerly side.

The calculated flows for existing condition are based on Rural Land Use runoff coefficient C=0.45, as shown on table A-1 of the City of San Diego Drainage Manual 2017, since existing condition does not have any impervious area and is considered 100% pervious.

Table 1

Peak Discharge Summary-Existing Condition					
Basin	Area (ac)	C-Value	Tc (min)	I (in/hr) average	Q_{100} (cfs)
(DA-1) Draining Towards-Westerly Side (slope)	0.12	0.45	5	4	0.237
(DA-2) Draining Towards South Side (street)	0.25	0.45	5	4	0.437
TOTAL	0.37				0.67

B. PROPOSED CONDITION

The proposed development consists of a new Single-Family dwelling with a basement that will serve as a garage area, and 2 story house, pool, wood deck and grass patio. The house will be constructed with a green roof to reduce the proposed impervious area.

The off-site drainage will sheet flow down the slope, directing runoff to a proposed concrete brow ditch along the property line. This ditch will channel the runoff to an existing Type F inlet, which will be modified with a new opening on the northern side. The 1.95 CFS of runoff collected in the brow ditch will have a maximum depth of 4.88 inches.

The project on-site drainage will maintain the two basin areas, the westerly basin that directs the runoff to the slope down the hill will be slightly reduced by 0.04 ac to alleviate the downstream runoff.

The calculated flows for proposed condition are based on Single Family Land Use runoff coefficient C=0.55, for basins that contains both pervious and impervious and Rural Land Use runoff coefficient of C=0.45 for areas that only contains pervious area as shown on table A-1 of the City of San Diego Drainage Manual 2017.

Table 2

Peak Discharge Summary-Proposed Condition					
Basin	Area (ac)	C-Value	Tc (min)	I (In/hr) average	Q_{100} (cfs)
(DA-1) Draining Towards-Westerly Side (slope)	0.08	0.55	5	4.3	0.168
(DA-2) Draining Towards South Side (street)	0.29	0.55	5	4	0.564
TOTAL	0.37				0.73

C. SUMMARY

The runoff to the westerly slope has been reduced, which will help mitigate any impact on the downstream area. With only a negligible 0.12 CFS increase in runoff to the street and the fact that the street is fully paved, there should be no significant concerns regarding downstream erosion.

Table 3

Basin	Existing Q_{100} (cfs)	Proposed Q_{100} (cfs)	Difference Q_{100} (cfs)	Discharge Node	Proposed V_{100} (fps)
(DA-1)	0.237	0.168	- 0.069	4 (Ex) 7(Prop)	5.55
(DA-2)	0.437	0.564	+ 0.12	2 (Ex) 13&17 (Prop)	1.86
TOTAL	0.67	0.73	+ 0.05		

According to the Storm Water Requirements Applicability Checklist DS-560, project is found to be categorized as “Standard Development Project.”

Soil type “D” is used for all areas in this design.

The project will preserve the current drainage pattern of the site and will not lead to erosion or siltation. There will be no adverse effects on downstream conditions as a result of this development.

The project is an infill project and is not in the close vicinity of navigable waters or wetlands. The proposed construction and any associated runoff will not result in discharge into the navigable waters and therefore exempt from the Regional Water Quality Board under federal Clean Water Act (CWA) Section 401 or 404.

Table 4

Pervious-Impervious	**EXISTING**		**PROPOSED**	
Basin	PERVIOUS Area (ac)	IMPERVIOUS Area (ac)	PERVIOUS Area (ac)	IMPERVIOUS Area (ac)
(DA-1) Draining Towards-Westerly Side (slope)	0.12	0	0.06	0.02
(DA-2) Draining Towards South Side (street)	0.25	0	0.20	0.09
TOTAL	0.37	0	0.26	0.11

2. HYDROLOGY DESIGN MODELS

A. *DESIGN METHODS*

THE RATIONAL METHOD IS USED IN THIS HYDROLOGY STUDY; THE RATIONAL FORMULA IS AS FOLLOWS:

Q = CIA, WHERE : Q= PEAK DISCHARGE IN CUBIC FEET/SECOND *

C = RUNOFF COEFFICIENT (DIMENSIONLESS)

I = RAINFALL INTENSITY IN INCHES/HOUR

A = TRIBUTARY DRAINAGE AREA IN ACRES

*1 ACRE INCHES/HOUR = 1.008 CUBIC FEET/SEC

THE OVERLAND METHOD IS ALSO USED IN THIS HYDROLOGY STUDY;
THE URBAN AREAS OVERLAND FORMULA IS AS FOLLOWS:

$T=[1.8(1.1-C)(L)^{(.5)})]/[S(100)]^{.333}$

L = LENGTH OF WATERSHED

C = COEFFICIENT OF RUNOFF

T = TIME IN MINUTES

S = DIFFERENCE IN ELEVATION DIVIDED BY DE LENGTH OF WATERSHED

B. *DESIGN CRITERIA*

- FREQUENCY 100 YEAR STORM.
- LAND USE PER SPECIFIC PLAN AND TENTATIVE MAP.
- RAIN FALL INTENSITY PER CITY OF SAN DIEGO DRAINAGE DESIGN MANUAL, JANUARY 2017.

C. *REFERENCES*

- CITY OF SAN DIEGO DRAINAGE DESIGN MANUAL, JANUARY 2017
- CITY OF SAN DIEGO 2021 STANDARD DRAWINGS.
- HAND BOOK OF HYDRAULICS BY BRATER & KING, SIXTH EDITION.
- 2002 AUTODESK CIVIL DESIGN 3.0 HYDROLOGY & HYDRAULIC DESIGN & ANALYSIS.

3. RATIONAL METHOD HYDROLOGY CALCULATION

EXISTING CONDITION
100 YEAR STORM

EXISTING CONDITION

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2007 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 08/12/24

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

Program License Serial Number 6501

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Initial subarea flow distance = 132.000(Ft.)
Highest elevation = 270.700(Ft.)
Lowest elevation = 260.530(Ft.)
Elevation difference = 10.170(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 6.81 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.4500)*(132.000^.5)/(7.705^(1/3)]= 6.81
Rainfall intensity (I) = 3.887(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.450
Subarea runoff = 0.437(CFS)
Total initial stream area = 0.250(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** INITIAL AREA EVALUATION ****

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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Initial subarea flow distance = 48.000(Ft.)
Highest elevation = 266.200(Ft.)
Lowest elevation = 241.000(Ft.)
Elevation difference = 25.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.16 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.4500)*(48.000^.5)/(52.500^(1/3)]= 2.16
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 4.389(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.450
Subarea runoff = 0.237(CFS)
Total initial stream area = 0.120(Ac.)
End of computations, total study area = 0.370 (Ac.)

PROPOSED CONDITION
100 YEAR STORM

PROPOSED CONDITION

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2007 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 02/16/25

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

Program License Serial Number 6501

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 17.000 to Point/Station 18.000
**** INITIAL AREA EVALUATION ****

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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Time of concentration computed by the
natural watersheds nomograph (App X-A)
TC = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
Initial subarea flow distance = 117.000(Ft.)
Highest elevation = 349.000(Ft.)
Lowest elevation = 293.000(Ft.)
Elevation difference = 56.000(Ft.)
TC=[(11.9*0.0222^3)/(56.00)]^.385= 0.41
Rainfall intensity (I) = 16.672(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.450
Subarea runoff = 1.951(CFS)
Total initial stream area = 0.260(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 293.000(Ft.)
Downstream point/station elevation = 292.800(Ft.)
Pipe length = 16.50(Ft.) Manning's N = 0.015
No. of pipes = 1 Required pipe flow = 1.951(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 1.951(CFS)
Normal flow depth in pipe = 4.88(In.)
Flow top width inside pipe = 19.31(In.)
Critical Depth = 5.81(In.)
Pipe flow velocity = 4.27(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 0.47 min.
++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 292.800(Ft.)
Downstream point/station elevation = 292.000(Ft.)
Pipe length = 23.50(Ft.) Manning's N = 0.015
No. of pipes = 1 Required pipe flow = 1.951(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 1.951(CFS)
Normal flow depth in pipe = 3.79(In.)
Flow top width inside pipe = 17.49(In.)
Critical Depth = 5.81(In.)
Pipe flow velocity = 6.14(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 0.53 min.
++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 292.000(Ft.)
Downstream point/station elevation = 290.000(Ft.)
Pipe length = 22.60(Ft.) Manning's N = 0.015
No. of pipes = 1 Required pipe flow = 1.951(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 1.951(CFS)
Normal flow depth in pipe = 3.01(In.)
Flow top width inside pipe = 15.89(In.)
Critical Depth = 5.81(In.)
Pipe flow velocity = 8.58(Ft/s)
Travel time through pipe = 0.04 min.
Time of concentration (TC) = 0.58 min.

++
Process from Point/Station 21.000 to Point/Station 22.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 290.000(Ft.)
Downstream point/station elevation = 288.500(Ft.)
Pipe length = 17.50(Ft.) Manning's N = 0.015
No. of pipes = 1 Required pipe flow = 1.951(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 1.951(CFS)
Normal flow depth in pipe = 3.03(In.)
Flow top width inside pipe = 15.94(In.)
Critical Depth = 5.81(In.)
Pipe flow velocity = 8.49(Ft/s)
Travel time through pipe = 0.03 min.
Time of concentration (TC) = 0.61 min.

++
Process from Point/Station 22.000 to Point/Station 23.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 288.500(Ft.)
Downstream point/station elevation = 288.000(Ft.)
Pipe length = 36.50(Ft.) Manning's N = 0.015
No. of pipes = 1 Required pipe flow = 1.951(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 1.951(CFS)
Normal flow depth in pipe = 4.73(In.)
Flow top width inside pipe = 19.09(In.)
Critical Depth = 5.81(In.)
Pipe flow velocity = 4.45(Ft/s)
Travel time through pipe = 0.14 min.
Time of concentration (TC) = 0.75 min.

++
Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

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
[SINGLE FAMILY area type]
Initial subarea flow distance = 15.500(Ft.)
Highest elevation = 288.000(Ft.)
Lowest elevation = 287.000(Ft.)
Elevation difference = 1.000(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.09 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.5500)*(15.500^.5)/(6.452^(1/3)]= 2.09
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 4.389(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.550
Subarea runoff = 0.017(CFS)
Total initial stream area = 0.007(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 0.007(Ac.)
Runoff from this stream = 0.017(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 4.389(In/Hr)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

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
[SINGLE FAMILY area type]
Initial subarea flow distance = 34.000(Ft.)
Highest elevation = 290.000(Ft.)
Lowest elevation = 287.000(Ft.)
Elevation difference = 3.000(Ft.)

Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.79 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.5500)*(34.000^.5)/(8.824^(1/3)]= 2.79
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 4.389(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.550
Subarea runoff = 0.012(CFS)
Total initial stream area = 0.005(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 0.005(Ac.)
Runoff from this stream = 0.012(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 4.389(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	0.017	5.00	4.389
2	0.012	5.00	4.389

Qmax(1) =
1.000 * 1.000 * 0.017) +
1.000 * 1.000 * 0.012) + = 0.029
Qmax(2) =
1.000 * 1.000 * 0.017) +
1.000 * 1.000 * 0.012) + = 0.029

Total of 2 streams to confluence:
Flow rates before confluence point:
0.017 0.012
Maximum flow rates at confluence using above data:
0.029 0.029
Area of streams before confluence:
0.007 0.005
Results of confluence:
Total flow rate = 0.029(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 0.012(Ac.)

++
Process from Point/Station 2.000 to Point/Station 4.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 280.000(Ft.)
Downstream point/station elevation = 275.900(Ft.)
Pipe length = 35.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.029(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.029(CFS)
Normal flow depth in pipe = 0.52(In.)
Flow top width inside pipe = 3.38(In.)
Critical Depth = 0.99(In.)
Pipe flow velocity = 3.58(Ft/s)
Travel time through pipe = 0.16 min.
Time of concentration (TC) = 5.16 min.

++
Process from Point/Station 2.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****

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
[SINGLE FAMILY area type]
Time of concentration = 5.16 min.
Rainfall intensity = 4.332(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.550
Subarea runoff = 0.024(CFS) for 0.010(Ac.)
Total runoff = 0.053(CFS) Total area = 0.02(Ac.)

++
Process from Point/Station 4.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 275.900(Ft.)
Downstream point/station elevation = 269.300(Ft.)
Pipe length = 33.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.053(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.053(CFS)
Normal flow depth in pipe = 0.60(In.)
Flow top width inside pipe = 3.61(In.)
Critical Depth = 1.35(In.)
Pipe flow velocity = 5.14(Ft/s)
Travel time through pipe = 0.11 min.
Time of concentration (TC) = 5.27 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 269.300(Ft.)
Downstream point/station elevation = 261.500(Ft.)
Pipe length = 31.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.053(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.053(CFS)
Normal flow depth in pipe = 0.57(In.)
Flow top width inside pipe = 3.51(In.)
Critical Depth = 1.35(In.)
Pipe flow velocity = 5.55(Ft/s)
Travel time through pipe = 0.09 min.
Time of concentration (TC) = 5.36 min.

++
Process from Point/Station 6.000 to Point/Station 7.000
**** SUBAREA FLOW ADDITION ****

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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Time of concentration = 5.36 min.
Rainfall intensity = 4.266(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450

Subarea runoff = 0.115(CFS) for 0.060(Ac.)

Total runoff = 0.168(CFS) Total area = 0.08(Ac.)

++
Process from Point/Station 1.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

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
[SINGLE FAMILY area type]
Initial subarea flow distance = 42.000(Ft.)
Highest elevation = 288.000(Ft.)
Lowest elevation = 287.000(Ft.)
Elevation difference = 1.000(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 4.80 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.5500)*(42.000^.5)/(2.381^(1/3)]= 4.80
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 4.389(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.550
Subarea runoff = 0.027(CFS)
Total initial stream area = 0.011(Ac.)
++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 275.000(Ft.)
Downstream point/station elevation = 264.150(Ft.)
Pipe length = 36.50(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.027(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.027(CFS)
Normal flow depth in pipe = 0.39(In.)
Flow top width inside pipe = 2.96(In.)
Critical Depth = 0.95(In.)
Pipe flow velocity = 4.76(Ft/s)
Travel time through pipe = 0.13 min.
Time of concentration (TC) = 5.13 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 0.011(Ac.)
Runoff from this stream = 0.027(CFS)
Time of concentration = 5.13 min.
Rainfall intensity = 4.344(In/Hr)

++
Process from Point/Station 10.000 to Point/Station 11.000
**** INITIAL AREA EVALUATION ****

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
[SINGLE FAMILY area type]
Initial subarea flow distance = 65.000(Ft.)
Highest elevation = 271.320(Ft.)
Lowest elevation = 270.700(Ft.)
Elevation difference = 0.620(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 8.11 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.5500)*(65.000^.5)/(0.954^(1/3)]= 8.11
Rainfall intensity (I) = 3.642(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.550
Subarea runoff = 0.076(CFS)
Total initial stream area = 0.038(Ac.)
++
Process from Point/Station 10.000 to Point/Station 11.000
**** SUBAREA FLOW ADDITION ****

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
[SINGLE FAMILY area type]
Time of concentration = 8.11 min.
Rainfall intensity = 3.642(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.550
Subarea runoff = 0.196(CFS) for 0.098(Ac.)
Total runoff = 0.272(CFS) Total area = 0.14(Ac.)

++
Process from Point/Station 11.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 266.400(Ft.)
Downstream point/station elevation = 264.150(Ft.)
Pipe length = 144.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.272(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.272(CFS)
Normal flow depth in pipe = 2.59(In.)

Flow top width inside pipe = 5.94(In.)
Critical Depth = 3.16(In.)
Pipe flow velocity = 3.35(Ft/s)
Travel time through pipe = 0.72 min.
Time of concentration (TC) = 8.83 min.

++
Process from Point/Station 11.000 to Point/Station 9.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 0.136(Ac.)
Runoff from this stream = 0.272(CFS)
Time of concentration = 8.83 min.
Rainfall intensity = 3.530(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	0.027	5.13	4.344
2	0.272	8.83	3.530

Qmax(1) =
1.000 * 1.000 * 0.027) +
1.000 * 0.581 * 0.272) + = 0.185
Qmax(2) =
0.813 * 1.000 * 0.027) +
1.000 * 1.000 * 0.272) + = 0.294

Total of 2 streams to confluence:
Flow rates before confluence point:
0.027 0.272
Maximum flow rates at confluence using above data:
0.185 0.294
Area of streams before confluence:
0.011 0.136
Results of confluence:
Total flow rate = 0.294(CFS)
Time of concentration = 8.826 min.
Effective stream area after confluence = 0.147(Ac.)

++
Process from Point/Station 9.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 264.150(Ft.)
Downstream point/station elevation = 260.330(Ft.)
Pipe length = 80.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.294(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.294(CFS)
Normal flow depth in pipe = 2.00(In.)
Flow top width inside pipe = 5.65(In.)
Critical Depth = 3.29(In.)
Pipe flow velocity = 5.13(Ft/s)
Travel time through pipe = 0.26 min.
Time of concentration (TC) = 9.09 min.

++
Process from Point/Station 12.000 to Point/Station 13.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Covered channel
Upstream point elevation = 260.330(Ft.)
Downstream point elevation = 260.200(Ft.)
Channel length thru subarea = 7.000(Ft.)
Channel base width = 3.000(Ft.)
Slope or 'Z' of left channel bank = 0.000
Slope or 'Z' of right channel bank = 0.000
Manning's 'N' = 0.015
Maximum depth of channel = 0.250(Ft.)
Flow(q) thru subarea = 0.294(CFS)
Depth of flow = 0.053(Ft.), Average velocity = 1.856(Ft/s)
Channel flow top width = 3.000(Ft.)
Flow Velocity = 1.86(Ft/s)
Travel time = 0.06 min.
Time of concentration = 9.15 min.
Critical depth = 0.066(Ft.)

++
Process from Point/Station 10.000 to Point/Station 14.000
**** INITIAL AREA EVALUATION ****

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
[SINGLE FAMILY area type]
Initial subarea flow distance = 55.000(Ft.)
Highest elevation = 271.320(Ft.)
Lowest elevation = 271.040(Ft.)
Elevation difference = 0.280(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 9.19 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.5500)*(55.000^.5)/(0.509^(1/3)]= 9.19
Rainfall intensity (I) = 3.478(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.550
Subarea runoff = 0.105(CFS)
Total initial stream area = 0.055(Ac.)

++
Process from Point/Station 14.000 to Point/Station 15.000
**** SUBAREA FLOW ADDITION ****

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
[SINGLE FAMILY area type]
Time of concentration = 9.19 min.
Rainfall intensity = 3.478(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.550
Subarea runoff = 0.165(CFS) for 0.086(Ac.)
Total runoff = 0.270(CFS) Total area = 0.14(Ac.)

++
Process from Point/Station 14.000 to Point/Station 15.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 270.370(Ft.)
Downstream point/station elevation = 269.650(Ft.)
Pipe length = 72.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.270(CFS)
Given pipe size = 6.00(In.)

Calculated individual pipe flow = 0.270(CFS)
Normal flow depth in pipe = 2.93(In.)
Flow top width inside pipe = 6.00(In.)
Critical Depth = 3.15(In.)
Pipe flow velocity = 2.83(Ft/s)
Travel time through pipe = 0.42 min.
Time of concentration (TC) = 9.62 min.

++
Process from Point/Station 15.000 to Point/Station 16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 260.820(Ft.)
Downstream point/station elevation = 260.700(Ft.)
Pipe length = 6.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.270(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.270(CFS)
Normal flow depth in pipe = 2.41(In.)
Flow top width inside pipe = 5.88(In.)
Critical Depth = 3.15(In.)
Pipe flow velocity = 3.65(Ft/s)
Travel time through pipe = 0.03 min.
Time of concentration (TC) = 9.65 min.

++
Process from Point/Station 16.000 to Point/Station 17.000
**** IMPROVED CHANNEL TRAVEL TIME ****
_____
Covered channel
Upstream point elevation = 260.700(Ft.)
Downstream point elevation = 260.600(Ft.)
Channel length thru subarea = 5.000(Ft.)
Channel base width = 3.000(Ft.)
Slope or 'Z' of left channel bank = 0.000
Slope or 'Z' of right channel bank = 0.000
Manning's 'N' = 0.015
Maximum depth of channel = 0.250(Ft.)
Flow(q) thru subarea = 0.270(CFS)
Depth of flow = 0.049(Ft.), Average velocity = 1.836(Ft/s)
Channel flow top width = 3.000(Ft.)
Flow Velocity = 1.84(Ft/s)
Travel time = 0.05 min.
Time of concentration = 9.69 min.
Critical depth = 0.063(Ft.)
End of computations, total study area = 0.37 On-site + 0.26 Off-site = 0.630 (Ac.)

4. TABLES AND CHARTS

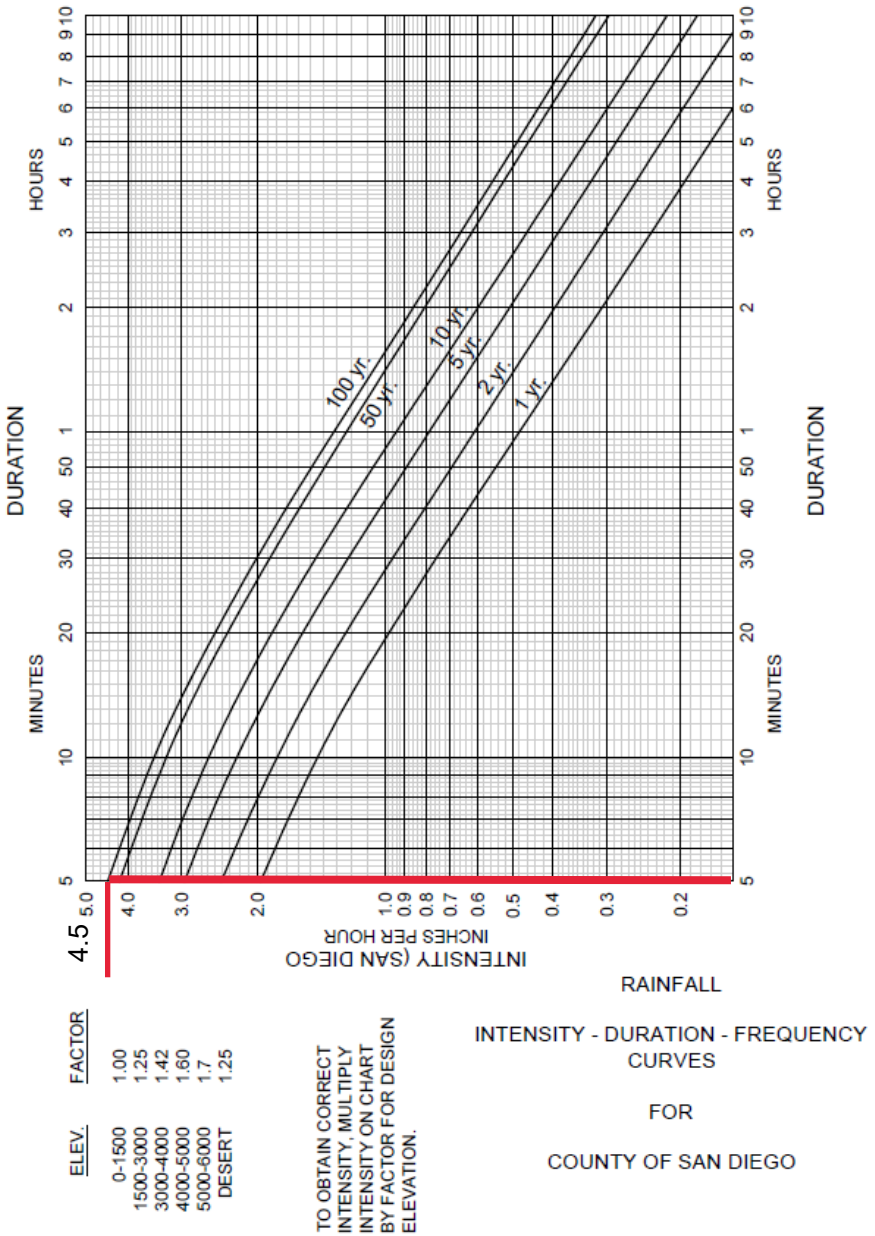


Figure A-1. Intensity-Duration-Frequency Design Chart

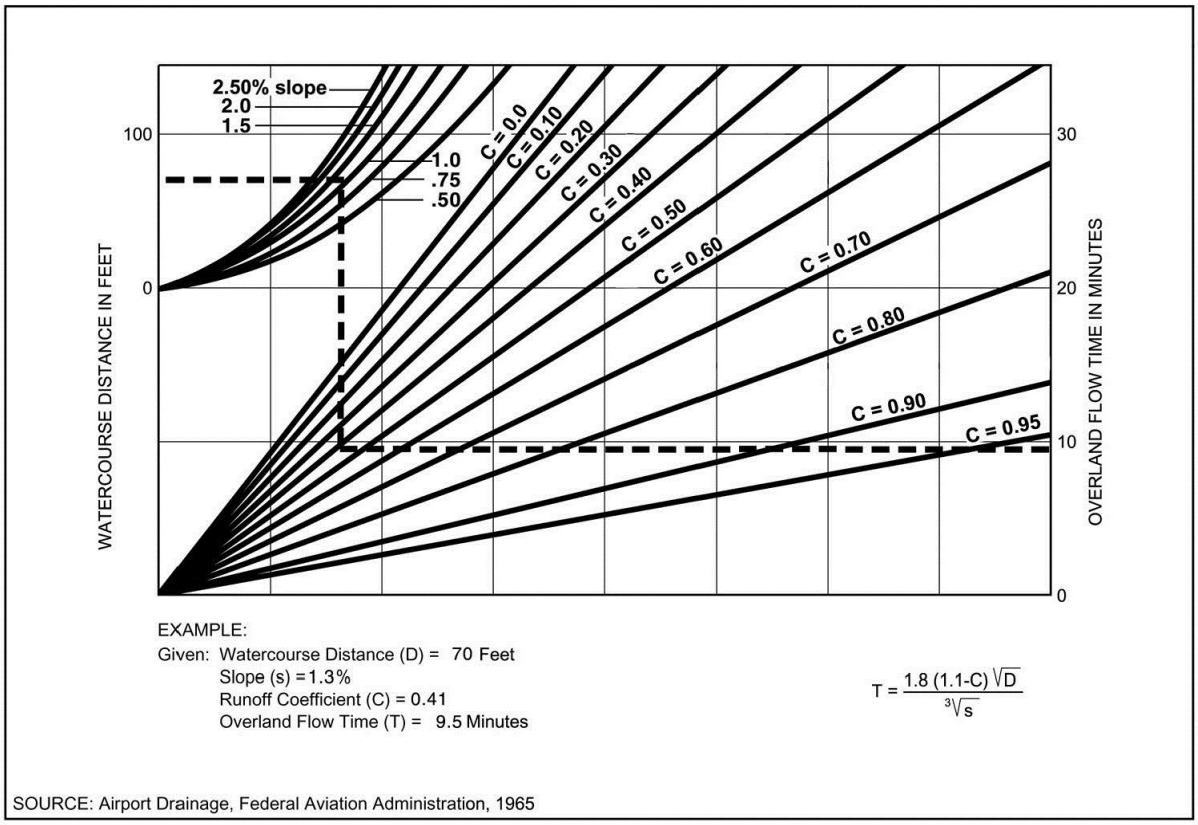


Figure A-4. Rational Formula – Overland Time of Flow Nomograph

Note: Use formula for watercourse distances in excess of 100 feet.

Ernest F. Brater and Horace Williams King

HANDBOOK OF HYDRAULICS

For the Solution of Hydraulic Engineering Problems

Table 7-14. Values of K' for Circular Channels in the Formula

$$Q = \frac{K'}{n} d^{8/3} s^{1/2}$$

D = depth of water d = diameter of channel

$\frac{D}{d}$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0		.00007	.00031	.00074	.00138	.00222	.00328	.00455	.00604	.00775
.1	.00967	.0118	.0142	.0167	.0195	.0225	.0257	.0291	.0327	.0366
.2	.0406	.0448	.0492	.0537	.0585	.0634	.0686	.0738	.0793	.0849
.3	.0907	.0966	.1027	.1089	.1153	.1218	.1284	.1352	.1420	.1490
.4	.1561	.1633	.1705	.1779	.1854	.1929	.2005	.2082	.2160	.2238
.5	.232	.239	.247	.255	.263	.271	.279	.287	.295	.303
.6	.311	.319	.327	.335	.343	.350	.358	.366	.373	.380
.7	.388	.395	.402	.409	.416	.422	.429	.435	.441	.447
.8	.453	.458	.463	.468	.473	.477	.481	.485	.488	.491
.9	.494	.496	.497	.498	.498	.498	.496	.494	.489	.483
1.0	.463									

Table A-1. Runoff Coefficients for Rational Method

Land Use	Runoff Coefficient (C) Soil Type [1]
Residential:	
Single Family	0.55
Multi-Units	0.70
Mobile Homes	0.65
Rural (lots greater than ½ acre)	0.45
Commercial [2]	
80% Impervious	0.85
Industrial [2]	
90% Impervious	0.95

PROPOSED W/ IMPERVIOUS AREA.

EXISTING & PERVIOUS AREAS.

Note:
[1] Type D soil to be used for all areas.
[2] Where actual conditions deviate significantly from the tabulated imperviousness values of 80% or 90%, the values given for coefficient C, may be revised by multiplying 80% or 90% by the ratio of actual imperviousness to the tabulated imperviousness. However, in case shall the final coefficient be less than 0.50. For example: Consider commercial property on D soil.

Actual imperviousness			=	50%
Tabulated imperviousness			=	80%
Revised C	=	(50/80) x 0.85	=	0.53

The values in Table A–1 are typical for urban areas. However, if the basin contains rural or agricultural land use, parks, golf courses, or other types of nonurban land use that are expected to be permanent, the appropriate value should be selected based upon the soil and cover and approved by the City.

A.1.3. Rainfall Intensity

The rainfall intensity (I) is the rainfall in inches per hour (in/hr.) for a duration equal to the T_c for a selected storm frequency. Once a particular storm frequency has been selected for design and a T_c calculated for the drainage area, the rainfall intensity can be determined from the Intensity-Duration-Frequency Design Chart (Figure A-1).

Appendix C

Manning Roughness Coefficients

The Manning roughness coefficient (n) is used to represent flow resistance in open-channel hydraulic computations. This Appendix offers a compilation of Manning roughness coefficients that may be used in the hydraulic design and evaluation of drainage facilities.

These values serve only as a basic guide. The procedure for selecting appropriate values for Manning roughness coefficient, especially in natural channel systems, is subjective and requires judgment and skill that is primarily developed through experience. For work where very accurate determination of water surface profile is necessary, the design engineer should consult the governing Agency to obtain data regarding roughness coefficient values applicable to specific streams. The design engineer may also examine Flood Insurance Study data, or one of several references for more specific information on determining roughness coefficient.

Table C-1. Average Manning Roughness Coefficients for Pavement and Gutters [1]

Material	Manning Roughness Coefficient (n)
Concrete Gutter [2]	0.015
Concrete Pavement Float Finish Broom Finish	 0.014 0.016
Concrete Gutter with Asphalt Pavement Smooth Finish Rough Texture	 0.013 0.015
Asphalt Pavement Smooth Finish Rough Texture	 0.013 0.016

Based on FHWA HEC-22.

[1] Based on materials and workmanship required by standard specifications.

[2] Increase roughness coefficient in gutters with mild slopes where sediment might accumulate by 0.020.

Table C-2. Average Manning Roughness Coefficients for Closed Conduits [1]

Conduit	Manning Roughness Coefficient (n)
Reinforced Concrete Pipe (RCP)	0.013
Corrugated Metal Pipe and Pipe Arch	
2-3/8 x ½ inch Corrugations	
Unlined	0.024
Half Lined	
Full Flow	0.018
d/D>=0.60	0.016
d/D<0.60	0.013
Fully Lined	0.013
3x1 inch Corrugations	0.027
6x2 inch Corrugations	0.032
Spiral Rib Pipe	0.013
Helically Wound Pipe	
18-inch	0.015
24-inch	0.017
30-inch	0.019
36-inch	0.021
42-inch	0.022
48-inch	0.023
Plastic Pipe (HPDE and PVC)	
Smooth	0.013
Corrugated	0.024
Vitrified Clay Pipe	0.014
Cast-Iron Pipe (Uncoated)	0.013
Steel Pipe	0.011
Brick	0.017
Cast-In-Place Concrete Pipe	
Rough Wood Forms	0.017
Smooth Wood or Steel Forms	0.014

[1] Based on materials and workmanship required by standard specifications.

Table C-3. Average Manning Roughness Coefficients for Small Open Channels Conveying Less than 50 cfs[1]

Lining Type	Design Flow Depth		
	0 – 0.5 ft	0.5 – 2.0 ft	> 2.0 ft
Concrete (Poured)	0.015	0.013	0.013
Air Blown Concrete	0.023	0.019	0.016
Grouted Riprap	0.040	0.030	0.028
Stone Masonry	0.042	0.032	0.030
Soil Cement	0.025	0.022	0.020
Bare Soil	0.023	0.020	0.020
Rock Cut	0.045	0.035	0.025
Rock Riprap	Based on Rock Size (See Chapter 7, Section 7.6.17)		

[1] Based on materials and workmanship required by standard specifications.

Table C-4. Average Manning Roughness Coefficients for Larger Open Channels

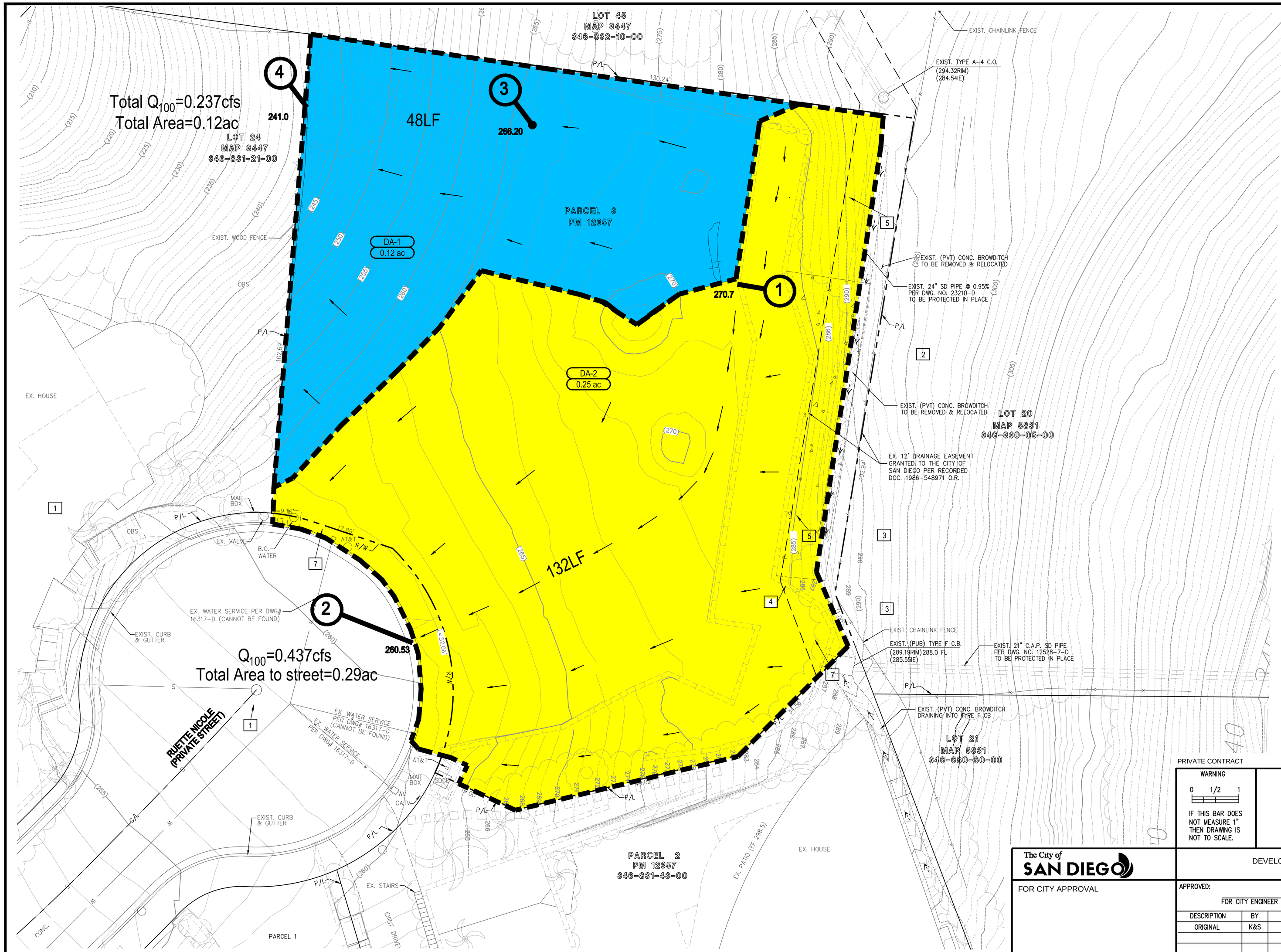
Channel	Manning Roughness Coefficient(n)
Unlined Channels Clay Loam Sand	 0.023 0.020
Lined Channels Grass Lined (well maintained) Grass Lined (not maintained)	 0.035 0.045
Wetland-Bottom Channels (New Channel)	0.023
Wetland-Bottom Channels (Mature Channel)	See Table A–5
Riprap-Lined Channels	See Chapter 7, Section 7.6.17
Concrete (Poured)	0.014
Air Blown Mortar (Gunite or Shotcrete)[1]	0.016
Asphaltic Concrete or Bituminous Plant Mix	0.018

[1] For air blown concrete, use n=0.012 (if troweled) and n=0.025 if purposely roughened.
Note: For channels with revetments or multiple lining types, use composite Manning roughness coefficient based on component lining materials.

Table C-5. Average Manning Roughness Coefficients for Natural Channels

Channel	Manning Roughness Coefficient (n)
Minor Streams (Surface Width at Flood Stage < 100 ft)	
Fairly Regular Section	
(A) Some Grass and Weeds, Little or No Brush	0.030
(B) Dense Growth of Weeds, Depth of Flow Materially Greater than Weed Height	0.040
(C) Some Weeds, Light Brush on Banks	0.040
(D) Some Weeds, Heavy Brush on Banks	0.060
(E) For Trees within Channel with Branches Submerged at High Stage, Increase all above values by:	0.015
Irregular Section, with Pools, Slight Channel Meander	
Channels (A) through (E) above, Increase all Values by:	0.015
Mountain Streams; No Vegetation in Channel, Banks Usually Steep, Trees and Brush along Banks Submerged at High Stage	0.050
(A) Bottom, Gravel, Cobbles and Few Boulders	0.060
(B) Bottom, Cobbles with Large Boulders	
Flood Plains (Adjacent to Natural Streams)	
Pasture, No Brush	
(A) Short Grass	0.030
(B) High Grass	0.040
Cultivated Areas	
(A) No Crop	0.040
(B) Mature Row Crops	0.040
(C) Mature Field Crops	0.050
Heavy Weeds, Scattered Brush	0.050
Light Brush and Trees	0.060
Medium-to-Dense Brush	0.090
Dense Willows	0.170
Cleared Land with Tree Stumps, 100-150 per Acre	0.060
Heavy Stand of Timber, Little Undergrowth	
(A) Flood Depth below Branches	0.110
(B) Flood Depth Reaches Branches	0.140

5. HYDROLOGY MAPS



EXISTING CONDITION

LOT AREA	16,671.44 SQ. FT. / 0.37 ACRES
IMPERVIOUS AREA	0 SQ. FT. / 0 ACRES
PERVIOUS AREA	16,671.44 SQ. FT. / 0.37 ACRES

RUNOFF COEFFICIENT PER TABLE A-1 DRAINAGE DESIGN MANUAL 2017

LAND USE: RURAL (ALL PERVIOUS BASIN AREAS) RUNOFF COEFFICIENT (C) 0.45

AREA DRAINING TO STREET (PERVIOUS)

AREA DRAINING TO WEST SIDE (SLOPE) (PERVIOUS)

DRAINAGE AREA — DA-1 / 0.30 AC — AREA (acres)

PRIVATE CONTRACT

WARNING

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

HERMANNY HOUSE

LOT 25 MONTORO

EXISTING HYDROLOGY MAP

The City of SAN DIEGO

DEVELOPMENT SERVICES DEPARTMENT

SHEET 1 OF 2 SHEETS

FOR CITY APPROVAL

APPROVED: _____ FOR CITY ENGINEER _____ DATE

DESCRIPTION	BY	APPROVED	DATE
ORIGINAL	K&S		
AS BUILTS			

CONTRACTOR _____ DATE STARTED _____

INSPECTOR _____ DATE COMPLETED _____

PMT NO. –

PRJ NO. –

1894-6253 NAD83 COORDINATES

254-1691 LAMBERT COORDINATES

DRAWING NO. -D 1

K&S ENGINEERING, INC.
Planning . Engineering . Surveying
7801 Mission Center Court, Suite 100 San Diego, CA 92108
(619) 296-5565 Fax: (619) 296-5564

PROPOSED CONDITION

LOT AREA	16,671.44 SQ. FT. / 0.37 ACRES
IMPERVIOUS AREA	4,795 SQ. FT. / 0.11 ACRES
PERVIOUS AREA	11,876.44 SQ. FT. / 0.26 ACRES

RUNOFF COEFFICIENT PER TABLE A-1
DRAINAGE DESIGN MANUAL 2017

LAND USE: SINGLE FAMILY (FOR IMPERVIOUS & PERVIOUS BASIN AREAS)	RUNOFF COEFFICIENT (C) 0.55
LAND USE: RURAL (FOR PERVIOUS BASIN AREAS)	RUNOFF COEFFICIENT (C) 0.45

MAX CUT DEPTH UNDER BUILDING FOOTPRINT	8 FT
MAX CUT DEPTH OUTSIDE BUILDING FOOTPRINT	9 FT
MAX FILL DEPTH UNDER BUILDING FOOTPRINT	7 FT
MAX FILL DEPTH OUTSIDE BUILDING FOOTPRINT	11.5 FT

AREA DRAINING TO STREET (IMPERVIOUS AND PERVIOUS)

AREA DRAINING TO WEST SIDE (SLOPE) (PERVIOUS)

DRAINAGE AREA — DA-1 / 0.30 AC — AREA (acres)

0.26 AC
OFF-SITE DRAINAGE AREA

Total Q_{100}=0.168cfs
Total Area=0.08ac

Q_{100}=0.053cfs
V_{100}=5.55fps

Q_{100}=0.029cfs
V_{100}=3.58fps

Q_{100}=0.107cfs
DA-1d
0.06 ac

Q_{100}=0.105cfs
DA-2e
0.055ac

Q_{100}=0.070cfs
DA-2c
0.038 ac

DA-1c
0.01 ac

DA-1b
0.005 ac

DA-1a
0.007 ac

Q_{100}=0.162cfs
DA-2f
0.086ac

Q_{100}=0.197cfs
DA-2d
0.098 ac

DA-2a
0.011 ac

DA-2b
0.009 ac

1	288.00HP	
2	287.00TG 280.00IE Q_{100}=0.029cfs	
3	290.00HP	
4	275.90IE	
5	269.30IE	
6	261.50IE	
7		
8	287.00TG 275.00IE	
9	264.15IE	
10	271.32HP	
11	271.30TG 266.40IE	
12	260.33	
13	260.20FL Q_{100}=0.294cfs V_{100}=1.86fps	
14	271.04 270.37IE	
15	260.70IE	
16	6.0% 260.82IE	
17	260.60FL Q_{100}=0.27cfs V_{100}=1.84fps	349.0FL
18	293.0FL	
19	292.8FL	
20	292.0FL	
21	290.0FL	
22	288.5FL	
23	288.00FL Q_{100}=1.95cfs V_{100}=4.45fps	

31LF · 33LF · 55LF · 65LF · 35LF · 34.0LF · 15.5LF · 42LF · 72LF · 6.95LF · 80LF · 144LF · 36.5LF

L=16.5' · L=23.5' · L=22.6' · L=17.5' · L=36.5' · L=117'

PROP. ROOT ZONE PER LANDSCAPE PLANS (SEPARATE PERMIT)

RUETTE NICOLE (PRIVATE STREET)

Total Area to street=0.29ac

EX. PATIO (FF 298.5)

0 5 10 20 30
GRAPHIC SCALE: 1" = 10'

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

HERMANNY HOUSE
LOT 25 MONTORO
PROPOSED HYDROLOGY MAP

The City of SAN DIEGO
FOR CITY APPROVAL

DEVELOPMENT SERVICES DEPARTMENT
SHEET 2 OF 2 SHEETS

APPROVED: _____ FOR CITY ENGINEER _____ DATE

DESCRIPTION	BY	APPROVED	DATE
ORIGINAL	K&S		
AS BUILTS			

CONTRACTOR _____ DATE STARTED _____
INSPECTOR _____ DATE COMPLETED _____

PMT NO. –
PRJ NO. –
1894-6253 NAD83 COORDINATES
254-1691 LAMBERT COORDINATES
DRAWING NO. -D 2

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