RANCHO COASTAL **ENGINEERING**
Single Source Development Consultant

Cielo Mar Subdivision
8280 Calle Del Cielo
La Jolla, CA 92037

PRELIMINARY DRAINAGE STUDY

PROJECT # 1085883

CITY OF SAN DIEGO, CA.

PREPARED: February 15, 2023
Revised: August 9, 2024

PREPARED FOR:

Cielo Mar La Jolla, LLC
1298 Prospect Street, #2S
La Jolla, CA 92037
661-979-0244

PREPARED UNDER THE SUPERVISION OF:

DOUGLAS E. LOGAN
CIVIL ENGINEER PE 39726

REGISTERED PROFESSIONAL ENGINEER
DOUGLAS E. LOGAN
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CIVIL
STATE OF CALIFORNIA

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Rancho Coastal Engineering and Surveying, Inc.
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Physical Address: 310 Via Vera Cruz, #205, San Marcos, CA 92078
Phone (760) 510-3152 / Fax: (760) 510-3153 / www.rcesd.com

1. Introduction

This Drainage Study for the proposed Cielo Mar Subdivision is prepared to analyze the hydrologic and hydraulic characteristics of the existing undeveloped site and proposed development. This report intends to present the methodology and the calculations used for determining the runoff from the project site produced by the 100- year 6-hour storm.
The project is not required to obtain approval from the Regional Water Quality Control Board (SWRCB) Under Federal Clean Water Act (CWA) Section 401 or 404. The project does no propose to discharge fill and dredged material to waters of the State, including waters of the U.S.

2. Existing Conditions

The subject property is located within the La Jolla Shores Planned District. The site consists of 1 developed lot, housing a single-family home. The site is bordered residential development all around. Access to the site is via by a public street, Calle del Cielo. The property's existing terrain consists mostly of mild slopes with some flat areas associated with the existing single family home and private driveway.

Elevations range from approximately 136 feet above mean sea level (MSL) in the easterly side of the property to approximately 66 feet (MSL) at the westerly end of the property.

The existing runoff flows overland westerly, with the majority of the runoff flowing to the 60' road easement westerly of the site and then to La Jolla Shores Drive street gutters that convey flows further to the south into existing curb inlets. A portion of the site runoff flows to the neighboring properties westerly of the site. There is no offsite run-on.

3. Proposed Project

The planned development consists of demolishing the existing residential structures and improvements to subdivide the existing lot into six (6) single-family residential lots. There will be a dead-end cul-de-sac to access all the lots, wet and dry utilities.

Runoff from new all permeable surfaces will be captured by pipes and concrete channels that will convey all runoff to a treatment facility and then discharge flows at a controlled rate to match pre -development peak flows.
All flows generated by the proposed development will discharge onto the same existing discharge points and patterns.

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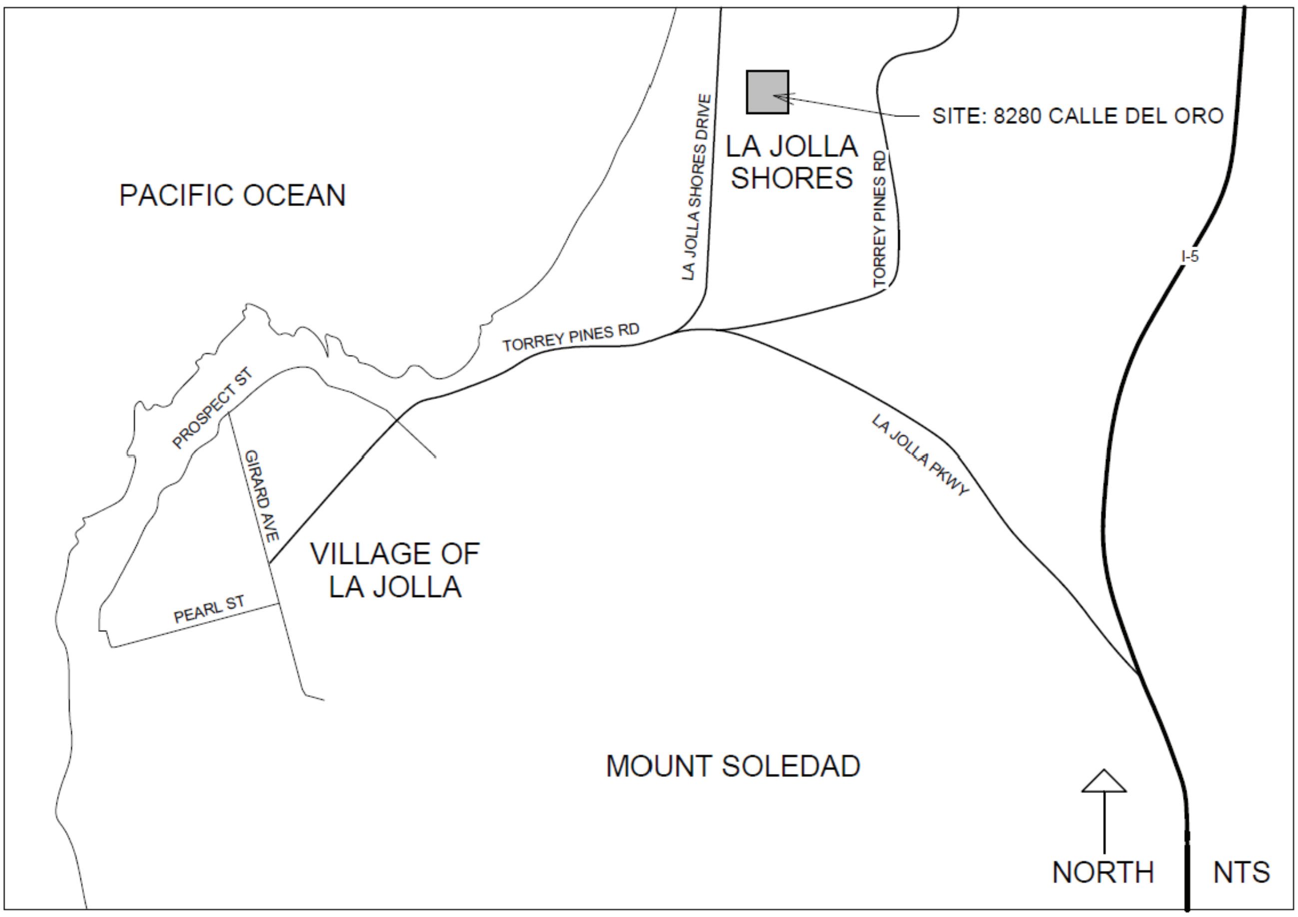

PROJECT VICINITY MAP

4. Methodology

RATIONAL METHOD

Watersheds Less than 0.5 Square Mile

Method of Computing Runoff

Use the Rational Formula Q = CIA where:

Q: is the peak rate of flow in cubic feet per second.

C: is a runoff coefficient expressed as that percentage of rainfall

A: is the drainage area in acres tributary to design point.

I: is the average rainfall intensity in inches per hour for storm duration equal to the time of concentration (Tc) of the contributing drainage area.

(1) Runoff Coefficient, C

Appendix A.1.2, Table A-1 list the Runoff Coefficient based on land use and are typical for urban areas. Select an appropriate coefficient for each type of land use from Table A-1, Appendix A.1.2.

The composite runoff coefficient, C, reflects the runoff potential of the drainage area. The range of runoff coefficients varies from 0.35 to 0.95, with higher values corresponding to greater runoff potential. The composite runoff coefficient is the weighted average of all of the land uses within the drainage area.

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Project Drainage Effective C-Factor - Pre-Development						
Basin ID	Total Area (ac)	Pervious Area - Soil Type D (sq-ft)	Impervious Area - Soil Type D (sq-ft)	% Impervious	% Pervious	Weighted Runoff Coef C:
A.1	0.150	6534	0	0%	100%	0.35
A.2	4.000	155390	18850	11%	89%	0.41
B.1	0.280	12197	0	0%	100%	0.35
Total	4.43	174121	18850			

Runoff Coefficient Table	
Soil Type	D (Assumed)
Impervious	0.9
Pervious (LS/Perm Pavers)	0.35

Project Drainage Effective C-Factor - Post-Development						
Basin ID	Total Area (ac)	Pervious Area - Soil Type D (sq-ft)	Impervious Area - Soil Type D (sq-ft)	% Impervious	% Pervious	Weighted Runoff Coef C:
A.1	0.050	0	2178	100%	0%	0.90
A.2	2.490	42867	65220	60%	40%	0.68
B.1	0.090	920	3000	77%	23%	0.77
B.2	1.780	32715	44822	58%	42%	0.67
C.1	0.028	1224	0	0%	100%	0.35
Total	4.438	77726	115220			

Runoff Coefficient Table	
Soil Type	D
Impervious	0.9
Pervious (LS/Perm Pavers)	0.35

(2) Rainfall Intensity, I

Rainfall intensity can be determined with the Intensity - duration - frequency Design chart (Figure A-1) on Appendix A.1.3 of "City of San Diego *Drainage Design Manual, Jan. 2017 edition"*.

(3) Time of Concentration, Tc

The time of concentration is the time required for runoff to flow from the most remote part of the watershed to the outlet point under consideration.

In addition to the above Ration Method assumptions, the conservative assumption that all runoff coefficients utilized for this report are based on type "D" soils. (WEB soil Survey Maps identified the site with Types C & A)
The City of San Diego Rational Method program within CivilD was utilized in calculating runoff for all basins smaller than 0.5 square miles in size.

5. Summary

Upon performing hydrologic analysis of the project site in both the proposed developed and existing condition, the following results were produced:

In existing conditions, the hydrologic model included the analysis of the project site at two (2) points of discharge. Output data from the hydrologic analysis model of the project site in the existing condition indicates that the 100-year peak runoff flow of 6.98 cfs is generated by the project site. The total area of the existing conditions contributing storm water runoff is 4.43 acres.

The output data, from the hydrologic analysis model of the proposed project, indicates that the confluence 100-year peak flow is equal to 11.76 cfs. The total area of the proposed project site in the post-development hydrologic basins is 4.44 acres.

6. Conclusions

The proposed storm drain system was designed in accordance with the guidelines set by the City of San Diego. During the design of the proposed drainage systems precautions were taken to limit adverse downstream affects and to maintain existing drainage characteristics wherever possible.

Table 1 – Summary of unmitigated conditions

	C (effective)	Tc Min	I In/hr	A (ac)	Q cfs (100-yr)
Pre-Development					
A.1	0.35	5.00	4.39	0.15	0.23
A.2	0.41	7.47	3.88	4.00	6.37
B.1	0.35	5.00	3.88	0.28	0.38
Post-Development					
A.1	0.90	5.00	4.39	0.05	0.20
A.2	0.68	6.45	3.97	2.49	6.72
B.1	0.77	5.09	4.36	0.09	0.14
B.2	0.67	6.17	4.04	1.78	4.82
C.1	0.35	6.75	3.90	0.028	0.04

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Table 2 – Summary of Peak flows

NODE # PRE/POST	Area (ac)			100-Yr peak Flows (cfs)			
	Existing	Developed	Diff	Existing	Developed Unmitigated	Developed Mitigated*	Diff
30&50 Pre / 55 Post	4.43	4.44	0.01	6.98	11.76	6.58	-0.4

* The proposed bio-planterS will detain and release post peak flows at a predevelopment rates.
A summary of the facts and findings associated with this project and the measures addressed by this report is as follows:

- The project will not significantly alter drainage patterns on the site.
- The ultimate discharge points will not be changed.
- Graded areas and slopes will be landscaped to reduce or eliminate sediment discharge
- Post development flows will not exceed predevelopment flows.

7. References

" City of San Diego Drainage Design Manual, Jan. 2017 edition"

"California Regional Water Quality Control Board Order No. 2001-07," California Regional Water Control Board, San Diego Region (SDRWQCB).

"Low Impact Development Handbook, Storm Water Management Strategies", County of San Diego, 2008 .

APPENDIX 1
Hydrology Calculations
& Basin Map

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EXISTING CONDITIONS

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BASIN MAP
PRE DEVELOPMENT

BASIN MAP FOR:

CIELO MAR SUBDIVISION

DESIGNED BY:	DRAWN BY:	SHEET 1 OF 1

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                 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: 02/18/23
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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


Program License Serial Number 6499

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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       10.000 to Point/Station       20.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
User specified 'C' value of 0.350 given for subarea
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =  143.200(Ft.)
Lowest elevation =  124.500(Ft.)
Elevation difference =   18.700(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     5.09 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3500)*( 100.000^.5)/(18.700^(1/3)]=   5.09
Rainfall intensity (I) =      4.359(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff =      0.229(CFS)
Total initial stream area =        0.150(Ac.)



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Process from Point/Station       20.000 to Point/Station       30.000
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**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   124.500(Ft.)
Downstream point elevation =    65.300(Ft.)
Channel length thru subarea  =   670.000(Ft.)
Channel base width     =    2.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =      3.280(CFS)
Manning's 'N'    = 0.020
Maximum depth of channel  =    0.750(Ft.)
Flow(q) thru subarea =      3.280(CFS)
Depth of flow =   0.197(Ft.), Average velocity =   6.432(Ft/s)
Channel flow top width =    3.181(Ft.)
Flow Velocity =    6.43(Ft/s)
Travel time  =    1.74 min.
Time of concentration =    6.82 min.
Critical depth =      0.363(Ft.)
 Adding area flow to channel
User specified 'C' value of 0.410 given for subarea
Rainfall intensity =      3.884(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.410
Subarea runoff =      6.370(CFS) for    4.000(Ac.)
Total runoff =      6.598(CFS)    Total area =        4.15(Ac.)

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Process from Point/Station       30.000 to Point/Station       30.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      4.150(Ac.)
Runoff from this stream =      6.598(CFS)
Time of concentration =    6.82 min.
Rainfall intensity =     3.884(In/Hr)
Summary of stream data:

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


1        6.598      6.82              3.884
Qmax(1) =
         1.000 *    1.000 *     6.598) + =       6.598

Total of 1 main streams to confluence:
Flow rates before confluence point:
       6.598
Maximum flow rates at confluence using above data:
        6.598
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Area of streams before confluence:
        4.150


Results of confluence:
Total flow rate =      6.598(CFS)
Time of concentration =     6.822 min.
Effective stream area after confluence  =      4.150(Ac.)


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Process from Point/Station       40.000 to Point/Station       50.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
User specified 'C' value of 0.350 given for subarea
Time of concentration =     6.82 min.
Rainfall intensity =      3.884(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.350
Subarea runoff =      0.381(CFS) for    0.280(Ac.)
Total runoff =      6.979(CFS)    Total area =        4.43(Ac.)
End of computations, total study area =           4.430 (Ac.)
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PROPOSED CONDITIONS

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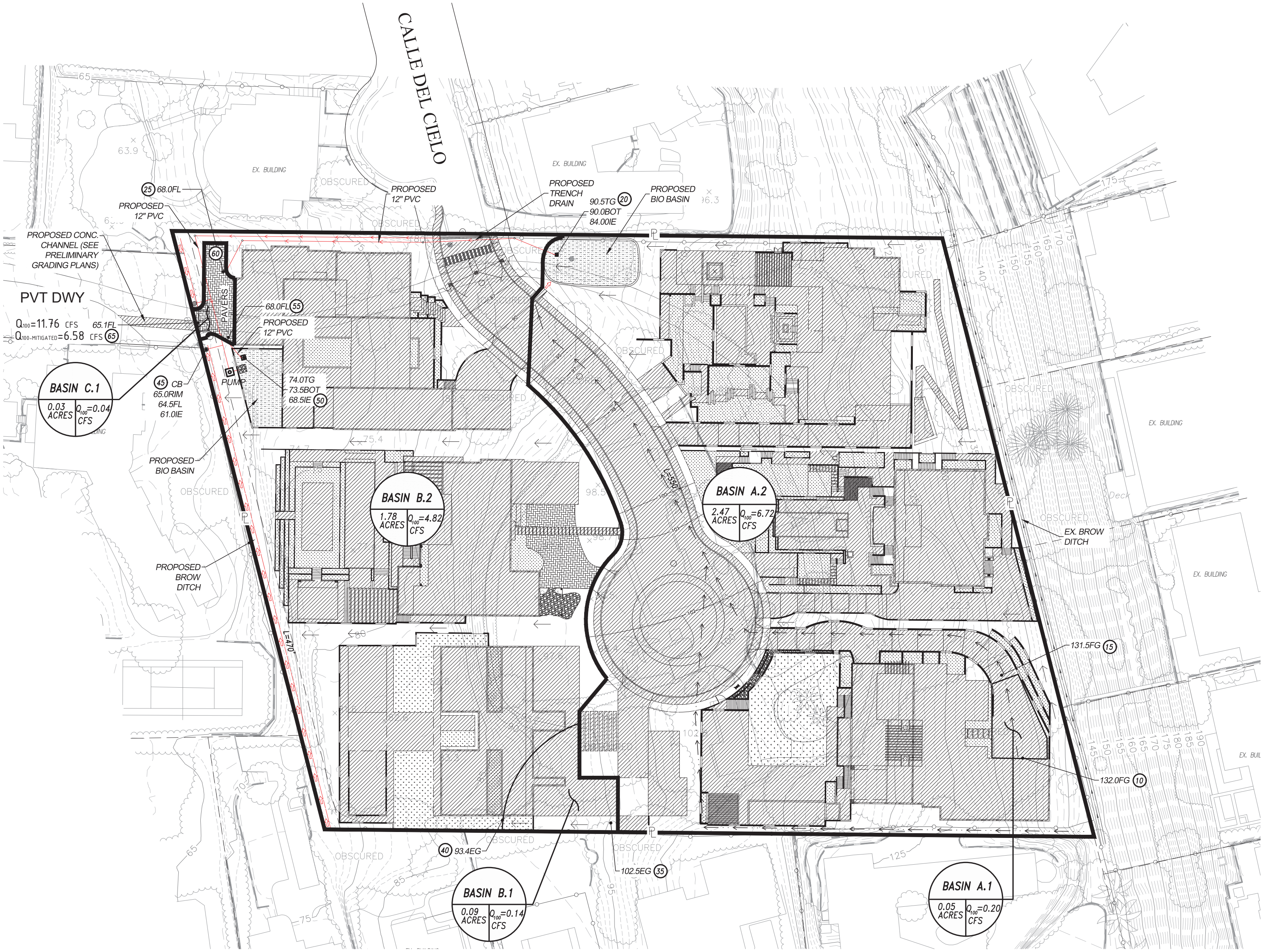
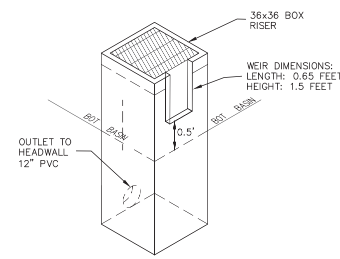


LEGEND

ITEM	SYMBOL
SUBBASIN BOUNDARY	
DRAINAGE DIRECTION	
NEW IMPERVIOUS	
NODE	10
DRAINAGE DESCRIPTION	BASIN A.1 0.06 ACRES Q_{100}=0.13 CFS



A BIO-FILTRATION OUTLET DETAIL (each)
NOT TO SCALE

BASIN MAP
POST DEVELOPMENT

BASIN MAP FOR:

CIELO MAR SUBVISION

DESIGNED BY: | DRAWN BY: | SHEET 1 OF 1

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              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 6499

------------------------------------------------------------------------
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       10.000 to Point/Station       15.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
User specified 'C' value of 0.900 given for subarea
Initial subarea flow distance  =   45.000(Ft.)
Highest elevation =  132.000(Ft.)
Lowest elevation =  131.500(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     2.33 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9000)*(  45.000^.5)/(   1.111^(1/3)]=   2.33
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 = 0.900
Subarea runoff =      0.198(CFS)
Total initial stream area =       0.050(Ac.)
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Process from Point/Station       15.000 to Point/Station       20.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   131.500(Ft.)
Downstream point elevation =    90.000(Ft.)
Channel length thru subarea  =   355.000(Ft.)
Channel base width     =   30.000(Ft.)
Slope or 'Z' of left channel bank =   0.000
Slope or 'Z' of right channel bank =   0.000
Estimated mean flow rate at midpoint of channel =      5.115(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.400(Ft.)
Flow(q) thru subarea =      5.115(CFS)
Depth of flow =   0.042(Ft.), Average velocity =   4.075(Ft/s)
Channel flow top width =   30.000(Ft.)
Flow Velocity =    4.07(Ft/s)
Travel time  =    1.45 min.
Time of concentration =    6.45 min.
Critical depth =      0.097(Ft.)
 Adding area flow to channel
User specified 'C' value of 0.680 given for subarea
Rainfall intensity =      3.968(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.680
Subarea runoff =      6.718(CFS) for    2.490(Ac.)
Total runoff =      6.915(CFS)    Total area =        2.54(Ac.)


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Process from Point/Station       20.000 to Point/Station       25.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =    84.000(Ft.)
Downstream point/station elevation =    68.000(Ft.)
Pipe length  =   230.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.915(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     6.915(CFS)
Normal flow depth in pipe =    7.65(In.)
Flow top width inside pipe =   11.54(In.)
Critical depth could not be calculated.
Pipe flow velocity =     13.08(Ft/s)
Travel time through pipe =    0.29 min.
Time of concentration (TC) =     6.75 min.
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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      25.000 to Point/Station      25.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      2.540(Ac.)
Runoff from this stream =      6.915(CFS)
Time of concentration =    6.75 min.
Rainfall intensity =     3.901(In/Hr)
Summary of stream data:

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


1        6.915      6.75             3.901
Qmax(1) =
         1.000 *    1.000 *     6.915) + =       6.915

Total of 1 streams to confluence:
Flow rates before confluence point:
       6.915
Maximum flow rates at confluence using above data:
        6.915
Area of streams before confluence:
        2.540
Results of confluence:
Total flow rate =      6.915(CFS)
Time of concentration =     6.745 min.
Effective stream area after confluence =      2.540(Ac.)


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Process from Point/Station      35.000 to Point/Station      40.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
User specified 'C' value of 0.350 given for subarea
Initial subarea flow distance  =   75.000(Ft.)
Highest elevation =  102.500(Ft.)
Lowest elevation =   93.400(Ft.)
Elevation difference =    9.100(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     5.09 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3500)*(  75.000^.5)/(12.133^(1/3)]=   5.09
Rainfall intensity (I) =      4.358(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff =      0.137(CFS)
Total initial stream area =        0.090(Ac.)
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Process from Point/Station       40.000 to Point/Station      45.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    93.400(Ft.)
Downstream point elevation =    64.500(Ft.)
Channel length thru subarea  =   470.000(Ft.)
Channel base width     =    0.000(Ft.)
Slope or 'Z' of left channel bank =   1.000
Slope or 'Z' of right channel bank =   1.000
Estimated mean flow rate at midpoint of channel =      1.495(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      1.495(CFS)
Depth of flow =   0.454(Ft.), Average velocity =   7.255(Ft/s)
Channel flow top width =    0.908(Ft.)
Flow Velocity =    7.25(Ft/s)
Travel time  =    1.08 min.
Time of concentration =    6.17 min.
Critical depth =      0.672(Ft.)
 Adding area flow to channel
User specified 'C' value of 0.670 given for subarea
Rainfall intensity =      4.037(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.670
Subarea runoff =      4.815(CFS) for    1.780(Ac.)
Total runoff =      4.952(CFS)    Total area =        1.87(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       50.000 to Point/Station      55.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =    68.500(Ft.)
Downstream point/station elevation =    68.000(Ft.)
Pipe length  =    14.50(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.952(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     4.952(CFS)
Normal flow depth in pipe =    7.75(In.)
Flow top width inside pipe =   11.48(In.)
Critical Depth =   10.97(In.)
Pipe flow velocity =      9.24(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     6.19 min.
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Process from Point/Station       50.000 to Point/Station       50.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.870(Ac.)
Runoff from this stream =      4.952(CFS)
Time of concentration =    6.19 min.
Rainfall intensity =     4.030(In/Hr)
Summary of stream data:

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


1        6.915      6.75             3.901
2        4.952      6.19             4.030
Qmax(1) =
         1.000 *    1.000 *     6.915) +
         0.968 *    1.000 *     4.952) + =      11.708
Qmax(2) =
         1.000 *    0.918 *     6.915) +
         1.000 *    1.000 *     4.952) + =      11.302

Total of 2 streams to confluence:
Flow rates before confluence point:
       6.915       4.952
Maximum flow rates at confluence using above data:
       11.708       11.302
Area of streams before confluence:
        2.540       1.870
Results of confluence:
Total flow rate =     11.708(CFS)
Time of concentration =     6.745 min.
Effective stream area after confluence =      4.410(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       60.000 to Point/Station       65.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
User specified 'C' value of 0.350 given for subarea
Time of concentration =     6.75 min.
Rainfall intensity =      3.901(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.350
Subarea runoff =      0.038(CFS) for    0.028(Ac.)
Total runoff =     11.756(CFS)    Total area =        4.44(Ac.)
End of computations, total study area =          4.438 (Ac.)
```


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APPENDIX 2
Unit Hydrograph and Modified-Puls Detention Routing
Planter P4

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```
                     FLOOD HYDROGRAPH ROUTING PROGRAM

            Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2018
                          Study date: 06/12/24

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

Program License Serial Number 6499

--------------------------------------------------------------------
******************** HYDROGRAPH INFORMATION *********************

            From study/file name: cielohyd.rte
****************************HYDROGRAPH DATA****************************
            Number of intervals =   364
            Time interval =    1.0 (Min.)
            Maximum/Peak flow rate =       11.760 (CFS)
            Total volume =       0.507 (Ac.Ft)
      Status of hydrographs being held in storage
                 Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
      Peak (CFS)      0.000     0.000     0.000     0.000     0.000
      Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
**********************************************************************



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       10.000
**** RETARDING BASIN ROUTING ****
______________________________________________________________________

User entry of depth-outflow-storage data
--------------------------------------------------------------------
Total number of inflow hydrograph intervals = 364
Hydrograph time unit =  1.000 (Min.)
Initial depth in storage basin =   0.00(Ft.)
--------------------------------------------------------------------
--------------------------------------------------------------------
Initial basin depth =   0.00 (Ft.)
Initial basin storage =      0.00 (Ac.Ft)
Initial basin outflow =   0.00 (CFS)
---------------------------------------------------------------------
--------------------------------------------------------------------
Depth vs. Storage and Depth vs. Discharge data:
 Basin Depth  Storage    Outflow   (S-O*dt/2)   (S+O*dt/2)
     (Ft.)    (Ac.Ft)    (CFS)      (Ac.Ft)    (Ac.Ft)
---------------------------------------------------------------------
    0.000       0.000       0.000       0.000         0.000
```


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0.100	0.008	0.127	0.008	0.008
0.200	0.017	0.360	0.017	0.017
0.300	0.025	0.662	0.025	0.025
0.400	0.033	1.020	0.032	0.034
0.500	0.041	1.425	0.040	0.042
0.600	0.050	1.873	0.049	0.051
0.700	0.058	2.360	0.056	0.060
0.800	0.066	2.884	0.064	0.068
0.900	0.074	3.441	0.072	0.076
1.000	0.083	4.030	0.080	0.086
1.100	0.091	4.649	0.088	0.094
1.200	0.099	5.298	0.095	0.103
1.300	0.107	5.973	0.103	0.111
1.400	0.116	6.676	0.111	0.121

Hydrograph Detention Basin Routing

Graph values: 'I'= unit inflow; 'O'=outflow at time shown

```
--------------------------------------------------------------------
 Time    Inflow  Outflow    Storage                                  Depth
(Hours)  (CFS)   (CFS)     (Ac.Ft)  .0      2.9    5.88    8.82   11.76 (Ft.)
 0.017    0.05    0.00      0.000  O        |       |       |       |     0.00
 0.033    0.11    0.00      0.000  O        |       |       |       |     0.00
 0.050    0.16    0.01      0.000  O        |       |       |       |     0.00
 0.067    0.22    0.01      0.001  O        |       |       |       |     0.01
 0.083    0.27    0.01      0.001  O        |       |       |       |     0.01
 0.100    0.32    0.02      0.001  O        |       |       |       |     0.02
 0.117    0.38    0.03      0.002  OI       |       |       |       |     0.02
 0.133    0.38    0.04      0.002  OI       |       |       |       |     0.03
 0.150    0.38    0.04      0.003  OI       |       |       |       |     0.03
 0.167    0.38    0.05      0.003  OI       |       |       |       |     0.04
 0.183    0.38    0.06      0.004  OI       |       |       |       |     0.04
 0.200    0.38    0.06      0.004  OI       |       |       |       |     0.05
 0.217    0.38    0.07      0.004  OI       |       |       |       |     0.06
 0.233    0.38    0.08      0.005  OI       |       |       |       |     0.06
 0.250    0.38    0.08      0.005  OI       |       |       |       |     0.07
 0.267    0.39    0.09      0.006  OI       |       |       |       |     0.07
 0.283    0.39    0.10      0.006  OI       |       |       |       |     0.08
 0.300    0.39    0.10      0.007  OI       |       |       |       |     0.08
 0.317    0.39    0.11      0.007  OI       |       |       |       |     0.09
 0.333    0.39    0.12      0.007  OI       |       |       |       |     0.09
 0.350    0.39    0.12      0.008  OI       |       |       |       |     0.10
 0.367    0.39    0.13      0.008  OI       |       |       |       |     0.10
 0.383    0.40    0.14      0.008  OI       |       |       |       |     0.10
 0.400    0.40    0.15      0.009  OI       |       |       |       |     0.11
 0.417    0.40    0.16      0.009  OI       |       |       |       |     0.11
 0.433    0.40    0.16      0.009  OI       |       |       |       |     0.12
 0.450    0.40    0.17      0.010  OI       |       |       |       |     0.12
 0.467    0.40    0.18      0.010  OI       |       |       |       |     0.12
 0.483    0.40    0.19      0.010  OI       |       |       |       |     0.13
 0.500    0.40    0.19      0.011  OI       |       |       |       |     0.13
 0.517    0.40    0.20      0.011  OI       |       |       |       |     0.13
```


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```
 0.533    0.41    0.21     0.011  OI      |       |       |       |      0.14
 0.550    0.41    0.22     0.011  OI      |       |       |       |      0.14
 0.567    0.41    0.22     0.012  OI      |       |       |       |      0.14
 0.583    0.41    0.23     0.012  OI      |       |       |       |      0.14
 0.600    0.41    0.24     0.012  OI      |       |       |       |      0.15
 0.617    0.41    0.24     0.012  OI      |       |       |       |      0.15
 0.633    0.41    0.25     0.013  OI      |       |       |       |      0.15
 0.650    0.41    0.25     0.013  OI      |       |       |       |      0.15
 0.667    0.41    0.26     0.013  OI      |       |       |       |      0.16
 0.683    0.42    0.26     0.013  OI      |       |       |       |      0.16
 0.700    0.42    0.27     0.014  OI      |       |       |       |      0.16
 0.717    0.42    0.28     0.014  OI      |       |       |       |      0.16
 0.733    0.42    0.28     0.014  OI      |       |       |       |      0.17
 0.750    0.42    0.29     0.014  OI      |       |       |       |      0.17
 0.767    0.42    0.29     0.014  OI      |       |       |       |      0.17
 0.783    0.43    0.29     0.014  OI      |       |       |       |      0.17
 0.800    0.43    0.30     0.015  OI      |       |       |       |      0.17
 0.817    0.43    0.30     0.015  OI      |       |       |       |      0.18
 0.833    0.43    0.31     0.015  OI      |       |       |       |      0.18
 0.850    0.43    0.31     0.015  OI      |       |       |       |      0.18
 0.867    0.43    0.32     0.015  OI      |       |       |       |      0.18
 0.883    0.43    0.32     0.015  OI      |       |       |       |      0.18
 0.900    0.43    0.32     0.016  OI      |       |       |       |      0.18
 0.917    0.44    0.33     0.016  OI      |       |       |       |      0.19
 0.933    0.44    0.33     0.016  OI      |       |       |       |      0.19
 0.950    0.44    0.34     0.016  OI      |       |       |       |      0.19
 0.967    0.44    0.34     0.016  OI      |       |       |       |      0.19
 0.983    0.44    0.34     0.016  OI      |       |       |       |      0.19
 1.000    0.44    0.35     0.016  OI      |       |       |       |      0.19
 1.017    0.45    0.35     0.017  OI      |       |       |       |      0.20
 1.033    0.45    0.35     0.017  OI      |       |       |       |      0.20
 1.050    0.45    0.36     0.017  OI      |       |       |       |      0.20
 1.067    0.45    0.36     0.017  OI      |       |       |       |      0.20
 1.083    0.45    0.37     0.017  OI      |       |       |       |      0.20
 1.100    0.45    0.37     0.017  |O      |       |       |       |      0.20
 1.117    0.45    0.37     0.017  |O      |       |       |       |      0.20
 1.133    0.46    0.38     0.017  |O      |       |       |       |      0.21
 1.150    0.46    0.38     0.018  |O      |       |       |       |      0.21
 1.167    0.46    0.39     0.018  |O      |       |       |       |      0.21
 1.183    0.46    0.39     0.018  |O      |       |       |       |      0.21
 1.200    0.46    0.39     0.018  |O      |       |       |       |      0.21
 1.217    0.47    0.40     0.018  |O      |       |       |       |      0.21
 1.233    0.47    0.40     0.018  |O      |       |       |       |      0.21
 1.250    0.47    0.40     0.018  |O      |       |       |       |      0.21
 1.267    0.47    0.41     0.018  |O      |       |       |       |      0.22
 1.283    0.47    0.41     0.018  |O      |       |       |       |      0.22
 1.300    0.48    0.41     0.018  |O      |       |       |       |      0.22
 1.317    0.48    0.42     0.019  |O      |       |       |       |      0.22
 1.333    0.48    0.42     0.019  |O      |       |       |       |      0.22
 1.350    0.48    0.42     0.019  |O      |       |       |       |      0.22
 1.367    0.48    0.43     0.019  |O      |       |       |       |      0.22
 1.383    0.48    0.43     0.019  |O      |       |       |       |      0.22
 1.400    0.48    0.43     0.019  |O      |       |       |       |      0.22
```


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1.417	0.49	0.43	0.019	O					0.22
1.433	0.49	0.44	0.019	O					0.23
1.450	0.49	0.44	0.019	O					0.23
1.467	0.49	0.44	0.019	O					0.23
1.483	0.50	0.45	0.019	O					0.23
1.500	0.50	0.45	0.019	O					0.23
1.517	0.50	0.45	0.019	O					0.23
1.533	0.50	0.45	0.019	O					0.23
1.550	0.51	0.46	0.020	O					0.23
1.567	0.51	0.46	0.020	O					0.23
1.583	0.51	0.46	0.020	O					0.23
1.600	0.51	0.46	0.020	O					0.23
1.617	0.51	0.47	0.020	O					0.24
1.633	0.51	0.47	0.020	O					0.24
1.650	0.52	0.47	0.020	O					0.24
1.667	0.52	0.47	0.020	O					0.24
1.683	0.52	0.48	0.020	O					0.24
1.700	0.53	0.48	0.020	O					0.24
1.717	0.53	0.48	0.020	O					0.24
1.733	0.53	0.48	0.020	O					0.24
1.750	0.54	0.49	0.020	O					0.24
1.767	0.54	0.49	0.020	O					0.24
1.783	0.54	0.49	0.020	O					0.24
1.800	0.54	0.49	0.021	O					0.24
1.817	0.54	0.50	0.021	O					0.24
1.833	0.54	0.50	0.021	O					0.25
1.850	0.55	0.50	0.021	O					0.25
1.867	0.55	0.50	0.021	O					0.25
1.883	0.55	0.50	0.021	O					0.25
1.900	0.55	0.51	0.021	O					0.25
1.917	0.56	0.51	0.021	O					0.25
1.933	0.56	0.51	0.021	O					0.25
1.950	0.57	0.51	0.021	O					0.25
1.967	0.57	0.52	0.021	O					0.25
1.983	0.57	0.52	0.021	O					0.25
2.000	0.58	0.52	0.021	O					0.25
2.017	0.58	0.53	0.021	O					0.25
2.033	0.58	0.53	0.021	O					0.26
2.050	0.58	0.53	0.022	O					0.26
2.067	0.58	0.53	0.022	O					0.26
2.083	0.59	0.54	0.022	O					0.26
2.100	0.59	0.54	0.022	O					0.26
2.117	0.59	0.54	0.022	O					0.26
2.133	0.60	0.54	0.022	O					0.26
2.150	0.60	0.55	0.022	O					0.26
2.167	0.61	0.55	0.022	O					0.26
2.183	0.61	0.55	0.022	O					0.26
2.200	0.62	0.56	0.022	O					0.26
2.217	0.62	0.56	0.022	O					0.27
2.233	0.62	0.56	0.022	O					0.27
2.250	0.62	0.57	0.022	O					0.27
2.267	0.63	0.57	0.023	O					0.27
2.283	0.63	0.57	0.023	O					0.27

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2.300	0.63	0.57	0.023	O					0.27
2.317	0.63	0.58	0.023	O					0.27
2.333	0.64	0.58	0.023	O					0.27
2.350	0.64	0.58	0.023	O					0.27
2.367	0.65	0.59	0.023	O					0.27
2.383	0.65	0.59	0.023	O					0.28
2.400	0.66	0.59	0.023	O					0.28
2.417	0.67	0.60	0.023	O					0.28
2.433	0.67	0.60	0.023	O					0.28
2.450	0.68	0.60	0.023	O					0.28
2.467	0.68	0.61	0.024	O					0.28
2.483	0.68	0.61	0.024	O					0.28
2.500	0.69	0.62	0.024	O					0.28
2.517	0.69	0.62	0.024	O					0.29
2.533	0.69	0.62	0.024	O					0.29
2.550	0.70	0.63	0.024	O					0.29
2.567	0.70	0.63	0.024	O					0.29
2.583	0.71	0.63	0.024	O					0.29
2.600	0.71	0.64	0.024	O					0.29
2.617	0.72	0.64	0.024	O					0.29
2.633	0.73	0.65	0.025	O					0.29
2.650	0.73	0.65	0.025	O					0.30
2.667	0.74	0.65	0.025	OI					0.30
2.683	0.75	0.66	0.025	OI					0.30
2.700	0.75	0.66	0.025	OI					0.30
2.717	0.76	0.67	0.025	OI					0.30
2.733	0.76	0.67	0.025	OI					0.30
2.750	0.77	0.68	0.025	OI					0.31
2.767	0.77	0.69	0.026	OI					0.31
2.783	0.77	0.69	0.026	OI					0.31
2.800	0.78	0.70	0.026	OI					0.31
2.817	0.79	0.70	0.026	OI					0.31
2.833	0.80	0.71	0.026	OI					0.31
2.850	0.81	0.71	0.026	OI					0.31
2.867	0.82	0.72	0.026	OI					0.32
2.883	0.83	0.72	0.026	OI					0.32
2.900	0.84	0.73	0.027	OI					0.32
2.917	0.85	0.74	0.027	O					0.32
2.933	0.85	0.74	0.027	O					0.32
2.950	0.86	0.75	0.027	O					0.32
2.967	0.86	0.76	0.027	O					0.33
2.983	0.87	0.76	0.027	O					0.33
3.000	0.87	0.77	0.027	O					0.33
3.017	0.88	0.78	0.028	O					0.33
3.033	0.89	0.78	0.028	O					0.33
3.050	0.90	0.79	0.028	O					0.34
3.067	0.91	0.80	0.028	O					0.34
3.083	0.93	0.80	0.028	O					0.34
3.100	0.94	0.81	0.028	O					0.34
3.117	0.95	0.82	0.029	O					0.34
3.133	0.97	0.83	0.029	O					0.35
3.150	0.98	0.84	0.029	O					0.35
3.167	0.99	0.85	0.029	O					0.35

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3.183    1.00    0.86      0.029   | O     |       |       |       |     0.35
3.200    1.01    0.86      0.030   | O     |       |       |       |     0.36
3.217    1.02    0.87      0.030   | O     |       |       |       |     0.36
3.233    1.03    0.88      0.030   | O     |       |       |       |     0.36
3.250    1.03    0.89      0.030   | O     |       |       |       |     0.36
3.267    1.04    0.90      0.030   | O     |       |       |       |     0.37
3.283    1.06    0.91      0.031   | O     |       |       |       |     0.37
3.300    1.09    0.92      0.031   | O     |       |       |       |     0.37
3.317    1.11    0.93      0.031   | OI    |       |       |       |     0.37
3.333    1.13    0.94      0.031   | OI    |       |       |       |     0.38
3.350    1.15    0.95      0.031   | OI    |       |       |       |     0.38
3.367    1.17    0.96      0.032   | OI    |       |       |       |     0.38
3.383    1.19    0.98      0.032   | OI    |       |       |       |     0.39
3.400    1.21    0.99      0.032   | OI    |       |       |       |     0.39
3.417    1.22    1.00      0.033   | OI    |       |       |       |     0.40
3.433    1.24    1.02      0.033   | OI    |       |       |       |     0.40
3.450    1.25    1.03      0.033   | OI    |       |       |       |     0.40
3.467    1.27    1.05      0.034   | OI    |       |       |       |     0.41
3.483    1.28    1.06      0.034   | OI    |       |       |       |     0.41
3.500    1.30    1.08      0.034   | OI    |       |       |       |     0.41
3.517    1.34    1.09      0.034   | OI    |       |       |       |     0.42
3.533    1.38    1.11      0.035   |  O    |       |       |       |     0.42
3.550    1.42    1.13      0.035   |  O    |       |       |       |     0.43
3.567    1.46    1.15      0.036   |  O    |       |       |       |     0.43
3.583    1.50    1.17      0.036   |  OI   |       |       |       |     0.44
3.600    1.54    1.20      0.037   |  OI   |       |       |       |     0.44
3.617    1.58    1.22      0.037   |  OI   |       |       |       |     0.45
3.633    1.61    1.25      0.037   |  OI   |       |       |       |     0.46
3.650    1.65    1.27      0.038   |  OI   |       |       |       |     0.46
3.667    1.68    1.30      0.039   |  OI   |       |       |       |     0.47
3.683    1.71    1.33      0.039   |  OI   |       |       |       |     0.48
3.700    1.74    1.35      0.040   |  OI   |       |       |       |     0.48
3.717    1.77    1.38      0.040   |  OI   |       |       |       |     0.49
3.733    1.80    1.41      0.041   |  OI   |       |       |       |     0.50
3.750    1.92    1.44      0.041   |  O I  |       |       |       |     0.50
3.767    2.04    1.47      0.042   |   OI  |       |       |       |     0.51
3.783    2.16    1.52      0.043   |   OI  |       |       |       |     0.52
3.800    2.29    1.56      0.044   |   O I |       |       |       |     0.53
3.817    2.41    1.61      0.045   |   O I |       |       |       |     0.54
3.833    2.53    1.67      0.046   |   O I |       |       |       |     0.56
3.850    2.65    1.73      0.047   |   O  I|       |       |       |     0.57
3.867    2.80    1.80      0.048   |   O  I|       |       |       |     0.58
3.883    2.96    1.87      0.050   |    O  I       |       |       |     0.60
3.900    3.11    1.96      0.051   |    O  I       |       |       |     0.62
3.917    3.27    2.06      0.053   |    O  I       |       |       |     0.64
3.933    3.42    2.16      0.055   |    O  |I      |       |       |     0.66
3.950    3.58    2.27      0.057   |     O |I      |       |       |     0.68
3.967    3.73    2.38      0.058   |     O | I     |       |       |     0.70
3.983    4.88    2.55      0.061   |     O |    I  |       |       |     0.74
4.000    6.02    2.80      0.065   |      O|       I       |       |     0.78
4.017    7.17    3.14      0.070   |       O       |  I    |       |     0.85
4.033    8.32    3.56      0.076   |       |O      |     I |       |     0.92
4.050    9.47    4.02      0.083   |       | O     |       |I      |     1.00
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4.067   10.61    4.62      0.091  |       |   O   |       |   I   |     1.10
4.083   11.76    5.32      0.099  |       |     O |       |       I     1.20
4.100   10.38    5.95      0.107  |       |       O       |   I   |     1.30
4.117    9.01    6.33      0.112  |       |       |O      I       |     1.35
4.133    7.63    6.54      0.114  |       |       |O  I   |       |     1.38
4.150    6.25    6.58      0.115  |       |       |O      |       |     1.39
4.167    4.88    6.47      0.113  |       |    I  |O      |       |     1.37
4.183    3.50    6.24      0.110  |       |I      O       |       |     1.34
4.200    2.12    5.89      0.106  |    I  |       O       |       |     1.29
4.217    2.02    5.47      0.101  |    I  |     O |       |       |     1.22
4.233    1.92    5.09      0.096  |    I  |    O  |       |       |     1.17
4.250    1.82    4.75      0.092  |   I   |   O   |       |       |     1.12
4.267    1.72    4.44      0.088  |   I   |   O   |       |       |     1.07
4.283    1.62    4.16      0.085  |   I   |  O    |       |       |     1.02
4.300    1.52    3.92      0.081  |   I   | O     |       |       |     0.98
4.317    1.42    3.71      0.078  |  I    | O     |       |       |     0.95
4.333    1.38    3.51      0.075  |  I    |O      |       |       |     0.91
4.350    1.33    3.32      0.072  |  I    |O      |       |       |     0.88
4.367    1.29    3.13      0.070  |  I    O       |       |       |     0.84
4.383    1.24    2.96      0.067  |  I    O       |       |       |     0.81
4.400    1.20    2.81      0.065  |  I   O|       |       |       |     0.79
4.417    1.16    2.67      0.063  |  I   O|       |       |       |     0.76
4.433    1.11    2.53      0.061  |  I  O |       |       |       |     0.73
4.450    1.09    2.41      0.059  | I   O |       |       |       |     0.71
4.467    1.06    2.30      0.057  | I   O |       |       |       |     0.69
4.483    1.03    2.20      0.055  | I  O  |       |       |       |     0.67
4.500    1.01    2.10      0.054  | I  O  |       |       |       |     0.65
4.517    0.98    2.01      0.052  | I  O  |       |       |       |     0.63
4.533    0.96    1.93      0.051  | I  O  |       |       |       |     0.61
4.550    0.93    1.86      0.050  | I  O  |       |       |       |     0.60
4.567    0.91    1.79      0.048  | I O   |       |       |       |     0.58
4.583    0.90    1.73      0.047  | I O   |       |       |       |     0.57
4.600    0.88    1.68      0.046  | I O   |       |       |       |     0.56
4.617    0.86    1.62      0.045  | I O   |       |       |       |     0.54
4.633    0.84    1.57      0.044  | I O   |       |       |       |     0.53
4.650    0.83    1.52      0.043  | I O   |       |       |       |     0.52
4.667    0.81    1.48      0.042  | I O   |       |       |       |     0.51
4.683    0.80    1.43      0.041  | IO    |       |       |       |     0.50
4.700    0.79    1.39      0.040  | IO    |       |       |       |     0.49
4.717    0.77    1.35      0.039  | IO    |       |       |       |     0.48
4.733    0.76    1.31      0.039  | IO    |       |       |       |     0.47
4.750    0.75    1.27      0.038  | IO    |       |       |       |     0.46
4.767    0.74    1.24      0.037  | IO    |       |       |       |     0.45
4.783    0.72    1.20      0.037  |I O    |       |       |       |     0.45
4.800    0.71    1.17      0.036  |I O    |       |       |       |     0.44
4.817    0.70    1.14      0.035  |I O    |       |       |       |     0.43
4.833    0.69    1.11      0.035  |I O    |       |       |       |     0.42
4.850    0.68    1.08      0.034  |IO     |       |       |       |     0.42
4.867    0.68    1.05      0.034  |IO     |       |       |       |     0.41
4.883    0.67    1.03      0.033  |IO     |       |       |       |     0.40
4.900    0.66    1.01      0.033  |IO     |       |       |       |     0.40
4.917    0.65    0.98      0.032  |IO     |       |       |       |     0.39
4.933    0.64    0.96      0.032  |IO     |       |       |       |     0.38
```


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 4.950     0.63     0.94       0.031  |IO       |        |        |        |       0.38
 4.967     0.63     0.93       0.031  |IO       |        |        |        |       0.37
 4.983     0.62     0.91       0.030  |IO       |        |        |        |       0.37
 5.000     0.61     0.89       0.030  |IO       |        |        |        |       0.36
 5.017     0.60     0.87       0.030  |IO       |        |        |        |       0.36
 5.033     0.60     0.86       0.029  |IO       |        |        |        |       0.35
 5.050     0.59     0.84       0.029  |IO       |        |        |        |       0.35
 5.067     0.58     0.83       0.029  |IO       |        |        |        |       0.35
 5.083     0.58     0.81       0.028  |IO       |        |        |        |       0.34
 5.100     0.57     0.80       0.028  |IO       |        |        |        |       0.34
 5.117     0.57     0.78       0.028  |IO       |        |        |        |       0.33
 5.133     0.56     0.77       0.027  |IO       |        |        |        |       0.33
 5.150     0.55     0.76       0.027  |IO       |        |        |        |       0.33
 5.167     0.55     0.75       0.027  |IO       |        |        |        |       0.32
 5.183     0.54     0.73       0.027  |O        |        |        |        |       0.32
 5.200     0.54     0.72       0.026  |O        |        |        |        |       0.32
 5.217     0.53     0.71       0.026  |O        |        |        |        |       0.31
 5.233     0.53     0.70       0.026  |O        |        |        |        |       0.31
 5.250     0.52     0.69       0.026  |O        |        |        |        |       0.31
 5.267     0.52     0.68       0.025  |O        |        |        |        |       0.30
 5.283     0.51     0.67       0.025  |O        |        |        |        |       0.30
 5.300     0.51     0.66       0.025  |O        |        |        |        |       0.30
 5.317     0.51     0.65       0.025  |O        |        |        |        |       0.30
 5.333     0.50     0.65       0.025  |O        |        |        |        |       0.29
 5.350     0.50     0.64       0.024  |O        |        |        |        |       0.29
 5.367     0.49     0.63       0.024  |O        |        |        |        |       0.29
 5.383     0.49     0.62       0.024  |O        |        |        |        |       0.29
 5.400     0.49     0.62       0.024  |O        |        |        |        |       0.29
 5.417     0.48     0.61       0.024  |O        |        |        |        |       0.28
 5.433     0.48     0.60       0.023  |O        |        |        |        |       0.28
 5.450     0.47     0.60       0.023  |O        |        |        |        |       0.28
 5.467     0.47     0.59       0.023  |O        |        |        |        |       0.28
 5.483     0.47     0.58       0.023  |O        |        |        |        |       0.27
 5.500     0.46     0.58       0.023  |O        |        |        |        |       0.27
 5.517     0.46     0.57       0.023  |O        |        |        |        |       0.27
 5.533     0.46     0.57       0.022  |O        |        |        |        |       0.27
 5.550     0.45     0.56       0.022  |O        |        |        |        |       0.27
 5.567     0.45     0.56       0.022  |O        |        |        |        |       0.26
 5.583     0.45     0.55       0.022  |O        |        |        |        |       0.26
 5.600     0.44     0.54       0.022  |O        |        |        |        |       0.26
 5.617     0.44     0.54       0.022  |O        |        |        |        |       0.26
 5.633     0.44     0.53       0.022  |O        |        |        |        |       0.26
 5.650     0.43     0.53       0.021  |O        |        |        |        |       0.26
 5.667     0.43     0.52       0.021  |O        |        |        |        |       0.25
 5.683     0.43     0.52       0.021  |O        |        |        |        |       0.25
 5.700     0.43     0.51       0.021  |O        |        |        |        |       0.25
 5.717     0.42     0.51       0.021  |O        |        |        |        |       0.25
 5.733     0.42     0.51       0.021  |O        |        |        |        |       0.25
 5.750     0.42     0.50       0.021  |O        |        |        |        |       0.25
 5.767     0.41     0.50       0.021  |O        |        |        |        |       0.25
 5.783     0.41     0.49       0.021  |O        |        |        |        |       0.24
 5.800     0.41     0.49       0.020  |O        |        |        |        |       0.24
 5.817     0.41     0.48       0.020  |O        |        |        |        |       0.24
```


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```
  5.833    0.40    0.48      0.020  |O         |         |         |         |      0.24
  5.850    0.40    0.48      0.020  |O         |         |         |         |      0.24
  5.867    0.40    0.47      0.020  |O         |         |         |         |      0.24
  5.883    0.40    0.47      0.020  |O         |         |         |         |      0.24
  5.900    0.40    0.47      0.020  |O         |         |         |         |      0.23
  5.917    0.39    0.46      0.020  |O         |         |         |         |      0.23
  5.933    0.39    0.46      0.020  |O         |         |         |         |      0.23
  5.950    0.39    0.45      0.020  |O         |         |         |         |      0.23
  5.967    0.39    0.45      0.019  |O         |         |         |         |      0.23
  5.983    0.38    0.45      0.019  |O         |         |         |         |      0.23
  6.000    0.38    0.44      0.019  |O         |         |         |         |      0.23
  6.017    0.38    0.44      0.019  |O         |         |         |         |      0.23
  6.033    0.38    0.44      0.019  |O         |         |         |         |      0.23
  6.050    0.38    0.44      0.019  |O         |         |         |         |      0.22
  6.067    0.37    0.43      0.019  |O         |         |         |         |      0.22
  6.083    0.00    0.42      0.019  IO         |         |         |         |      0.22
  6.100    0.00    0.40      0.018  IO         |         |         |         |      0.21
  6.117    0.00    0.38      0.017  IO         |         |         |         |      0.21
  6.133    0.00    0.36      0.017  O          |         |         |         |      0.20
  6.150    0.00    0.35      0.016  O          |         |         |         |      0.19
  6.167    0.00    0.33      0.016  O          |         |         |         |      0.19
  6.183    0.00    0.32      0.016  O          |         |         |         |      0.18
  6.200    0.00    0.31      0.015  O          |         |         |         |      0.18
  6.217    0.00    0.30      0.015  O          |         |         |         |      0.17
  6.233    0.00    0.29      0.014  O          |         |         |         |      0.17
  6.250    0.00    0.28      0.014  O          |         |         |         |      0.17
  6.267    0.00    0.27      0.014  O          |         |         |         |      0.16
  6.283    0.00    0.26      0.013  O          |         |         |         |      0.16
  6.300    0.00    0.25      0.013  O          |         |         |         |      0.15
  6.317    0.00    0.24      0.012  O          |         |         |         |      0.15
  6.333    0.00    0.23      0.012  O          |         |         |         |      0.15
  6.350    0.00    0.23      0.012  O          |         |         |         |      0.14
  6.367    0.00    0.22      0.012  O          |         |         |         |      0.14
  6.383    0.00    0.21      0.011  O          |         |         |         |      0.14
  6.400    0.00    0.20      0.011  O          |         |         |         |      0.13
  6.417    0.00    0.20      0.011  O          |         |         |         |      0.13
  6.433    0.00    0.19      0.010  O          |         |         |         |      0.13
  6.450    0.00    0.18      0.010  O          |         |         |         |      0.12
  6.467    0.00    0.18      0.010  O          |         |         |         |      0.12
  6.483    0.00    0.17      0.010  O          |         |         |         |      0.12
  6.500    0.00    0.16      0.009  O          |         |         |         |      0.12
  6.517    0.00    0.16      0.009  O          |         |         |         |      0.11
  6.533    0.00    0.15      0.009  O          |         |         |         |      0.11
  6.550    0.00    0.15      0.009  O          |         |         |         |      0.11
  6.567    0.00    0.14      0.009  O          |         |         |         |      0.11
  6.583    0.00    0.14      0.008  O          |         |         |         |      0.10
  6.600    0.00    0.13      0.008  O          |         |         |         |      0.10
  6.617    0.00    0.13      0.008  O          |         |         |         |      0.10
  6.633    0.00    0.12      0.008  O          |         |         |         |      0.10
  6.650    0.00    0.12      0.008  O          |         |         |         |      0.10
  6.667    0.00    0.12      0.008  O          |         |         |         |      0.09
  6.683    0.00    0.12      0.007  O          |         |         |         |      0.09
  6.700    0.00    0.11      0.007  O          |         |         |         |      0.09
```

6.717	0.00	0.11	0.007	O	|	|	|	|	0.09
6.733	0.00	0.11	0.007	O	|	|	|	|	0.09
6.750	0.00	0.11	0.007	O	|	|	|	|	0.08
6.767	0.00	0.10	0.007	O	|	|	|	|	0.08
6.783	0.00	0.10	0.006	O	|	|	|	|	0.08
6.800	0.00	0.10	0.006	O	|	|	|	|	0.08
6.817	0.00	0.10	0.006	O	|	|	|	|	0.08
6.833	0.00	0.10	0.006	O	|	|	|	|	0.08
6.850	0.00	0.09	0.006	O	|	|	|	|	0.07
6.867	0.00	0.09	0.006	O	|	|	|	|	0.07
6.883	0.00	0.09	0.006	O	|	|	|	|	0.07
6.900	0.00	0.09	0.006	O	|	|	|	|	0.07
6.917	0.00	0.09	0.005	O	|	|	|	|	0.07
6.933	0.00	0.08	0.005	O	|	|	|	|	0.07
6.950	0.00	0.08	0.005	O	|	|	|	|	0.06
6.967	0.00	0.08	0.005	O	|	|	|	|	0.06
6.983	0.00	0.08	0.005	O	|	|	|	|	0.06
7.000	0.00	0.08	0.005	O	|	|	|	|	0.06
7.017	0.00	0.08	0.005	O	|	|	|	|	0.06
7.033	0.00	0.07	0.005	O	|	|	|	|	0.06
7.050	0.00	0.07	0.005	O	|	|	|	|	0.06
7.067	0.00	0.07	0.004	O	|	|	|	|	0.06
7.083	0.00	0.07	0.004	O	|	|	|	|	0.05
7.100	0.00	0.07	0.004	O	|	|	|	|	0.05
7.117	0.00	0.07	0.004	O	|	|	|	|	0.05
7.133	0.00	0.06	0.004	O	|	|	|	|	0.05
7.150	0.00	0.06	0.004	O	|	|	|	|	0.05
7.167	0.00	0.06	0.004	O	|	|	|	|	0.05
7.183	0.00	0.06	0.004	O	|	|	|	|	0.05
7.200	0.00	0.06	0.004	O	|	|	|	|	0.05
7.217	0.00	0.06	0.004	O	|	|	|	|	0.05
7.233	0.00	0.06	0.004	O	|	|	|	|	0.04
7.250	0.00	0.06	0.003	O	|	|	|	|	0.04
7.267	0.00	0.05	0.003	O	|	|	|	|	0.04
7.283	0.00	0.05	0.003	O	|	|	|	|	0.04
7.300	0.00	0.05	0.003	O	|	|	|	|	0.04
7.317	0.00	0.05	0.003	O	|	|	|	|	0.04
7.333	0.00	0.05	0.003	O	|	|	|	|	0.04
7.350	0.00	0.05	0.003	O	|	|	|	|	0.04
7.367	0.00	0.05	0.003	O	|	|	|	|	0.04
7.383	0.00	0.05	0.003	O	|	|	|	|	0.04
7.400	0.00	0.05	0.003	O	|	|	|	|	0.04
7.417	0.00	0.04	0.003	O	|	|	|	|	0.04
7.433	0.00	0.04	0.003	O	|	|	|	|	0.03
7.450	0.00	0.04	0.003	O	|	|	|	|	0.03
7.467	0.00	0.04	0.003	O	|	|	|	|	0.03
7.483	0.00	0.04	0.003	O	|	|	|	|	0.03
7.500	0.00	0.04	0.003	O	|	|	|	|	0.03
7.517	0.00	0.04	0.002	O	|	|	|	|	0.03
7.533	0.00	0.04	0.002	O	|	|	|	|	0.03
7.550	0.00	0.04	0.002	O	|	|	|	|	0.03
9.333	0.00	0.00	0.000	O	|	|	|	|	0.00
9.350	0.00	0.00	0.000	O	|	|	|	|	0.00

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9.367	0.00	0.00	0.000	O	|	|	|	|	0.00
9.383	0.00	0.00	0.000	O	|	|	|	|	0.00
9.400	0.00	0.00	0.000	O	|	|	|	|	0.00
9.417	0.00	0.00	0.000	O	|	|	|	|	0.00
9.433	0.00	0.00	0.000	O	|	|	|	|	0.00
9.450	0.00	0.00	0.000	O	|	|	|	|	0.00
9.467	0.00	0.00	0.000	O	|	|	|	|	0.00
9.483	0.00	0.00	0.000	O	|	|	|	|	0.00
9.500	0.00	0.00	0.000	O	|	|	|	|	0.00
9.517	0.00	0.00	0.000	O	|	|	|	|	0.00
9.533	0.00	0.00	0.000	O	|	|	|	|	0.00
9.550	0.00	0.00	0.000	O	|	|	|	|	0.00
9.567	0.00	0.00	0.000	O	|	|	|	|	0.00
9.583	0.00	0.00	0.000	O	|	|	|	|	0.00
9.600	0.00	0.00	0.000	O	|	|	|	|	0.00
9.617	0.00	0.00	0.000	O	|	|	|	|	0.00
9.633	0.00	0.00	0.000	O	|	|	|	|	0.00
9.650	0.00	0.00	0.000	O	|	|	|	|	0.00
9.667	0.00	0.00	0.000	O	|	|	|	|	0.00
9.683	0.00	0.00	0.000	O	|	|	|	|	0.00
9.700	0.00	0.00	0.000	O	|	|	|	|	0.00
9.717	0.00	0.00	0.000	O	|	|	|	|	0.00
9.733	0.00	0.00	0.000	O	|	|	|	|	0.00
9.750	0.00	0.00	0.000	O	|	|	|	|	0.00
9.767	0.00	0.00	0.000	O	|	|	|	|	0.00
9.783	0.00	0.00	0.000	O	|	|	|	|	0.00
9.800	0.00	0.00	0.000	O	|	|	|	|	0.00
9.817	0.00	0.00	0.000	O	|	|	|	|	0.00
9.833	0.00	0.00	0.000	O	|	|	|	|	0.00
9.850	0.00	0.00	0.000	O	|	|	|	|	0.00
9.867	0.00	0.00	0.000	O	|	|	|	|	0.00
9.883	0.00	0.00	0.000	O	|	|	|	|	0.00
9.900	0.00	0.00	0.000	O	|	|	|	|	0.00
9.917	0.00	0.00	0.000	O	|	|	|	|	0.00
9.933	0.00	0.00	0.000	O	|	|	|	|	0.00
9.950	0.00	0.00	0.000	O	|	|	|	|	0.00
9.967	0.00	0.00	0.000	O	|	|	|	|	0.00
9.983	0.00	0.00	0.000	O	|	|	|	|	0.00
10.000	0.00	0.00	0.000	O	|	|	|	|	0.00
10.017	0.00	0.00	0.000	O	|	|	|	|	0.00
10.033	0.00	0.00	0.000	O	|	|	|	|	0.00
10.050	0.00	0.00	0.000	O	|	|	|	|	0.00
10.067	0.00	0.00	0.000	O	|	|	|	|	0.00
10.083	0.00	0.00	0.000	O	|	|	|	|	0.00
10.100	0.00	0.00	0.000	O	|	|	|	|	0.00
10.117	0.00	0.00	0.000	O	|	|	|	|	0.00
10.133	0.00	0.00	0.000	O	|	|	|	|	0.00

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	BMPs 1 & 2					
	Elevation		Elev. Difference	Area (sf)	Acre-feet	
1	0.00		0.00	3600	0.0000	Invert of weir
2	0.10		0.10	3600	0.0083	
3	0.20		0.10	3600	0.0165	
4	0.30		0.10	3600	0.0248	
5	0.40		0.10	3600	0.0331	
6	0.50		0.10	3600	0.0413	
7	0.60		0.10	3600	0.0496	
8	0.70		0.10	3600	0.0579	
9	0.80		0.10	3600	0.0661	
10	0.90		0.10	3600	0.0744	
11	1.00		0.10	3600	0.0826	
12	1.10		0.10	3600	0.0909	
13	1.20		0.10	3600	0.0992	
14	1.30		0.10	3600	0.1074	
15	1.40		0.10	3600	0.1157	
16	1.50		0.10	3600	0.1240	

Outlet structure for Discharge of Detention Basin BMPs 1 & 2

Discharge vs Elevation Table

Emergency Weir			
Invert:	0.500	ft	
B:	1.3	ft	Weir Perimeter Length(combined)

h (ft)	H/D-low -	H/D-mid -	Qemer (cfs)	
0.000	0.000	0.000	0.000	Bottom of Basin
0.100	1.200	0.000	0.000	
0.200	2.400	0.000	0.000	
0.300	3.600	0.600	0.000	
0.400	4.800	1.800	0.000	
0.500	6.000	3.000	0.000	Emergency Weir
0.600	7.200	4.200	0.127	
0.700	8.400	5.400	0.360	
0.800	9.600	6.600	0.662	
0.900	10.800	7.800	1.020	
1.000	12.000	9.000	1.425	
1.100	13.200	10.200	1.873	
1.200	14.400	11.400	2.360	
1.300	15.600	12.600	2.884	
1.400	16.800	13.800	3.441	
1.500	18.000	15.000	4.030	
1.600	19.200	16.200	4.649	
1.700	20.400	17.400	5.298	
1.800	21.600	18.600	5.973	
1.900	22.800	19.800	6.676	
2.000	24.000	21.000	7.404	
2.100	25.200	22.200	8.156	
2.200	26.400	23.400	8.933	
2.300	27.600	24.600	9.732	
2.400	28.800	25.800	10.554	
2.500	30.000	27.000	11.399	Free Board

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APPENDIX 3
Soil Map, City Maps and Charts

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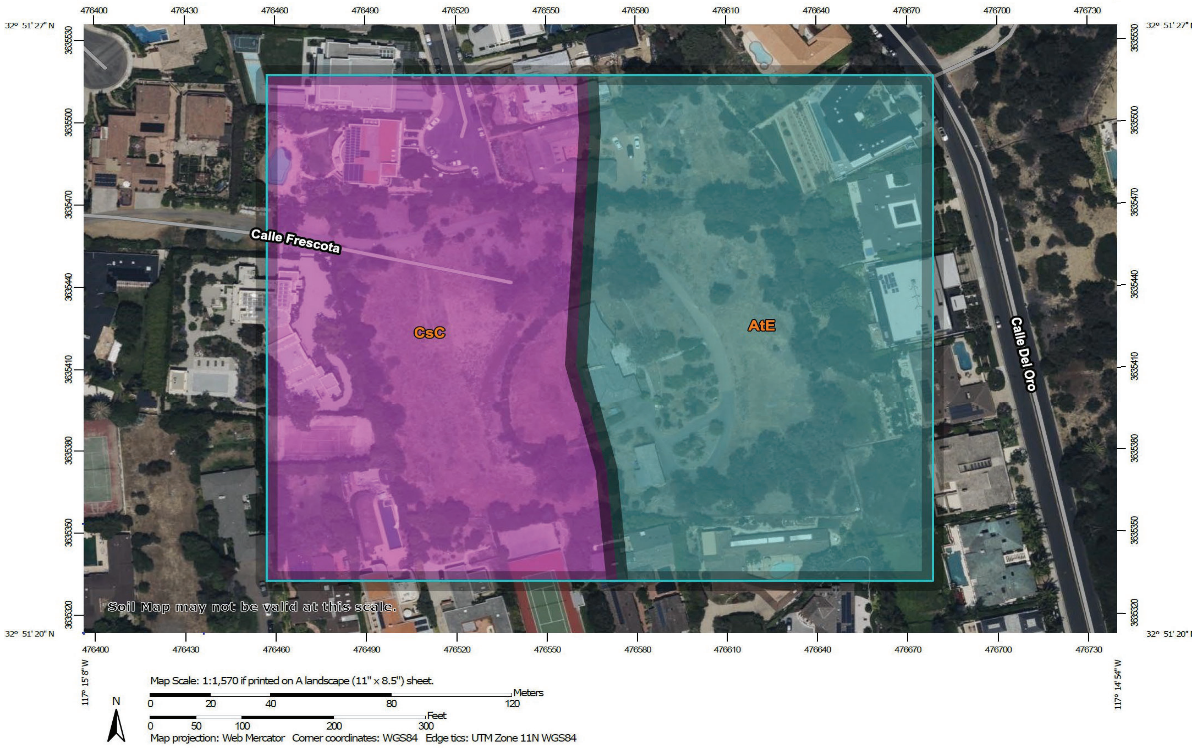
Hydrologic Soil Group—San Diego County Area, California
(CALLE DEL CIELO)



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Hydrologic Soil Group—San Diego County Area, California
(CALLE DEL CIELO)

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
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: San Diego County Area, California
Survey Area Data: Version 18, Sep 14, 2022

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

Date(s) aerial images were photographed: Mar 24, 2022—Apr 29, 2022

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.

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Appendix A

Rational Method and Modified Rational Method

A.1. Rational Method (RM)

The Rational Method (RM) is a mathematical formula used to determine the maximum runoff rate from a given rainfall. It has particular application in urban storm drainage where it is used to estimate peak runoff rates from small urban and rural watersheds for the design of storm drains and drainage structures. The RM is recommended for analyzing the runoff response from drainage areas for watersheds less than 0.5 square miles. It should not be used in instances where there is a junction of independent drainage systems or for drainage areas greater than approximately 0.5 square mile in size. In these instances, the Modified Rational Method (MRM) should be used for junctions of independent drainage systems in watersheds up to approximately 1 square mile in size (see Section A.2); or the NRCS Hydrologic Method should be used for watersheds greater than approximately 1 square mile in size (see Appendix B).

A.1.1. Rational Method Formula

The RM formula estimates the peak rate of runoff at any location in a watershed as a function of the drainage area (A), runoff coefficient (C), and rainfall intensity (I) for a duration equal to the time of concentration (T_c), which is the time required for water to flow from the most remote point of the basin to the location being analyzed. The RM formula is expressed in Equation A-1.

Equation A-1. RM Formula Expression

$$Q = C\ I\ A$$

where:

Q	=	peak discharge, in cubic feet per second (cfs)
C	=	runoff coefficient expressed as that percentage of rainfall which becomes surface runoff (no units); Refer to Appendix A.1.2
I	=	average rainfall intensity for a storm duration equal to the time of concetrnatation (T_c) of the contributing draiange area, in inches per hour; Refer to Appendix A.1.3 and Appendix A.1.4
A	=	drainage area contributing to the design location, in acres

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Combining the units for the expression CIA yields:

$$\left(\frac{1\,\text{acre} \times \text{inch}}{\text{hour}}\right)\left(\frac{43{,}560\,\text{ft}^2}{\text{acre}}\right)\left(\frac{1\,\text{foot}}{12\,\text{inches}}\right)\left(\frac{1\,\text{hour}}{3{,}600\,\text{seconds}}\right) \Rightarrow 1.008\,\text{cfs}$$

For practical purposes, the unit conversion coefficient difference of 0.8% can be ignored.

The RM formula is based on the assumption that for constant rainfall intensity, the peak discharge rate at a point will occur when the raindrop that falls at the most upstream point in the tributary drainage basin arrives at the point of interest.

Unlike the MRM (discussed in Appendix A.2) or the NRCS hydrologic method (discussed in Appendix B), the RM does not create hydrographs and therefore does not add separate subarea hydrographs at collection points. Instead, the RM develops peak discharges in the main line by increasing the T_c as flow travels downstream.

Characteristics of, or assumptions inherent to, the RM are listed below:

1. The discharge resulting from any I is maximum when the I lasts as long as or longer than the T_c.
2. The storm frequency of peak discharges is the same as that of I for the given T_c.
3. The fraction of rainfall that becomes runoff (or the runoff coefficient, C) is independent of I or precipitation zone number (PZN) condition (PZN Condition is discussed in the NRCS method).
4. The peak rate of runoff is the only information produced by using the RM.

A.1.2. Runoff Coefficient

The runoff coefficients are based on land use (see Table A-1). Soil type "D" is used throughout the City of San Diego for storm drain conveyance design. An appropriate runoff coefficient (C) for each type of land use in the subarea should be selected from this table and multiplied by the percentage of the total area (A) included in that class. The sum of the products for all land uses is the weighted runoff coefficient (Σ[CA]). Good engineering judgment should be used when applying the values presented in Table A-1, as adjustments to these values may be appropriate based on site-specific characteristics.

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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

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).

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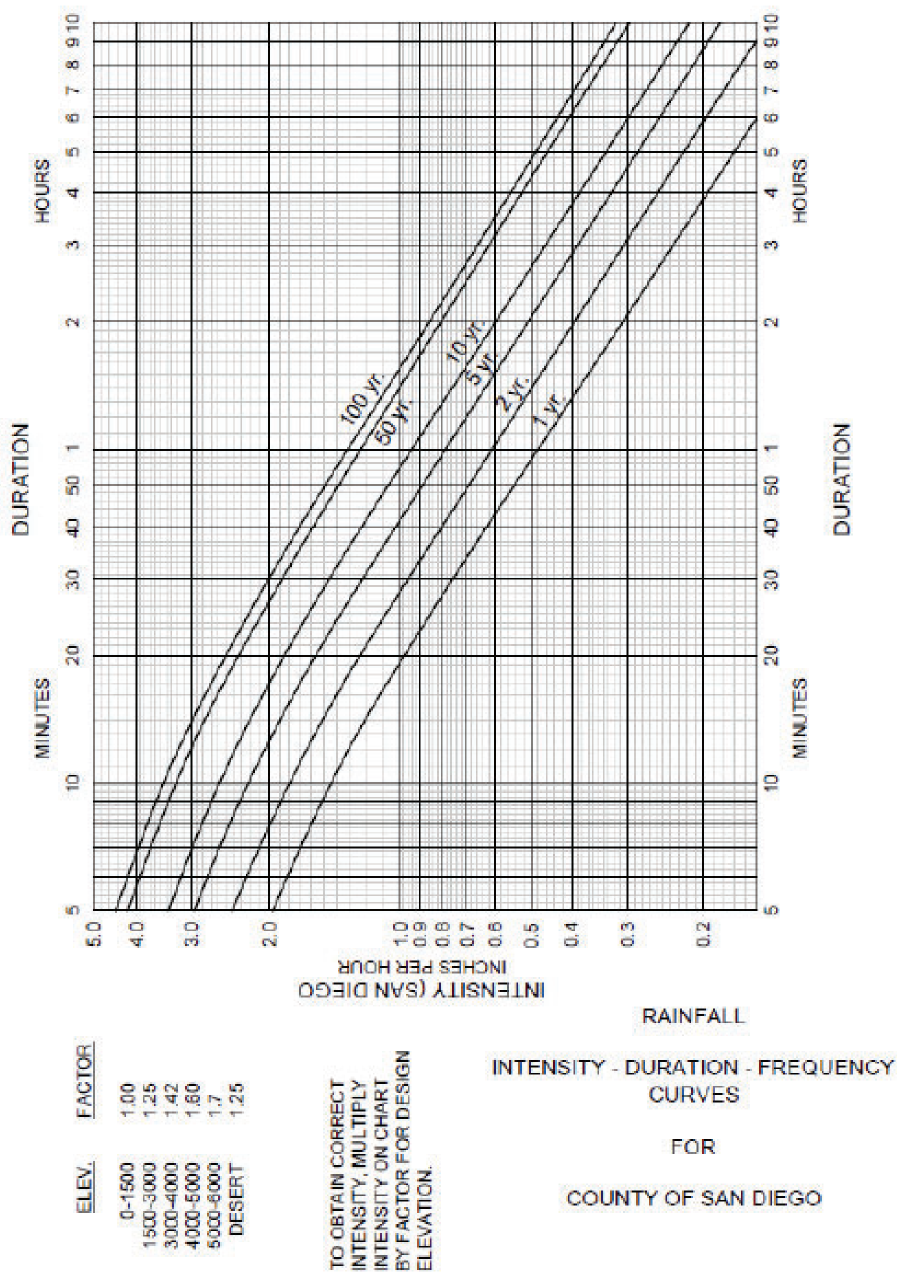

Figure A-1. Intensity-Duration-Frequency Design Chart

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A.1.4. Time of Concentration

The Time of Concentration (T_c) is the time required for runoff to flow from the most remote part of the watershed to the outlet point under consideration.

Methods of calculation differ for natural watersheds (non-urbanized) and for urban drainage systems. Also, when designing storm drain systems, the designer must consider the possibility that an existing natural watershed may become urbanized during the useful life of the storm drain system. Future land uses must be used for Tc and runoff calculations, and can be determined from the Community Plans.

a. Natural watersheds: Obtain Tc from Figures A.2 and A.3

b. Urban drainage systems: In the case of urban drainage systems, the time of concentration at any point within the drainage area is given by:

   $T_c = T_i + T_t$ where

   T_i is the inlet time or the time required for the storm water to flow to the first inlet in the system. It is the sum of time in overland flow across lots and in the street gutter.

   T_t is the travel time or the time required for the storm water to flow in the storm drain from the most upstream inlet to the point in question.

   Travel Time, T_t is computed by dividing the length of storm drain by the computed flow velocity. Since the velocity normally changes at each inlet because of changes in flow rate or slope, total travel time must be computed as the sum of the travel times for each section of the storm drain.

   The overland flow component of inlet time, T_i, may be estimated by the use of the chart shown in Figure A-4. Use Figure A-5 to estimate time of travel for street gutter flow.

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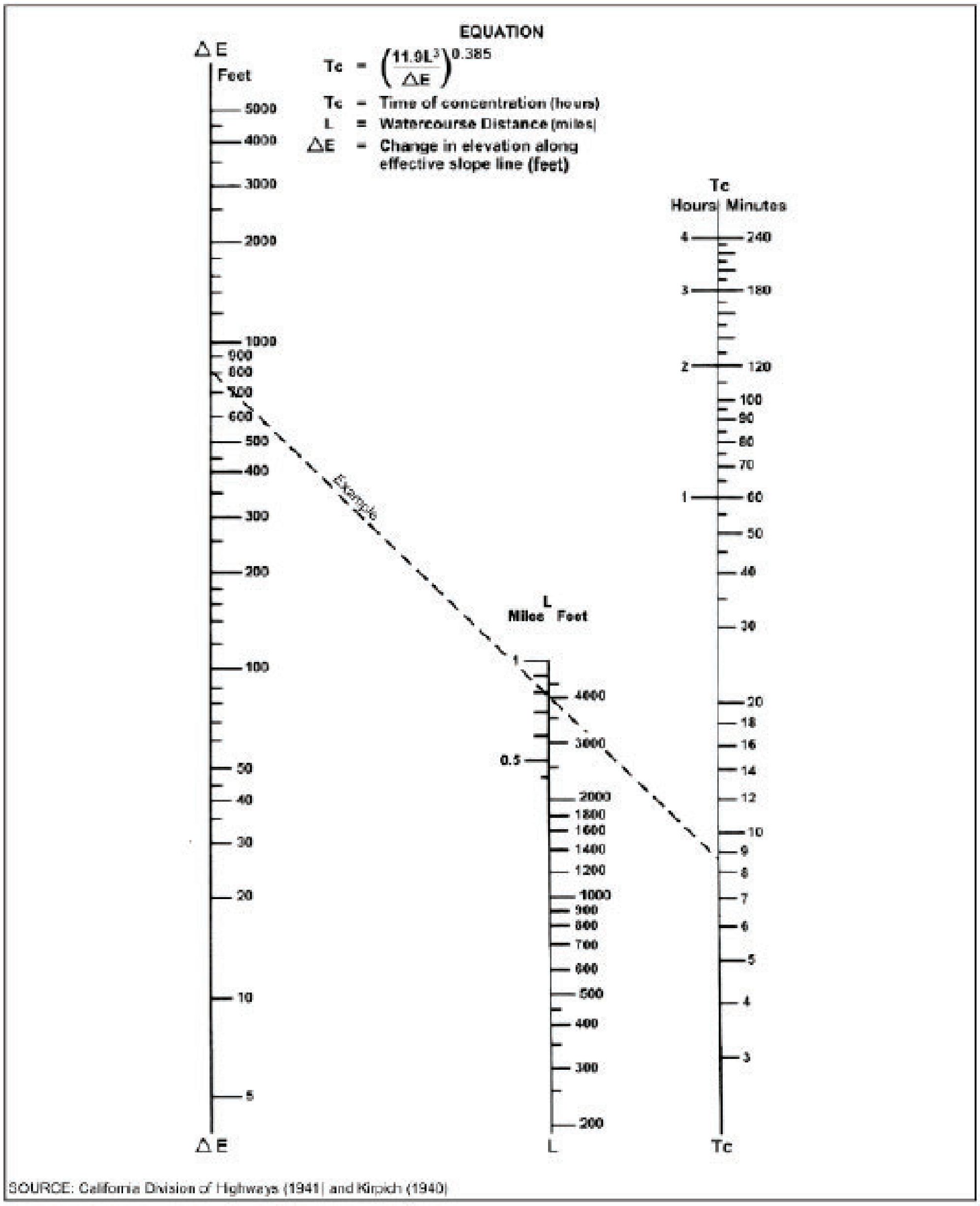

Figure A-2. Nomograph for Determination of T_c for Natural Watersheds

__Note__: Add ten minutes to the computed time of concentration from Figure A-2.

z

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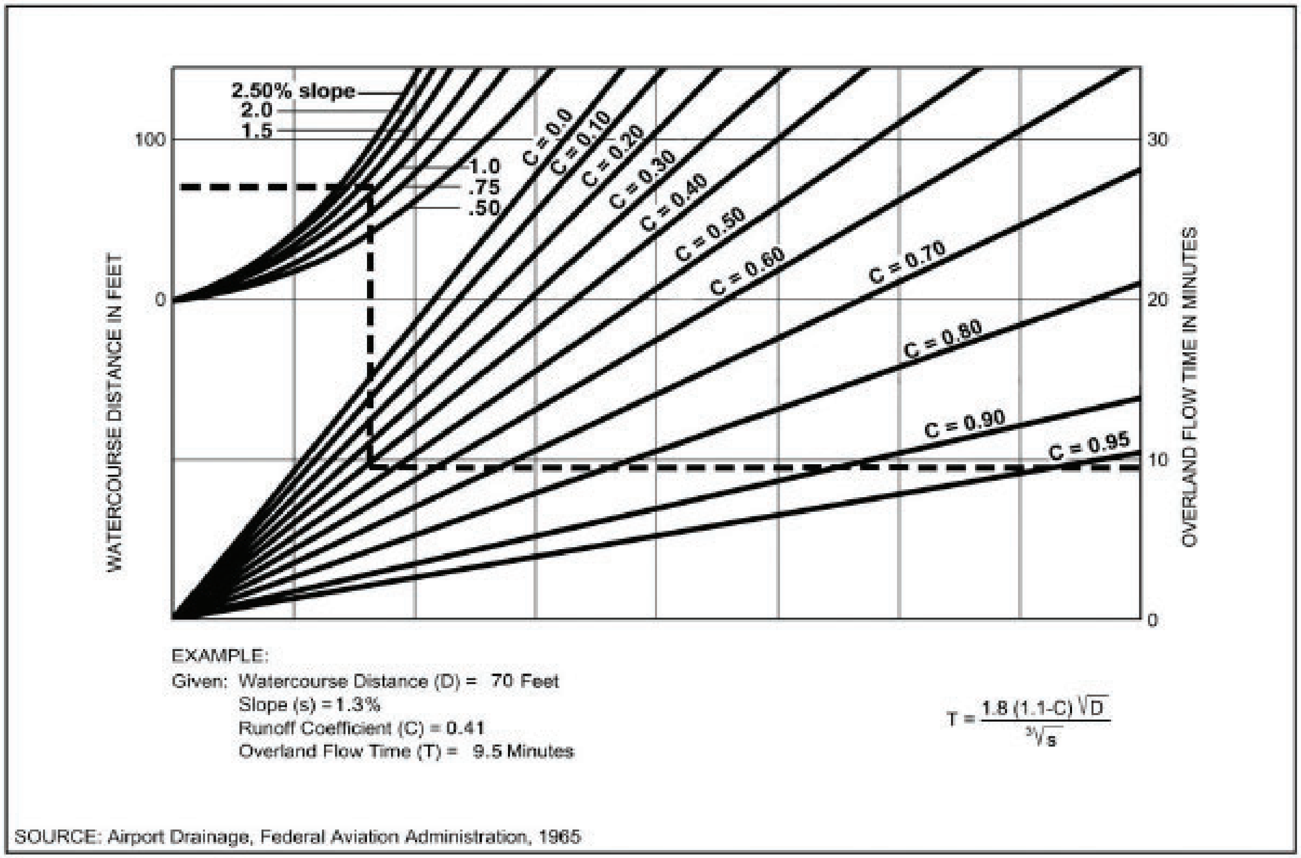

Figure A-4. Rational Formula – Overland Time of Flow Nomograph

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

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APPENDIX 4
Hydraulics – Sizing of offsite facilities along Calle Frescota

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Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Aug 12 2024

12 WIDE CONCRETE DRIVEWAY - V TYPE CHANNEL

Triangular		**Highlighted**	
Side Slopes (z:1)	= 12.00, 12.00	Depth (ft)	= 0.38
Total Depth (ft)	= 0.50	Q (cfs)	= 6.580
		Area (sqft)	= 1.73
Invert Elev (ft)	= 0.01	Velocity (ft/s)	= 3.80
Slope (%)	= 1.50	Wetted Perim (ft)	= 9.15
N-Value	= 0.015	Crit Depth, Yc (ft)	= 0.46
		Top Width (ft)	= 9.12
Calculations		EGL (ft)	= 0.60
Compute by:	Known Q		
Known Q (cfs)	= 6.58