LOS COCHES TPM
HYDROLOGY AND DRAINAGE STUDY FOR PRELIMINARY GRADING PLAN

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Date:
March 30, 2007

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REFERENCES

- County of San Diego Hydrology Manual, June 2003
- City of San Diego Drainage Design Manual, 1989 Edition

LOS COCHES TPM
HYDROLOGY AND DRAINAGE STUDY

INTRODUCTION

The Los Coches Subdivision Project proposes that a portion of the vacant lot 138 of Map No. 289 be subdivided into 3-residential lots and subsequently developed with a detached single-family dwelling on each. The owners, Angel P. and Marilou S. Antonio, are proposing that the 0.82 net-acre Assessor Parcel No. (APN) 397-060-81 be subdivided as described above. The proposed parcels are 0.33 acres, 0.39 acres and 0.68 acres, respectively. The Los Coches property is located on the northwest corner of the intersection of Los Coches Road and Ha Hana Road in a community known as Los Coches, an unincorporated area of East San Diego County. See the attached Exhibit A at the end of this report for a vicinity map.

The purpose of this Study is to quantify existing storm water runoff developed both within the project site and significant runoff developed off-site. Further, how runoff is conveyed, what impacts may exist and to where the storm water discharges will be examined and identified. In addition, the Study shall introduce a proposed ultimate site hydrology, including anticipated storm water runoff resulting from both 10-year and 100-year rainfall events, based on the proposed project's ultimate developed condition. Presented herein are the proposed drainage facilities designed to capture and convey these storm water runoff flows, including a hydraulic analysis of these systems. Finally, impacts to existing storm drain infrastructure resulting from any increase or diversion of runoff will also be evaluated.

EXISTING CONDITIONS

The proposed project has terrain with 50 percent of its slopes ranging from zero to 15 percent, 25 percent of its slopes ranging from 15 to 25 percent, and 25 percent of its slopes ranging from 25 to 50 percent. The 0.82 net-acre site is lightly vegetated with trees and bushes. In addition, rock outcroppings are present along the ground surface throughout the site. The 0.82 net-acre parcel is currently undeveloped vacant land that was previously disturbed by sand mining operations.

Medium-density residential housing to the north and west, Los Coches Road and undeveloped land to the east and Los Coches Flood Channel to the south bind the subject property. See Exhibit 'D' Los Coches TPM - Offsite Hydrology and Drainage Map located at the back of this report. Runoff developed within the Los Coches Road right-of-way adjacent to the project site sheet flows from the roadway surface east and west to curb and gutter as the roadway is crowned along its centerline. Runoff traveling along the western edge of Los

Coches Road flows northerly past the project site in curb and gutter to Los Coches Ct. where it turns westerly (following the Los Coches Ct. alignment) for approximately 100 feet, then southerly for approximately 100 feet to a storm drain curb inlet structure. The drainage area tributary to this curb inlet includes a 1.35 acre portion of Los Coches Road and Los Coches Ct., and an additional 1.82 acres of developed land comprised of (7) seven residential lots located along the northern boundary of Los Coches Ct. Based upon 10-year and 100-year storm frequencies, the offsite drainage area described above produces 5.78 cubic feet per second (cfs) and 8.44 cfs of peak flow runoff, respectively. See Appendix 'A' Off-Site Hydrology Calculations at the back of this report. Once storm water enters the drainage structure, it is routed to the Los Coches Flood Channel through 18-inch diameter storm drain that discharges at the face of the open flood channel wall.

The existing site hydrology is defined by one (1) drainage basin that collects rainfall and conveys runoff by a combination of sheet and concentrated flows over natural surfaces contained within the 0.82-acre site. Runoff flowing within the site, in general, travels from the east to west and south to north into a large depression within the site and accumulates there. Storm water from the site, however, ultimately discharges to the Los Coches Flood Channel by migrating westerly across the existing private properties of the adjacent housing development. Therefore, no significant runoff currently enters the Los Coches Road right-of-way from the existing undeveloped site. Based upon a 100-year storm frequency, the existing site produces 1.06 cubic feet per second (cfs) of peak flow runoff. See Exhibit 'B' Los Coches TPM - Existing On Site Hydrology and Drainage Map and Appendix 'A' – Existing Hydrology Calculations at the back of this report for additional details.

SUMMARY OF EXISTING HYDRAULICS

The topography of the existing site is such that storm water runoff produced within the existing site accumulates and remains stored on site before migrating across the adjacent residential properties to the west and ultimately entering the Los Coches Flood Channel. Therefore, no impacts to existing storm drain infrastructure occurs due to on-site runoff, thus no hydraulic analysis can be conducted for existing on-site runoff. However, in order to establish the existing hydraulic performance of pertinent storm drainage facilities that will be impacted by the proposed developed site, storm water runoff produced by the above-described off-site drainage basin has been examined.

Based upon a 100-year storm frequency the peak runoff produced within Los Coches Road right-of-way that flows though curb and gutter adjacent to the project site is 3.42 cfs. This storm water is conveyed at a velocity of 4.1 feet per second (fps) and produces an 8.7 feet spread into the roadway. However, the existing peak runoff flow does not encroach into the travel lanes of the street. In addition, as stated above, the curb inlet located in Los Coches Ct. captures 8.44 cfs of peak flow and produces a 7.4 feet spread into Los Coches Ct. at the structure's 4-foot curb opening. The 18-inch diameter storm drain constructed with a 14.5% slope that conveys these flows to Los Coches Flood Channel discharges with a normal depth of 0.47 feet and a velocity of 17.9 fps. See Appendix 'B' Los Coches TPM - Existing Condition Hydraulic Calculations at the back of this report.

PROPOSED CONDITIONS

Final site grading for the proposed Los Coches project includes inclined slopes varying between (1) one and (5) five percent and building pads to accommodate construction of three single family homes. Drainage Basins A, B, C and D define the proposed site's hydrologic areas. Basin A is divided into 2 sub-areas (A1.0, A1.1) and represents the eastern portion of Lot 1 adjacent to Los Coches Road; Basin B (B1.0) represents the remainder of the 0.255 net-acre Lot 1; Basin C (C1.0) represents the eastern segment of Lot 2 adjacent to Los Coches Road; Drainage Basin D (D1.0, D1.1, D1.2, D1.3, D1.4) corresponds to the remainder of the 0.241 net-acre Lot 2 and the entire 0.318 net-acre Lot 3.

The proposed 0.255 net-acre Lot 1 is comprised of the southeastern segment of the existing site. The following three (3) sub-areas define the overall drainage area for Lot 1: A1.0, A1.1, and B1.0. A grass-lined swale and two grated catch basins have been incorporated into the site design for sub-areas A1.0 and A1.1 in order to capture runoff. Runoff entering this swale discharges into a catch basin near the eastern property line where the flows confluence with storm water traveling though 4-inch storm drain that originates within sub-area A1.0. Storm water will continue northeasterly through 4-inch pipe underneath the existing sidewalk and finally discharge to curb and gutter of Los Coches Road at Node A. See Exhibit 'C' – Los Coches TPM - Proposed On Site Hydrology and Drainage Map at the back of this report.

Runoff from Basin B1.0 will also sheet flow into a grass-lined swale. This swale will discharge runoff near the boundary of Los Coches Flood Channel at Node B, which is located at the southern corner of Lot 1. Also, a rip-rap energy dissipator will mitigate potential outlet velocities and consequent erosion potential at Node B.

The proposed 0.241 net-acre Lot 2 is comprised of the middle segment of the existing site. The following (3) three sub-areas define the overall drainage area for Lot 2: C1.0, D1.0, and D1.2.

A portion of runoff from sub-area C1.0 sheet flows into a grass-lined swale positioned along the southern boundary of that area. The swale routes storm water easterly and northerly to a combination trench drain/under drain that discharges to a second vegetated swale located along sub-area C1.0's northern boundary. The remaining amount of runoff produced within this area will discharge directly to either the trench drain or the swale along the northern boundary. See Exhibit 'C' – Los Coches TPM - Proposed On Site Hydrology and Drainage Map at the back of this report. All runoff from sub-area C1.0 will enter the Los Coches Road right-of-way at Node C located at the northern corner of Lot 2. A rip-rap energy dissipator will mitigate potential outlet velocities and consequent erosion potential at Node C.

The runoff produced from sub-areas D1.0 and D1.1 will discharge to the western corner of Lot 2. Storm water from sub-area D1.0 will discharge within a vegetated swale to the western corner of Lot 2 where it will confluence sub-area D1.1 runoff at Node D1. Runoff from sub-area D1.1 sheet flows into a grass-lined swale and discharges to the western corner of Lot 2.

Moreover, based on a 10-year and 100-year storm frequency, the storm water runoff developed by sub-areas D1.0 and D1.1 that will combine at this location (Node D1) is 0.23 cfs and 0.33 cfs, respectively. This storm water will be routed through a 6-inch PVC pipe sleeve constructed within the retaining wall proposed at the southwestern property boundary. This flow will then be diverted into a vegetative swale located within Lot 3.

The proposed 0.318 net-acre Lot 3 is comprised of the westerly segment of the existing undeveloped land and is divided into (3) three sub-areas to define the parcel's drainage basin, sub-areas D1.2, D1.3 and D1.4. Two grass-lined swales, two grated catch basins, storm drain and a sediment basin have been incorporated into the site design for sub-areas D1.2, D1.3 and D1.4.

Runoff developed within sub-area D1.3 will flow into a vegetated swale that will convey runoff easterly and northerly to a grated catch basin positioned adjacent to the Los Coches Road right-of-way near a new driveway entrance. Once these flows are captured within the catch basin they will travel through (2) two 4-inch storm drain pipes that discharge to a sediment basin described below.

Runoff from sub-area D 1.2 will sheet flow along the ground into a grass-lined swale that flows in a westerly direction along the western property line to a grated catch basin located west of a new driveway entrance. This runoff will combine with runoff from sub-areas D1.0 and D1.1, which enter the swale as described above. The combined runoff from sub-areas D1.0, D1.1, and D1.2 will then be conveyed through the swale and enter a catch basin located at downstream end of the swale. From there, runoff flows travel through (2) two 4-inch storm drain pipes to discharge over a rip-rap energy dissipator into a sediment basin located near the northwest corner of Lot 3. The purpose of routing these flows through the sediment basin prior to entering the Los Coches Road right-of-way is to ensure runoff water quality as described in the *Storm Water Management Plan for the Los Coches TPM,* dated March 20, 2007. Once flows are released from the Sediment Basin they pass over another rip-rap energy dissipater at Node H before releasing into the curb and gutter of Los Coches Road. See Exhibit 'C' Los Coches TPM – On Site Hydrology and Drainage Map located at the back of this report.

Sub-area D1.4 discharges runoff directly to the above referenced sediment basin along the ground surface.

The total peak flow of storm water runoff developed by the improved site based upon a 10-year and 100-year storm frequency is 1.69 cfs and 2.47 cfs, respectively. Corresponding runoff flows for each discharge location (Nodes A-C, D2) can be found illustrated on Exhibit 'C' Los Coches TPM - Proposed On Site Hydrology and Drainage Map located at the back of this report. Therefore, for a 100-year storm event, the developed site will increase the peak runoff flow produced by 1.41 cfs or a 57% increase in peak flow runoff. See Appendix 'A' Existing Hydrology Calculations and Appendix 'B' Proposed Hydrology Calculations located at the back of this report for specific computations.

However, since the existing site does not discharge runoff to the public storm drain system in the right-of-way, the consequences of the proposed development will be the introduction of new runoff flows to the surrounding area by diverting flows from the site as detailed in the above discussion. Therefore, the amount of runoff increase originating at the project site that will discharge to the Los Coches Road right-of-way and eventually to the storm drain inlet located in Los Coches Ct. is 2.12 cfs based upon a 100 year-storm event. While 0.35 cfs of peak runoff will be discharged to the Los Coches Flood Channel directly, as described in the discussion for drainage Basin B.

SUMMARY OF PROPOSED HYDRAULICS

Vegetative swales have been incorporated into the proposed site plan to convey runoff from the proposed project site to Los Coches Road's curb and gutter. The typical vegetative drainage swale cross section will be trapezoidal with a base dimension of 6 inches, top width of 3.5 feet, a side slope ratio of 3 to 1 and depth equal to 0.5 feet. Conveying a maximum flow equal to 0.53 cfs based upon a 100-year storm frequency a typical swale will be constructed with a longitudinal slope of between 1% and 2.9% and cross section meeting the previously described parameters. The flow depth for a maximum flow condition will be 0.29 feet with a velocity of 1.37 feet per second (fps). In addition, 4-inch diameter storm drain will be incorporated with 1% and 2% minimum and maximum constructed slopes, respectively. In order to accommodate the runoff flows with smaller diameter pipe, dual 4-inch pipes will be used to ensure adequate soil cover over the pipes. The maximum flow that a dual assembly will convey is 0.53 cfs, each 4-inch pipe discharging with a velocity of 4.4 fps. See Appendix 'D' Proposed Condition Hydraulic Calculations at the end of this report.

Basin D will have (4) four vegetative swales with longitudinal slopes ranging from 1 percent to 2.9 percent and velocities ranging from 0.90 feet per second (fps) to 1.47 fps. Runoff carried within the vegetative swales from sub-areas D1.0 and D1.1 combine at the western corner of proposed Lot 2 and will continue west through a 6-inch diameter PVC pipe into the swale located within sub-area D1.2. The proposed 6-inch pipe will be constructed within the retaining wall at a slope of approximately 20 percent. The pipe will convey the 0.33 cfs combined 100-year peak flow for sub-areas D1.0 and D1.1 at a maximum velocity of 9.5 fps and flow depth of 0.14 feet. As described previously, this diverted flow will confluence with runoff developed within drainage sub-area D1.2 and ultimately discharge to a sediment basin. Calculations for sizing the Sediment Basin can be found in Appendix 'D' Proposed Condition Hydraulic Calculations. The basin's volume is adequate to store runoff from 0.7-inches of rain accumulated within the tributary area based upon the 85th Percentile Isopluvials. Once runoff exceeds this amount, an overflow discharge will convey the larger flows to the Los Coches Road right-of-way.

Once all the developed sites runoff enters the Los Coches Road curb and gutter, the 100-year storm peak flow amount of 2.12 cfs will combine with existing right-of-way flows being 3.42 cfs to give 5.54 cfs. This peak amount of runoff will be conveyed at a velocity of 4.6 fps and results in a 10.7 feet spread into the roadway. Based upon the existing condition, this results in a 38% increase in the amount of storm water runoff traveling through the Los Coches Road curb and gutter in the vicinity of the project site. In addition, the flow spread into the

roadway increases by 2 feet. However, no impact to the travel way will occur as a result of this increase in flow spread within the right-of-way.

Further, the performance of the storm drain inlet to which these described flows will be conveyed is not drastically altered. The existing condition, as described in the 'Summary of Existing Hydraulics" section of this report, at the curb inlet, produces a 7.4 feet spread into Los Coches Ct. at the structure's 4-foot curb opening, while the 2.12 cfs increase results in a 7.7 feet spread. The 2.12 cfs increase at the curb inlet accounts for a 20% increase in runoff that ultimately reaches the drainage structure. See Exhibit 'D' Offsite Hydrology and Drainage Map located at the back of this report. Moreover, once flows enter the structure, an 18-inch storm drain constructed with a 14.5% slope conveys the flows to the Los Coches Flood Channel located approximately 60 feet to the west. This storm drain will have adequate capacity to convey the additional 2.12 cfs of runoff as the increase in the pipes full capacity only increases from 31.2% to 35.7% and increases the normal depth from 0.47 feet to 0.54 feet. Also, the flow velocity increases from 17.9 fps to 19.3 fps. See Appendix 'D' Proposed Condition Hydraulic Calculations included as an attachment to this report.

Basin B has one vegetative swale and will be constructed with varying longitudinal slope of 1.0 and 1.23 percent and results in an exit velocity of 1.0 fps based on a 100-year storm frequency flow of 0.35 cfs. A San Diego Regional Standard Drawing D-40 Type energy dissipator using Number 2 Backing has been placed at the outlet of this swale for protection of the channel in the dimension of 10 feet by 7.5 feet by 1.1 foot thick over 0.5 feet of filter blanket and sand.

All hydraulic calculations specifications can be found in the Appendix C - Proposed Condition Hydraulic Calculations located at the back of this report.

COMPUTATIONAL METHOD

Runoff flows developed within the existing site and proposed developed site were computed using the Rational Method mathematical formula used for determining maximum runoff rates from a given rainfall. In addition, the City of San Diego Drainage Design Manual and the San Diego County Hydrology Manual 2003 Edition were used as a basis for analysis. Each sub-drain area was assigned a runoff coefficient based on whether the area's surface was proposed to be pervious or impervious. A time of concentration (Tc) was determined for each area by summarizing how the storm water will be routed and using the applicable Nomograph provided in the above referenced Hydrology Manual. See Appendix 'A' - Existing Hydrology Calculations and See Appendix 'B' - Proposed Hydrology Calculations for copies of design aids used to calculate runoff for existing and propose site conditions. Runoff flows were quantified and tabulated as provided in the Appendix.

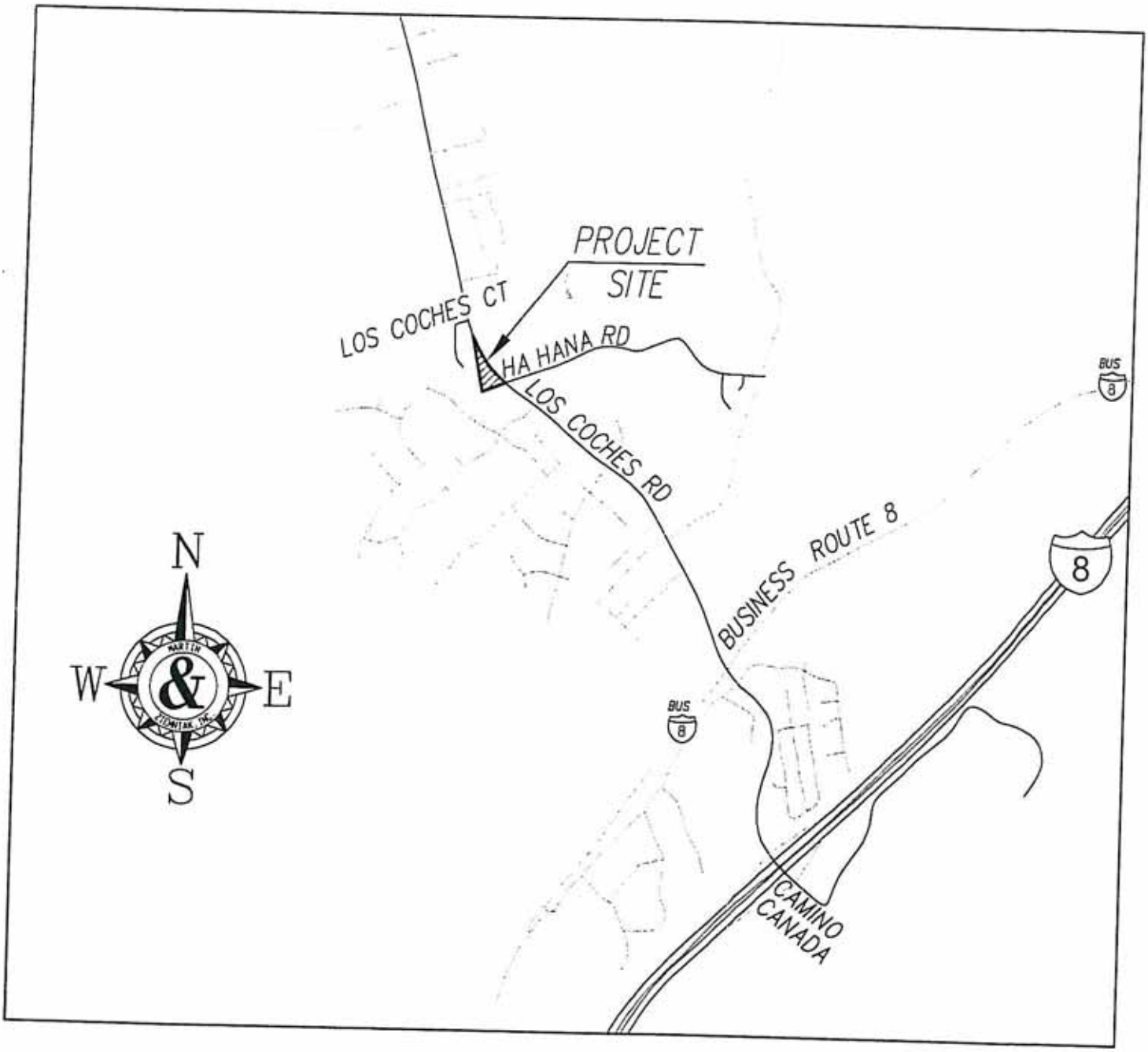
Hydraulic Computations were conducted with the use of FlowMaster 2005, a Bentley Systems, Inc. engineering analysis program. Results for all analysis can be found in Appendix C and D, as described above.

CONCLUSION

The peak storm water runoff flow resulting from a 100-year storm event increases by approximately 57 percent due to the proposed developed site. In addition, impervious surfaces will increase from 0 percent to 27.2 percent as a result of the proposed Los Coches 3-parcel residential subdivision. However, average slopes at the existing site will be decreased once the proposed subdivision grading is complete. As a result, a decrease in potential erosion at the site will occur. The use of several vegetative swales has also been incorporated into the site plan in order to increase the time of concentration and consequently minimize peak runoff flows. In addition the use of vegetative swales as a drainage conveyance mechanism will function not only to discharge storm water runoff, but to improve the water quality prior to release into the public storm drain system. Moreover, although the proposed condition introduces new runoff flows to the Los Coches Road right-of-way, they still ultimately discharge to the Los Coches Flood Channel as they currently do. In fact, the proposed condition will route runoff in a manner that prevents them from crossing onto the adjacent private properties. Finally, the proposed development, as demonstrated by this Study, minimizes the increase in storm water runoff from the site and impacts to the surrounding drainage infrastructure and surface water are acceptable.

EXHIBIT A

VICINITY MAP



VICINITY MAP

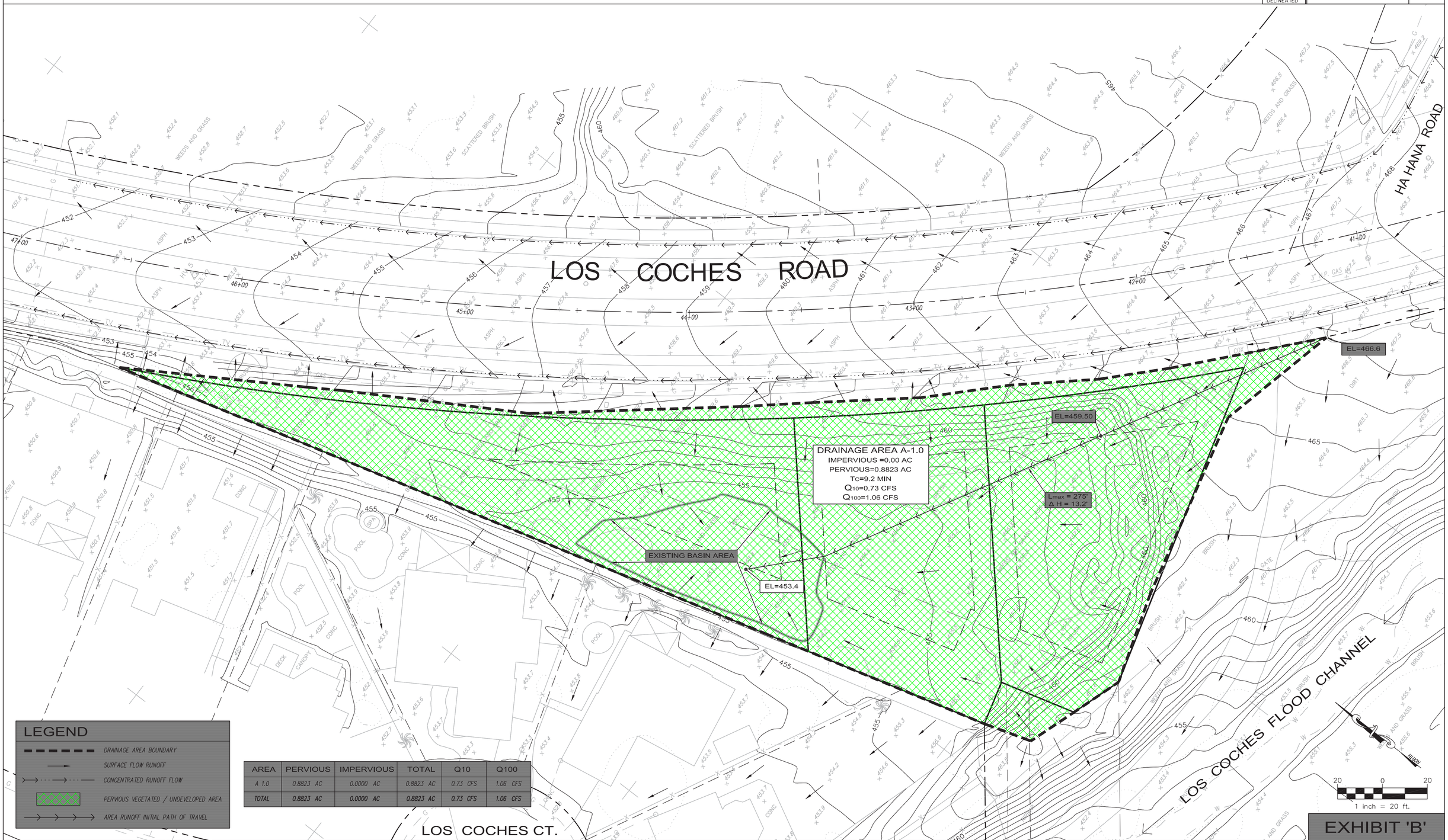
NTS

EXHIBIT B

Los Coches TPM - Existing On-Site Hydrology
and Drainage Map

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES

PLANS	BY	DATE
DESIGNED		
CHECKED		
DELINEATED		



AREA	PERVIOUS	IMPERVIOUS	TOTAL	Q10	Q100
A 1.0	0.8823 AC	0.0000 AC	0.8823 AC	0.73 CFS	1.06 CFS
TOTAL	0.8823 AC	0.0000 AC	0.8823 AC	0.73 CFS	1.06 CFS

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COUNTY OF SAN DIEGO
DEPARTMENT OF PUBLIC WORKS
5555 OVERLAND AVENUE, SAN DIEGO, CA 92123-1295

RECOMMENDED BY: _____ DATE _____
_____ DATE _____
APPROVED BY: _____ DATE _____

REVISIONS	BY	APPROVED	DATE

COORDINATE INDEX
_____ N. _____ E.
CONST. COMPL. _____
FIELD REVISIONS _____

ANGEL ANTONIO LOT SPLIT – LOS COCHES
EXISTING ONSITE HYDROLOGY & DRAINAGE MAP

EXHIBIT 'B'

SCALE: HOR. 1"=20' VERT. 1"=20'
W.A. _____ R.S. _____
FILE NO. #
SHEET 1 OF 1 SHEETS

EXHIBIT C

Los Coches TPM - Proposed On-Site Hydrology
and Drainage Map

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES

PLANS	BY	DATE
DESIGNED		XX-XX-XX
CHECKED		
DELINEATED		

AREA	PERVIOUS	IMPERVIOUS	TOTAL	Q100
A1.0	0.0583	0.0159	0.0742	0.00
A1.1	0.0000	0.0432	0.0432	0.00
A1.2	0.0279	0.0000	0.0279	0.00
B1.0	0.0000	0.0256	0.0256	0.00
B1.1	0.0695	0.0000	0.0695	0.00
C1.0	0.0209	0.0000	0.0209	0.00
D1.0	0.0000	0.0187	0.0187	0.00
D1.1	0.0414	0.0043	0.0457	0.00
D1.2	0.0000	0.0387	0.0387	0.00
D1.3	0.0186	0.0000	0.0186	0.00
E1.0	0.0000	0.0122	0.0122	0.00
E1.1	0.0182	0.0000	0.0182	0.00
F1.0	0.0000	0.0224	0.0224	0.00
F1.1	0.0965	0.0000	0.0965	0.00
F1.2	0.2674	0.0000	0.2674	0.00
F1.3	0.0000	0.0213	0.0213	0.00
TOTAL	0.6187	0.2023	0.8210	0.00

LEGEND

- DRAINAGE AREA BOUNDARY
- SURFACE FLOW RUNOFF
- CONCENTRATED RUNOFF FLOW
- TOTAL AREA RUNOFF DISCHARGE
- VEGETATED DRAINAGE SWALE PER CASQA TC-30
- PERVIOUS VEGETATED / UNDEVELOPED AREA
- IMPERVIOUS HARDSCAPE AREA
- IMPERVIOUS ROOF AREA
- AREA RUNOFF INITIAL PATH OF TRAVEL (T_i)

EXHIBIT 'C'

COUNTY OF SAN DIEGO
DEPARTMENT OF PUBLIC WORKS
5555 OVERLAND AVENUE, SAN DIEGO, CA 92123-1295

RECOMMENDED BY: _____ DATE XX-XX-XX
_____ DATE XX-XX-XX
APPROVED BY: _____ DATE XX-XX-XX

REVISIONS	BY	APPROVED	DATE
X	X		XX-XX-XX

COORDINATE INDEX
N. _____ E. _____
CONST. COMPL. _____
FIELD REVISIONS _____

ANTONIO MINOR SUBDIVISION – TPM 21030
PROPOSED ONSITE HYDROLOGY & DRAINAGE MAP

SCALE: HOR. 1"=20' VERT. 1"=20'
W.A. _____ R.S. _____
FILE NO. #
SHEET 1 OF 1 SHEETS

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EXHIBIT D

Los Coches TPM – Off-Site Hydrology and Drainage Map

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES

PLANS	BY	DATE
DESIGNED		
CHECKED		
DELINEATED		

OVERALL OFFSITE	ACRES
TOTAL SITE	3.1615
IMPERVIOUS	2.1792
PERVIOUS	0.9823

DRAINAGE AREA R1	PERVIOUS (AC)	IMPERVIOUS (AC)	AREA TOTAL (AC)
AREA R1.0	0.0000	1.0557	1.0557
AREA R1.1	0.0000	0.2867	0.2867
TOTALS	0.0000	1.3424	1.3424

DRAINAGE AREA E1	PERVIOUS (AC)	IMPERVIOUS (AC)	AREA TOTAL (AC)
AREA E1.0	0.1341	0.1143	0.2484
TOTALS	0.1341	0.1143	0.2484

DRAINAGE AREA E2	PERVIOUS (AC)	IMPERVIOUS (AC)	AREA TOTAL (AC)
AREA E2.0	0.1281	0.1091	0.2372
AREA E2.1	0.1345	0.1146	0.2491
AREA E2.2	0.1247	0.1062	0.2309
AREA E2.3	0.1603	0.1365	0.2968
AREA E2.4	0.1586	0.1351	0.2937
AREA E2.5	0.1420	0.1210	0.2630
TOTALS	0.8482	0.7225	1.5707

COUNTY OF SAN DIEGO
DEPARTMENT OF PUBLIC WORKS
5555 OVERLAND AVENUE, SAN DIEGO, CA 92123-1295

RECOMMENDED BY: _____ DATE _____
_____ DATE _____
APPROVED BY: _____ DATE _____

REVISIONS	BY	APPROVED	DATE

COORDINATE INDEX
N. _____ E. _____
CONST. COMPL. _____
FIELD REVISIONS _____

ANGEL ANTONIO LOT SPLIT – LOS COCHES
OFFSITE HYDROLOGY & DRAINAGE MAP

EXHIBIT 'D'

SCALE: HOR. 1"=50' VERT. 1"=50'
W.A. _____ R.S. _____
FILE NO. _____
SHEET 1 OF 1 SHEETS

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EXHIBIT E

Los Coches TPM – County 200-Scale Topographic Map

COUNTY OF SAN DIEGO

TOPOGRAPHIC SURVEY

PROJECT SITE:
SEE EXHIBIT 'C' LAS COCHES TPM- PROPOSED ON SITE HYDROLOGY AND DRAINAGE MAP
SEE EXHIBIT 'D' LAS COCHES TPM- OFFSITE HYDROLOGY AND DRAINAGE MAP

-LEGEND-

- Horizontal Control Monument *Third Order*; Vertical Control Monument *Second Order or Better*
- Horizontal Control Monument *Second Order or Better*; Vertical Control Monument *Third Order*
- Horizontal Control Monument *Second Order or Better*
- Horizontal Control Monument & Bench Mark *Second Order or Better*
- Horizontal Control Monument *Third Order*
- Horizontal Control Monument & Bench Mark *Third Order*
- Bench Mark *Second Order or Better*
- Vertical Control Monument *Third Order*
- Found Section, Grant or Subdivision Corner. (4 3 / 9 10 T 10 S T 11 S R 1 W R 2 W)
- Photograph, Nadir Point
- Geographic Tick

BOUNDARIES IN ORDER OF PRECEDENCE

- .025" National
- Name .025" / Name — County
- .015 City (*Use of Border with County*)
- Name within Bdry .015" — Reservation
- Name within Bdry. .015" — National, State or County Park
- Name within Bdry. .015" — Land Grant
- T 2 S / T 3 S .015" — Township, Range, Section or Subdivision (*Name of Subdivision within Bdry.*)

PREPARED UNDER THE DIRECTION OF THE COUNTY ENGINEER OF THE COUNTY OF SAN DIEGO, CALIFORNIA.

MAP CONTROL DATA FURNISHED BY THE COUNTY OF SAN DIEGO.

HORIZONTAL CONTROL IS BASED ON NORTH AMERICAN 1927 DATUM.

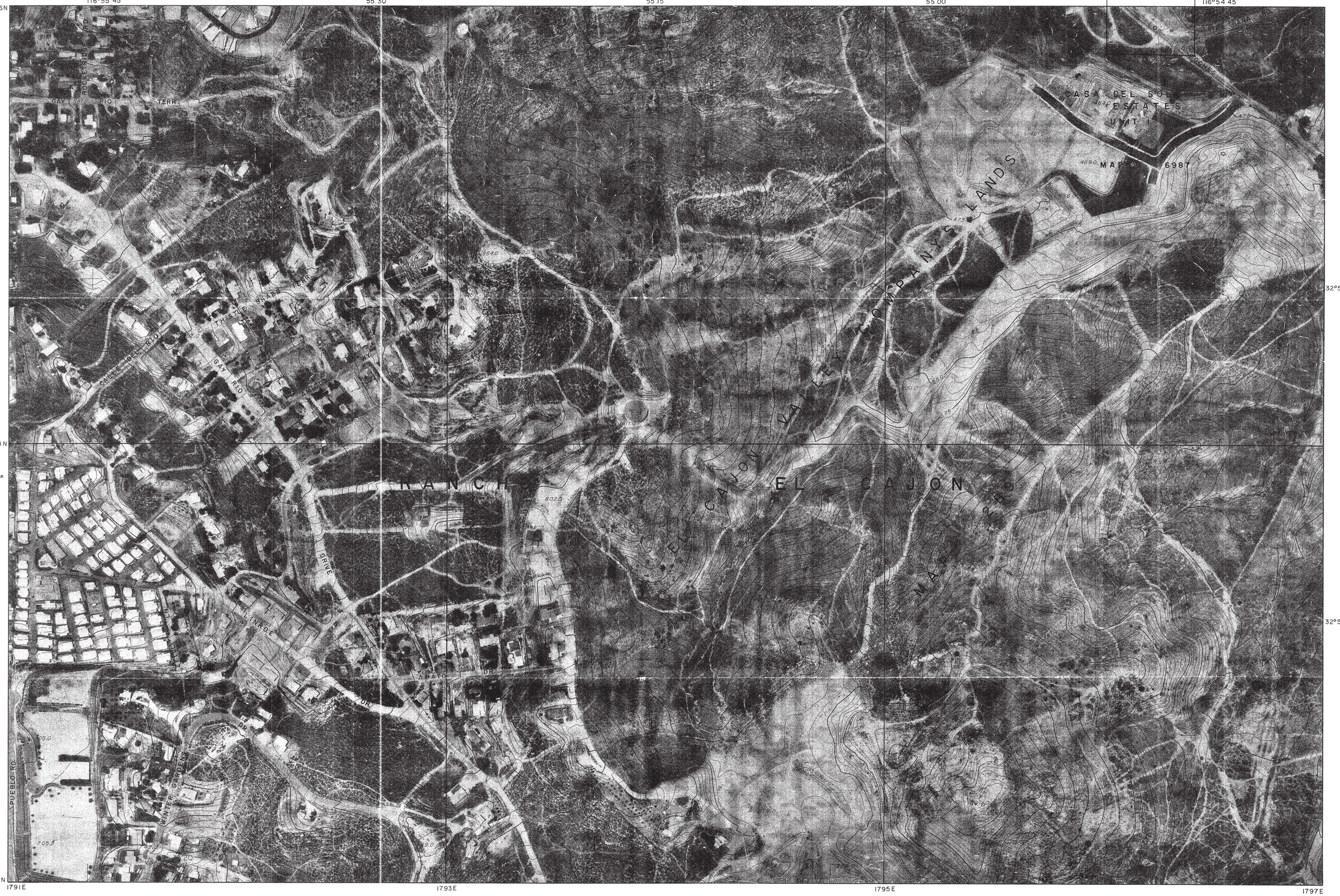
LAND LINES SHOWN ARE APPROXIMATE.

TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHODS FROM PHOTOGRAPHY DATED 6-14-72 BY

INLAND AERIAL SURVEYS, INC
RIVERSIDE - CALIFORNIA

ORTHOPHOTO IMAGE PREPARED FROM PHOTOGRAPHY DATED 6-12-72 BY

AERO SERVICE CORPORATION



SCALE 1:2400

200 0 200 400 600 800 1000

CONTOUR INTERVAL 5 FEET

U.S.C. & G.S. SEA LEVEL DATUM OF 1929

TWO THOUSAND FOOT CALIFORNIA RECTANGULAR GRID (ZONE VI)
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED
THE RECTANGULAR COORDINATE VALUES ARE SHOWN ON THE SOUTH AND WEST MARGINS

INDEX TO ADJOINING SHEETS

246-1785	246-1791	246-1797
242-1785	242-1791	242-1797
238-1785	238-1791	238-1797

SAN DIEGO COUNTY
CALIFORNIA

EDITION OF 1973

SHEET 242-1791

APPENDIX A

Existing On-Site Hydrology Calculations

Existing Off-Site Hydrology Calculations

Table 3-1 RUNOFF COEFFICIENTS FOR URBAN AREAS

Table 3-2 MAXIMUM OVERLAND FLOW LENGTH (L_m) & INITIAL TIME OF CONCENTRATION (T_i)

Figure 3-4 NOMOGRAPH FOR DETERMINATION OF TIME OF CONCENTRATION (T_c) OR TRAVEL TIME (T_t) FOR NATURAL WATERSHEDS

Figure 3-4 INTENSITY-DURATION DESIGN CHART – TEMPLATE

10-YEAR RAINFALL EVENT – 6 HOURS RAINFALL ISOPLUVIALS

100-YEAR RAINFALL EVENT – 6 HOURS RAINFALL ISOPLUVIALS

LOS COCHES TPM
EXISTING ON-SITE HYDROLOGY CALCULATIONS

TABLE A1 - C FACTOR TABLE

DRAINAGE AREA (ACRES)	PERVIOUS AREA IN ACRES (C=0.25)	IMPERVIOUS AREA IN ACRES (C=0.95)	WEIGHTED C PERVIOUS	WEIGHTED C IMPERVIOUS	COMBINED FINAL WEIGHTED C FOR AREA
A 1.0 = 0.8823 AC	0.8823	0.0000	0.25	0.00	0.25

TABLE A2 - SLOPE AND DISTANCE FACTOR TABLE FOR INITIAL TIME OF CONCENTRATION [T_i]

DRAINAGE AREA (ACRES)	HIGH UPSTREAM ELEVATION (FEET)	LOW DOWNSTREAM ELEVATION (FEET)	VERTICAL HEIGHT DIFFERENCE (FEET)	MAX OVERLAND DISTANCE PER FIGURE 3-2 (FEET)	SLOPE AVERAGE (PERCENT)
A 1.0 = 0.8823 AC	466.6	459.5	7.1	100.0	7.10

TABLE A3 - SLOPE AND DISTANCE FACTOR TABLE FOR TIME OF TRAVEL [T_t]

DRAINAGE AREA (ACRES)	HIGH UPSTREAM ELEVATION (FEET)	LOW DOWNSTREAM ELEVATION AT INLET	VERTICAL HEIGHT DIFFERENCE (FEET)	DISTANCE TRAVELED (FEET)	SLOPE AVERAGE (PERCENT)
A 1.0 = 0.8823 AC	459.5	453.4	6.1	175.0	3.49

TABLE A4 - URBAN TIME OF CONCENTRATION OVER EXISTING GRADE/SURFACES

DRAINAGE AREA (ACRES)	DISTANCE TRAVELED (FEET)	VERTICAL HEIGHT DIFFERENCE (FEET)	INITIAL TIME [T_i] TABLE 3-2[1] (Minutes)	TIME OF TRAVEL [T_t] FIGURE 3-4 (Minutes)	TIME OF CONCENTRATION $T_c=T_i+T_t$ (MIN)
A 1.0 = 0.8823 AC	175.0	6.10	7.8	1.4	9.18

[1] INTERPOLATED TIME VALUE

TABLE A5 - RAINFALL INTENSITY AND RUNOFF Q IN CFS

DRAINAGE NUMBER	COMBINED FINAL WEIGHTED C FOR AREA	AREA (ACRES)	MINIMUM TIME $T_c=T_i+T_t$ (MIN)	10 YEAR STORM INTENSITY FIGURE 3-1 (INCH/HR)	100 YEAR STORM INTENSITY FIGURE 3-1 (INCH/HR)	Q=CIA 10 YEAR STORM RUNOFF (CFS)	Q=CIA 100 YEAR STORM RUNOFF (CFS)
A 1.0	0.25	0.8823	9.18	3.29	4.81	0.73	1.06
TOTAL ON SITE STORM WATER RUNOFF						0.73	1.06

LOS COCHES TPM
EXISTING OFF-SITE HYDROLOGY CALCULATIONS

TABLE A6 - C FACTOR TABLE

DRAINAGE AREA (ACRES)	PERVIOUS AREA IN ACRES (C=0.25)	IMPERVIOUS AREA IN ACRES (C=0.95)	WEIGHTED C PERVIOUS	WEIGHTED C IMPERVIOUS	COMBINED FINAL WEIGHTED C FOR AREA
R 1.0 = 1.0557 AC	0.0000	1.0557	0.00	0.95	0.95
R 2.0 = 0.2867 AC	0.0000	0.2867	0.00	0.95	0.95
E 1.0 = 0.2484 AC	0.1341	0.1143	0.13	0.44	0.57
E 2.0 = 0.2372 AC	0.1281	0.1091	0.14	0.44	0.57
E 2.1 = 0.2491 AC	0.1345	0.1146	0.13	0.44	0.57
E 2.2 = 0.2309 AC	0.1247	0.1062	0.14	0.44	0.57
E 2.3 = 0.2968 AC	0.1603	0.1365	0.14	0.44	0.57
E 2.4 = 0.2937 AC	0.1586	0.1351	0.14	0.44	0.57
E 2.5 = 0.2630 AC	0.1420	0.1210	0.13	0.44	0.57

TABLE A7 - SLOPE AND DISTANCE FACTOR TABLE FOR INITIAL TIME OF CONCENTRATION [T_i]

DRAINAGE AREA (ACRES)	HIGH UPSTREAM ELEVATION (FEET)	LOW DOWNSTREAM ELEVATION (FEET)	VERTICAL HEIGHT DIFFERENCE (FEET)	DISTANCE TRAVELED (FEET)	SLOPE AVERAGE (PERCENT)
R 1.0 = 1.0557 AC	468.7	448.5	20.2	1070.0	1.89
R 2.0 = 0.2867 AC	452.6	448.5	4.1	420.0	0.98
E 1.0 = 0.2484 AC	451.1	448.5	2.6	135.0	1.93
E 2.0 = 0.2372 AC	454.8	452.6	2.2	150.0	1.47
E 2.1 = 0.2491 AC	454.3	452.2	2.1	180.0	1.17
E 2.2 = 0.2309 AC	452.6	451.9	0.7	135.0	0.52
E 2.3 = 0.2968 AC	451.8	450.2	1.6	180.0	0.89
E 2.4 = 0.2937 AC	450.9	450	0.9	180.0	0.50
E 2.5 = 0.2630 AC	451.1	449.3	1.8	170.0	1.06

TABLE A8 - SLOPE AND DISTANCE FACTOR TABLE FOR TIME OF TRAVEL [T_t]

DRAINAGE AREA (ACRES)	HIGH UPSTREAM ELEVATION (FEET)	LOW DOWNSTREAM ELEVATION	VERTICAL HEIGHT DIFFERENCE (FEET)	DISTANCE TRAVELED (FEET)	SLOPE AVERAGE (PERCENT)
R 1.0 = 1.0557 AC	0.00	0.00	0.0	0.0	0.00
R 2.0 = 0.2867 AC	0.00	0.00	0.0	0.0	0.00
E 1.0 = 0.2484 AC	0.00	0.00	0.0	0.0	0.00
E 2.0 = 0.2372 AC	452.60	448.50	4.1	400.0	1.03
E 2.1 = 0.2491 AC	452.20	448.50	3.7	370.0	1.00
E 2.2 = 0.2309 AC	451.90	448.50	3.4	355.0	0.96
E 2.3 = 0.2968 AC	450.20	448.50	1.7	165.0	1.03
E 2.4 = 0.2937 AC	450.00	448.50	1.5	155.0	0.97
E 2.5 = 0.2630 AC	449.30	448.50	0.8	80.0	1.00

LOST COCHES TPM
EXISTING OFF-SITE HYDROLOGY CALCULATIONS

TABLE A9 - INITIAL TIME OF CONCENTRATION [T_i] OVER PROPOSED GRADE/SURFACES

DRAINAGE AREA (ACRES)	COMBINED FINAL WEIGHTED C FOR AREA	DISTANCE SURFACE TRAVEL (FEET)	MAX OVERLAND DISTANCE PER FIGURE 3-2[1] (FEET)	REMAINING HEIGHT DIFFERENCE (FEET)	INITIAL TIME [T_i] FIGURE 3-22[2] (Minutes)
R 1.0 = 1.0557 AC	0.95	1070	76.9	18.71	8.3
R 2.0 = 0.2867 AC	0.95	420	70.0	3.42	9.6
E 1.0 = 0.2484 AC	0.57	135	79.3	1.07	8.2
E 2.0 = 0.2372 AC	0.57	150	74.7	1.10	8.9
E 2.1 = 0.2491 AC	0.57	180	71.7	1.26	9.2
E 2.2 = 0.2309 AC	0.57	135	50.0	0.44	10.2
E 2.3 = 0.2968 AC	0.57	180	57.8	1.09	9.9
E 2.4 = 0.2937 AC	0.57	180	50.0	0.65	10.2
E 2.5 = 0.2630 AC	0.57	170	70.6	1.05	9.5

[1] INTERPOLATED DISTANCE VALUE
[2] INTERPOLATED TIME VALUE

TABLE A10 - TIME OF CONCENTRATION [T_t] OVER EXISTING GRADE/SURFACES

DRAINAGE AREA (ACRES)	REMAINING DISTANCE FROM TABLE A9 (FEET)	ADDITIONAL DISTANCE FROM TABLE A8 (FEET)	TOTAL TRAVEL DISTANCE FOR [T_t] (FEET)	REMAINING HEIGHT FROM TABLE A9 (FEET)	VERTICAL HEIGHT FROM TABLE A8 (FEET)	TOTAL HEIGHT [E] FOR [T_t] (FEET)	TIME OF TRAVEL [T_t] FIGURE 3-4 (Minutes)
R 1.0 = 1.0557 AC	991.1	0.0	991.1	18.7	0.0	18.7	7.3
R 2.0 = 0.2867 AC	350.0	0.0	350.0	3.4	0.0	3.4	4.2
E 1.0 = 0.2484 AC	55.7	0.0	55.7	1.1	0.0	1.1	0.8
E 2.0 = 0.2372 AC	75.3	400.0	475.3	1.1	4.1	5.2	5.1
E 2.1 = 0.2491 AC	108.3	370.0	478.3	1.3	3.7	5.0	5.2
E 2.2 = 0.2309 AC	85.0	355.0	440.0	0.4	3.4	3.8	5.3
E 2.3 = 0.2968 AC	122.2	165.0	287.2	1.1	1.7	2.8	3.6
E 2.4 = 0.2937 AC	130.0	155.0	285.0	0.6	1.5	2.1	4.0
E 2.5 = 0.2630 AC	99.4	80.0	179.4	1.1	0.8	1.9	2.5

TABLE A11 - TIME OF CONCENTRATION [T_c] SUMMARY

DRAINAGE AREA (ACRES)	TIME OF CONCENTRATION [$T_c=T_i+T_t$] (Minutes)
R 1.0 = 1.0557 AC	15.60
R 2.0 = 0.2867 AC	13.82
E 1.0 = 0.2484 AC	8.99
E 2.0 = 0.2372 AC	14.01
E 2.1 = 0.2491 AC	14.45
E 2.2 = 0.2309 AC	15.46
E 2.3 = 0.2968 AC	13.53
E 2.4 = 0.2937 AC	14.18
E 2.5 = 0.2630 AC	11.97

LOS COCHES TPM
EXISTING OFF-SITE HYDROLOGY CALCULATIONS

TABLE A12 -RAINFALL INTENSITY AND RUNOFF Q IN CFS

AREA	COMBINED FINAL WEIGHTED C FOR AREA INCONSIDERATION	AREA (ACRES)	MINIMUM TIME $T_a=T_i+T_t$ (Minutes)	10-YEAR STORM INTENSITY (INCH/HR)	100-YEAR STORM INTENSITY (INCH/HR)	Q=CIA 10-YEAR STORM RUNOFF (CFS)	Q=CIA 100-YEAR STORM FUNOFF (CFS)
R 1.0	0.95	1.0557	15.60	2.34	3.41	2.35	3.42
R 2.0	0.95	0.2867	13.82	2.53	3.69	0.69	1.01
E 1.0	0.57	0.2484	8.99	3.34	4.87	0.47	0.69
E 2.0	0.57	0.2372	14.01	2.51	3.66	0.34	0.50
E 2.1	0.57	0.2491	14.45	2.46	3.59	0.35	0.51
E 2.2	0.57	0.2309	15.46	2.35	3.44	0.31	0.45
E 2.3	0.57	0.2968	13.53	2.56	3.74	0.44	0.64
E 2.4	0.57	0.2937	14.18	2.49	3.63	0.42	0.61
E 2.5	0.57	0.2630	11.97	2.78	4.05	0.42	0.61
TOTAL OFF-SITE STORM WATER RUNOFF						5.78	8.44

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use			Runoff Coefficient "C"			
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

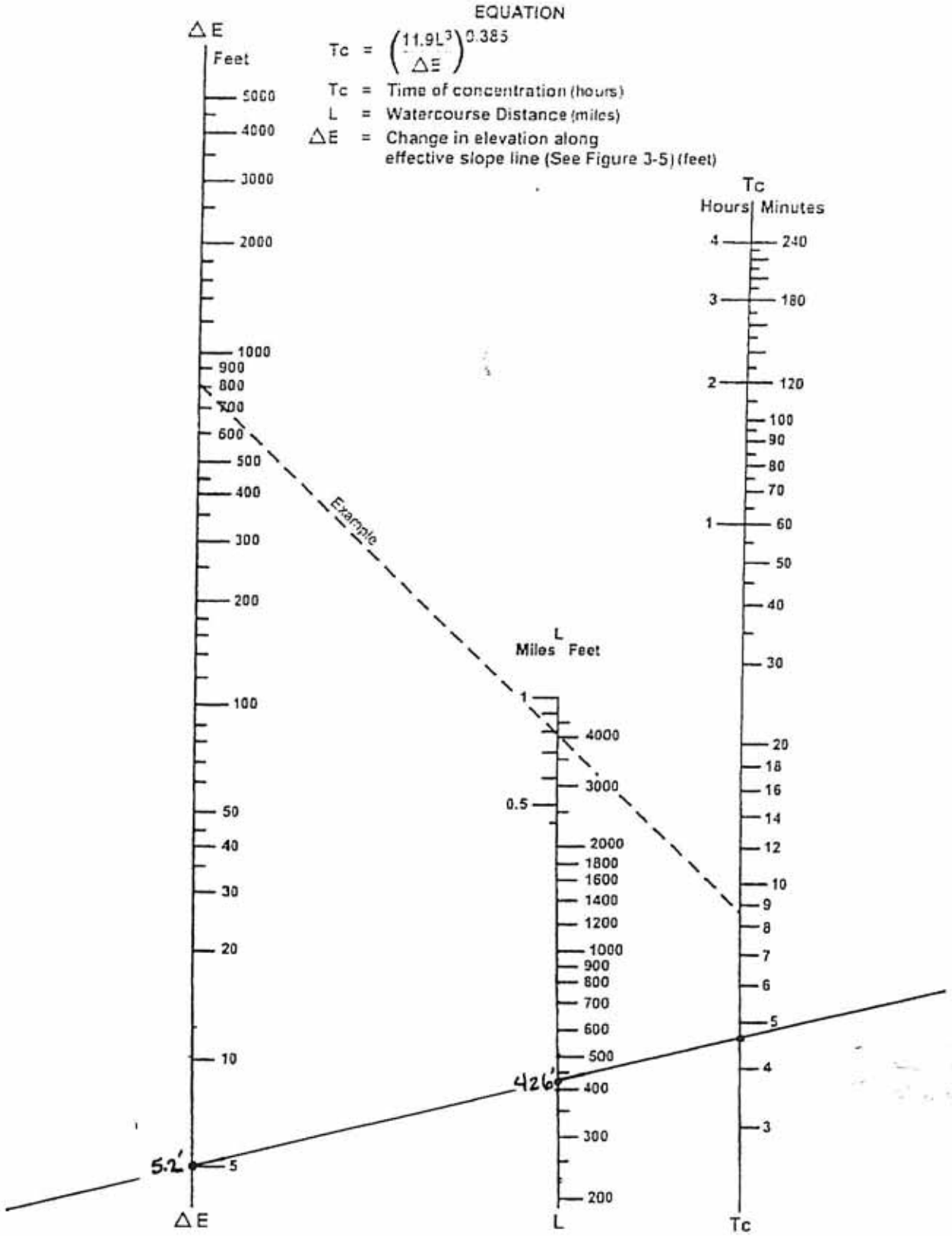
Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M) & INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/	.5%		1%		2%		3%		5%		10%	
	Acre	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description

EXISTING AREA A1.0

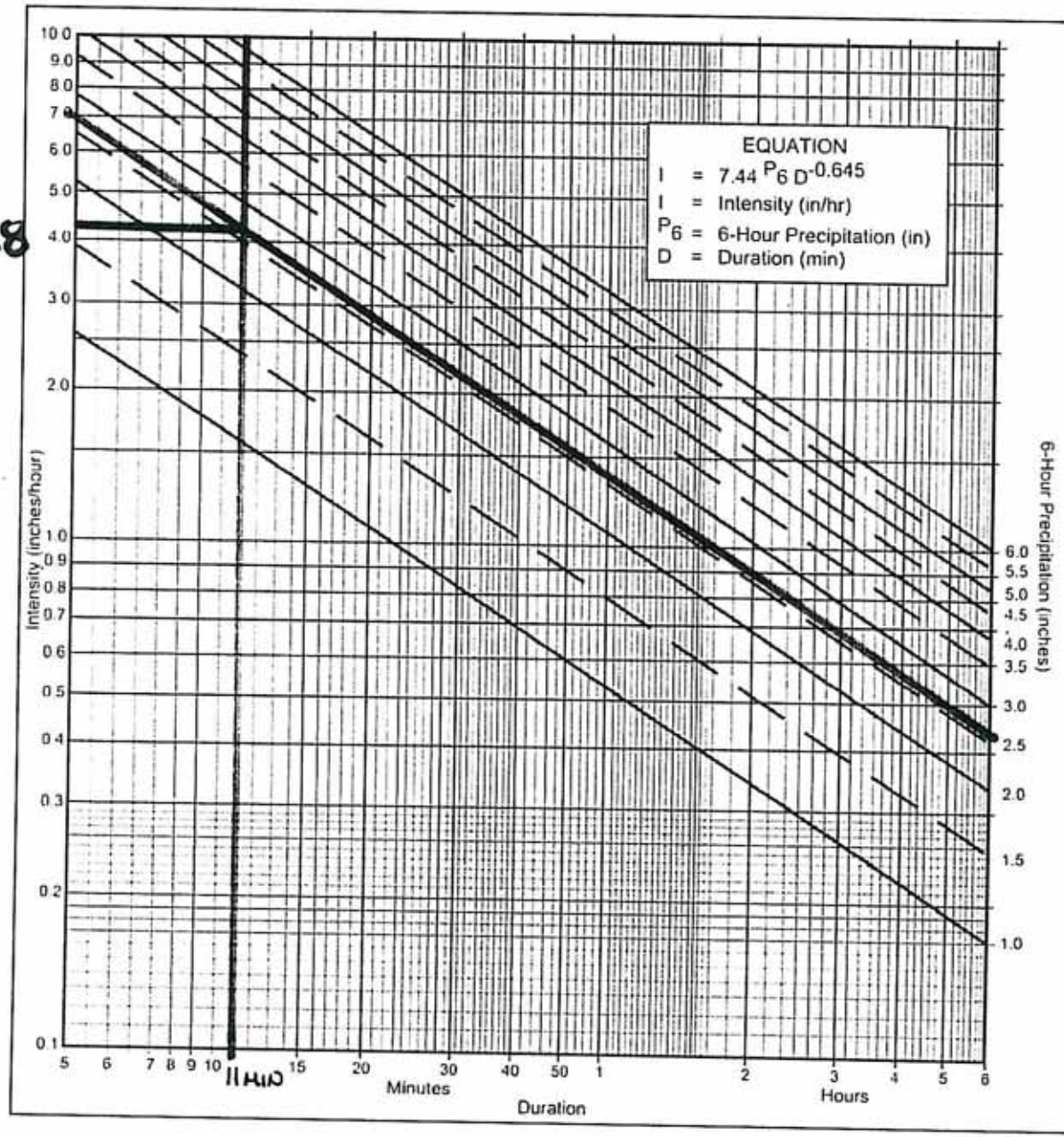


SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-4

Nomograph for Determination of Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds

Existing Area A1.0



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.7 in., P_{24} = 6.0 , $\frac{P_6}{P_{24}}$ = 45 %(2)

(c) Adjusted P_6(2) = 2.7 in.

(d) t_x = 11.0 min.

(e) I = 4.28 in./hr

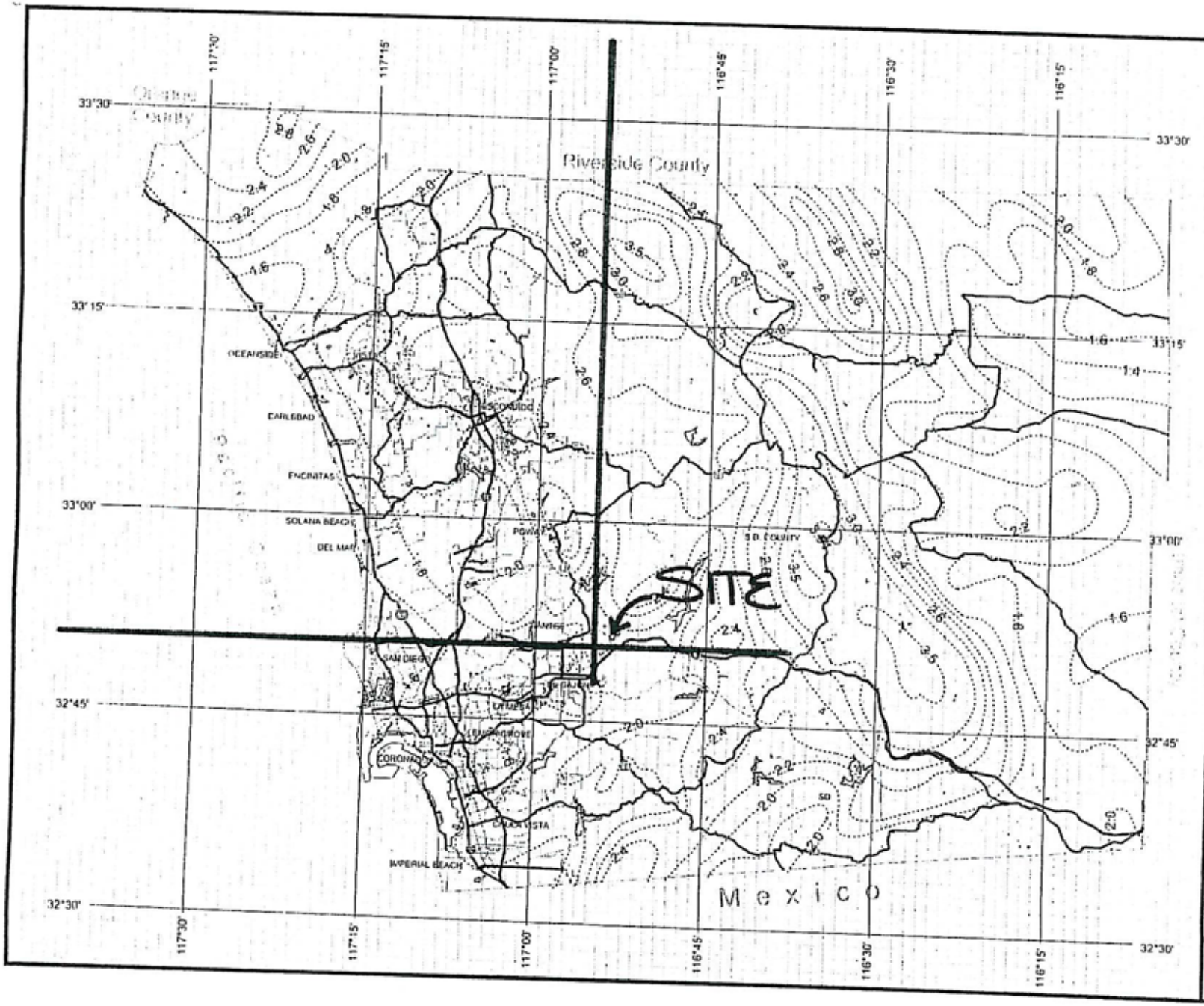
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

3-1



County of San Diego Hydrology Manual

Rainfall Isopluvials

10 Year Rainfall Event - 6 Hours

Isopluvial (inches)

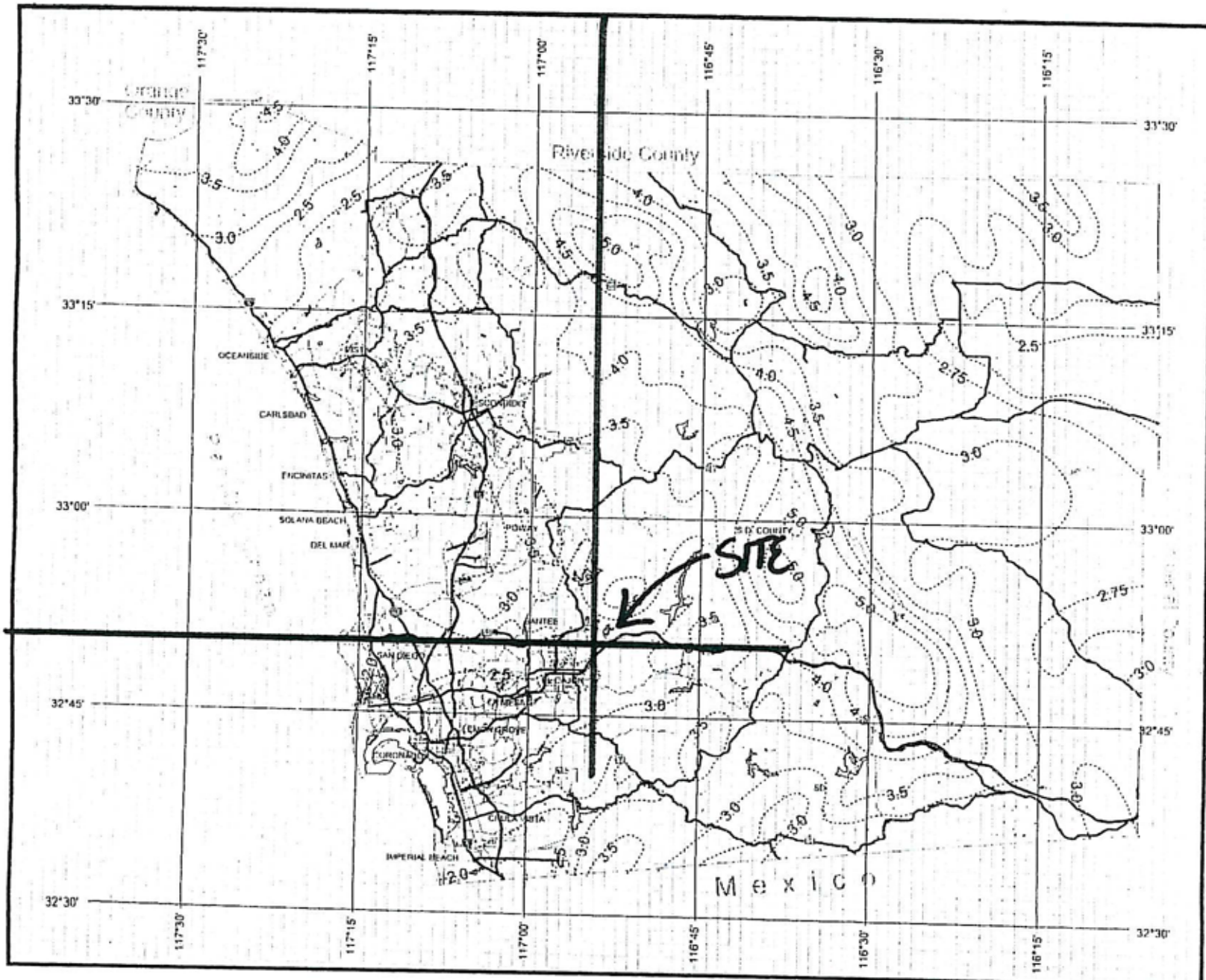
1.85"

GIS

GIS

N
W
E
S

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

2.7"

GIS GIS

N W E S

3 0 3 Miles

APPENDIX B

Proposed On-Site Hydrology Calculations

Table 3-1 RUNOFF COEFFICIENTS FOR URBAN AREAS

Table 3-2 MAXIMUM OVERLAND FLOW LENGTH (L_m) & INITIAL TIME OF CONCENTRATION (T_i)

Figure 3-4 NOMOGRAPH FOR DETERMINATION OF TIME OF CONCENTRATION (T_c) OR TRAVEL TIME (T_t) FOR NATURAL WATERSHEDS

Figure 3-4 INTENSITY-DURATION DESIGN CHART – TEMPLATE

10-YEAR RAINFALL EVENT – 6 HOURS RAINFALL ISOPLUVIALS

100-YEAR RAINFALL EVENT – 6 HOURS RAINFALL ISOPLUVIALS

LOS COCHES TPM
PROPOSED CONDITION HYDROLOGY CALCULATIONS

TABLE B1 - C FACTOR TABLE

DRAINAGE AREA (ACRES)	PERVIOUS AREA IN ACRES (C=0.45)	IMPERVIOUS AREA IN ACRES (C = 0.95)	WEIGHTED C PERVIOUS	WEIGHTED C IMPERVIOUS	COMBINED FINAL WEIGHTED C FOR AREA
A 1.0 = 0.0794 AC	0.0496	0.0298	0.28	0.36	0.64
A 1.1 = 0.0624 AC	0.0461	0.0624	0.19	0.55	0.74
B 1.0 = 0.1137 AC	0.0647	0.0490	0.26	0.41	0.67
C 1.0 = 0.1118 AC	0.0468	0.0650	0.19	0.55	0.74
D 1.0 = 0.0879 AC	0.0675	0.0205	0.35	0.22	0.57
D 1.1 = 0.0405 AC	0.0214	0.0191	0.24	0.45	0.69
D 1.2 = 0.0875 AC	0.0807	0.0067	0.42	0.07	0.49
D 1.3 = 0.1565 AC	0.0767	0.0798	0.22	0.48	0.70
D 1.4 = 0.0752 AC	0.0513	0.0238	0.31	0.30	0.61

TABLE B2 - SLOPE AND DISTANCE FACTOR TABLE FOR INITIAL TIME OF CONCENTRATION [T_i]

DRAINAGE AREA (ACRES)	HIGH UPSTREAM ELEVATION (FEET)	LOW DOWN STREAM ELEVATION (FEET)	VERTICAL HEIGHT DIFFERENCE (FEET)	DISTANCE TRAVELED (FEET)	SLOPE AVERAGE (PERCENT)
A 1.0 = 0.0794 AC	465.72	463.45	2.3	60.0	3.78
A 1.1 = 0.0624 AC	464.50	463.46	1.0	60.0	1.73
B 1.0 = 0.1137 AC	464.12	463.00	1.1	95.0	1.16
C 1.0 = 0.1118 AC	462.03	460.04	2.0	155.0	1.28
D 1.0 = 0.0879 AC	462.03	460.72	1.3	125.0	1.05
D 1.1 = 0.0405 AC	462.33	460.72	1.6	65.0	2.48
D 1.2 = 0.0875 AC	460.49	457.20	3.3	145.0	2.27
D 1.3 = 0.1565 AC	459.95	456.00	3.9	195.0	2.03
D 1.4 = 0.0752 AC	457.20	455.35	1.8	65.0	2.85

TABLE B3 - SLOPE AND DISTANCE FACTOR TABLE FOR TIME OF TRAVEL [T_t]

DRAINAGE AREA (ACRES)	HIGH UPSTREAM ELEVATION (FEET)	LOW DOWN STREAM ELEVATION (FEET)	VERTICAL HEIGHT DIFFERENCE (FEET)	DISTANCE TRAVELED (FEET)	SLOPE AVERAGE (PERCENT)
A 1.0 = 0.0794 AC	463.45	462.05	1.4	113.0	1.24
A 1.1 = 0.0624 AC	462.65	462.05	0.6	35.0	1.71
B 1.0 = 0.1137 AC	0.00	0.00	0.0	0.0	0.00
C 1.0 = 0.1118 AC	0.00	0.00	0.0	0.0	0.00
D 1.0 = 0.0879 AC	460.49	455.35	5.1	210.0	2.45
D 1.1 = 0.0405 AC	460.49	455.35	5.1	210.0	2.45
D 1.2 = 0.0875 AC	457.20	455.35	1.8	65.0	2.85
D 1.3 = 0.1565 AC	457.20	455.35	1.8	65.0	2.85
D 1.4 = 0.0752 AC	0.00	0.00	0.0	0.0	0.00

LOS COCHES TPM
PROPOSED CONDITION HYDROLOGY CALUCLATIONS

TABLE B4 - INITIAL TIME OF CONCENTRATION [T_i] OVER PROPOSED GRADE/SURFACES

DRAINAGE AREA (ACRES)	COMBINED FINAL WEIGHTED C FOR AREA	DISTANCE SURFACE TRAVEL (FEET)	MAX OVERLAND DISTANCE PER FIGURE 3-21[1] (FEET)	REMAINING HEIGHT DIFFERENCE (FEET)	INITIAL TIME [T_i] FIGURE 3-22[2] (Minutes)
A 1.0 = 0.0794 AC	0.64	60.0	97	0.00	7.4
A 1.1 = 0.0624 AC	0.74	60.0	77.3	0.00	8.5
B 1.0 = 0.1137 AC	0.67	95.0	71.8	0.27	9.3
C 1.0 = 0.1118 AC	0.74	155.0	72.8	1.06	9.2
D 1.0 = 0.0879 AC	0.57	125.0	70.5	0.57	9.5
D 1.1 = 0.0405 AC	0.69	65.0	67.2	0.00	7.9
D 1.2 = 0.0875 AC	0.49	145.0	84.1	1.38	8.0
D 1.3 = 0.1565 AC	0.70	195.0	80.5	2.32	8.1
D 1.4 = 0.0752 AC	0.61	65.0	92.8	0.00	7.8

[1] INTERPOLATED DISTANCE VALUE
[2] INTERPOLATED TIME VALUE

TABLE B5 - TIME OF CONCENTRATION [T_t] OVER PROPOSED GRADE/SURFACES

DRAINAGE AREA (ACRES)	REMAINING DISTANCE FROM TABLE B4 (FEET)	ADDITIONAL DISTANCE FROM TABLE B3 (FEET)	TOTAL TRAVEL DISTANCE FOR [T_t] (FEET)	REMAINING HEIGHT FROM TABLE B4 (FEET)	VERTICAL HEIGHT FROM TABLE B3 (FEET)	TOTAL HEIGHT [E] FOR [T_t] (FEET)	TIME OF TRAVEL [T_t] FIGURE 3-4 (Minutes)
A 1.0 = 0.0794 AC	0.0	113.0	113.0	0.0	1.4	1.4	1.6
A 1.1 = 0.0624 AC	0.0	35.0	35.0	0.0	0.6	0.6	0.6
B 1.0 = 0.1137 AC	23.2	0.0	23.2	0.3	0.0	0.3	0.5
C 1.0 = 0.1118 AC	82.2	0.0	82.2	1.1	0.0	1.1	1.2
D 1.0 = 0.0879 AC	54.5	210.0	264.5	0.6	5.1	5.7	2.5
D 1.1 = 0.0405 AC	0.0	210.0	210.0	0.0	5.1	5.1	2.0
D 1.2 = 0.0875 AC	60.9	65.0	125.9	1.4	1.8	3.2	1.3
D 1.3 = 0.1565 AC	114.5	65.0	179.5	2.3	1.8	4.2	1.8
D 1.4 = 0.0752 AC	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE B6 - TIME OF CONCENTRATION [T_c] SUMMARY

DRAINAGE AREA (ACRES)	TIME OF CONCENTRATION [$T_c=T_i+T_t$] (Minutes)
A 1.0 = 0.0794 AC	9.01
A 1.1 = 0.0624 AC	9.08
B 1.0 = 0.1137 AC	9.79
C 1.0 = 0.1118 AC	10.45
D 1.0 = 0.0879 AC	12.01
D 1.1 = 0.0405 AC	9.90
D 1.2 = 0.0875 AC	9.32
D 1.3 = 0.1565 AC	9.91
D 1.4 = 0.0752 AC	7.80

LOS COCHES TPM
PROPOSED CONDITION HYDROLOGY CALCULATIONS

TABLE B7 -RAINFALL INTENSITY AND RUNOFF Q IN CFS

AREA	COMBINED FINAL WEIGHTED C FOR AREA INCONSIDERATION	AREA (ACRES)	MINIMUM TIME $T_c=T_i+T_t$ (Minutes)	10-YEAR STORM INTENSITY (INCH/HR)	100-YEAR STORM INTENSITY (INCH/HR)	Q=CIA 10-YEAR STORM RUNOFF (CFS)	Q=CIA 100-YEAR STORM FUNOFF (CFS)
A 1.0	0.64	0.0794	9.01	3.33	4.86	0.17	0.25
A 1.1	0.74	0.0624	9.08	3.32	4.84	0.15	0.22
B 1.0	0.67	0.1137	9.79	3.16	4.61	0.24	0.35
C 1.0	0.74	0.1118	10.45	3.03	4.42	0.25	0.37
D 1.0	0.57	0.0879	12.01	2.77	4.04	0.14	0.20
D 1.1	0.69	0.0405	9.90	3.14	4.58	0.09	0.13
D 1.2	0.49	0.0875	9.32	3.26	4.76	0.14	0.20
D 1.3	0.70	0.1565	9.91	3.14	4.58	0.35	0.50
D 1.4	0.61	0.0752	7.80	3.66	5.34	0.17	0.24
TOTAL ON-SITE STORM WATER RUNOFF						1.69	2.47

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

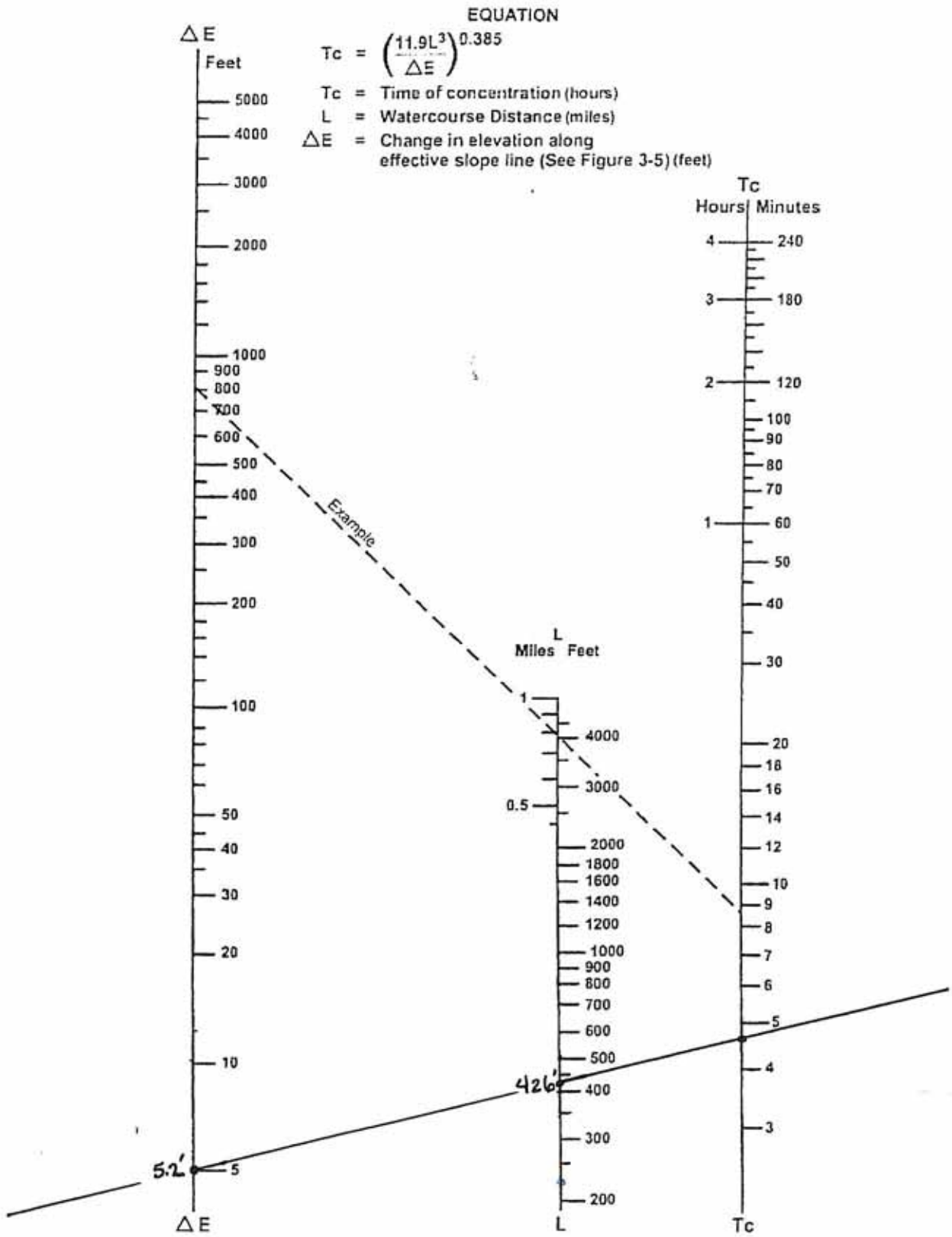
Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M) & INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/	.5%		1%		2%		3%		5%		10%	
	Acre	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description

EXISTING AREA A1.0



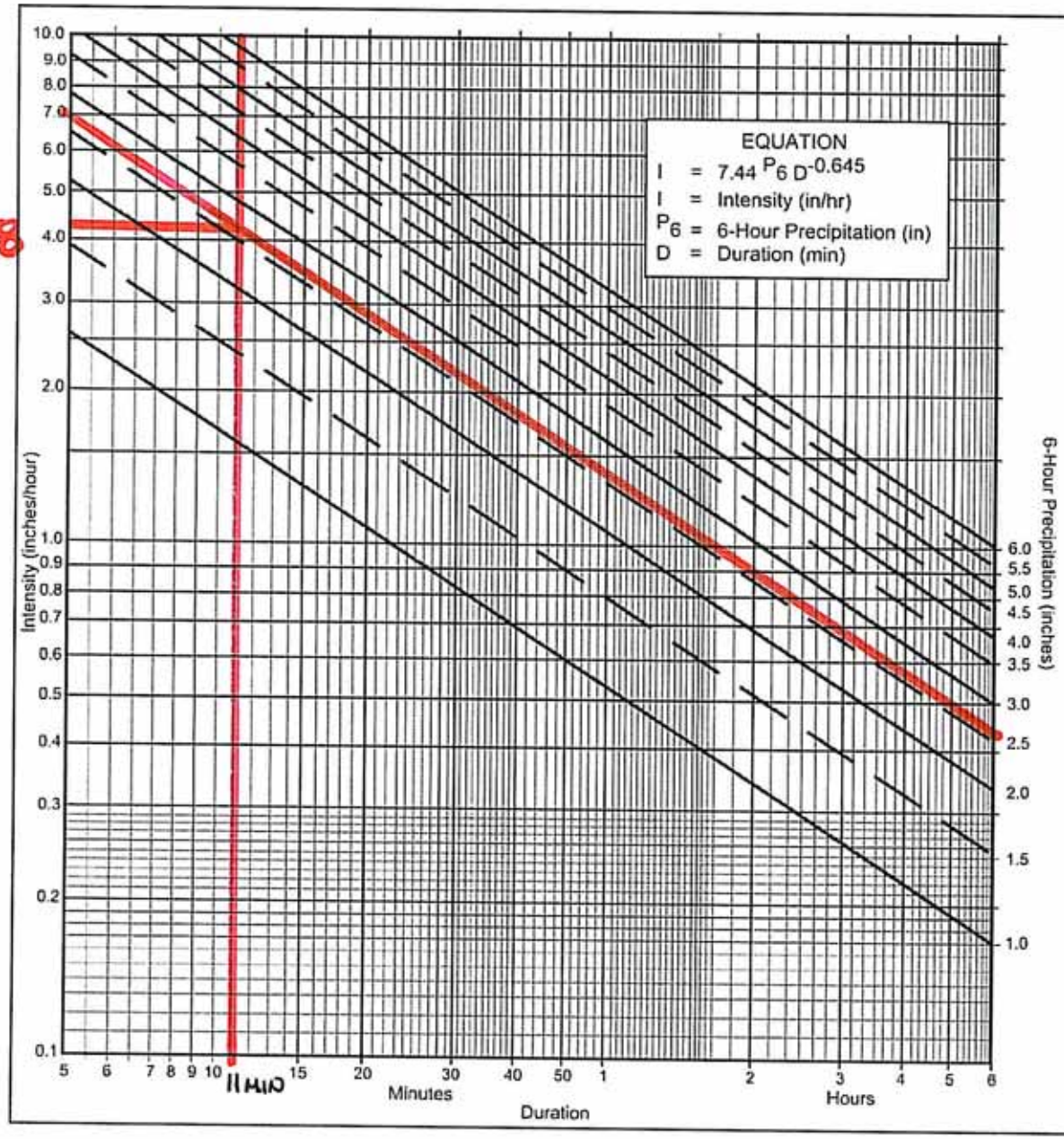
SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE

Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds

3-4

Existing Area A1.0



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.7 in., P_{24} = 6.0 , $\frac{P_6}{P_{24}}$ = 45 %(2)

(c) Adjusted P_6(2) = 2.7 in.

(d) t_x = 11.0 min.

(e) I = 4.28 in./hr.

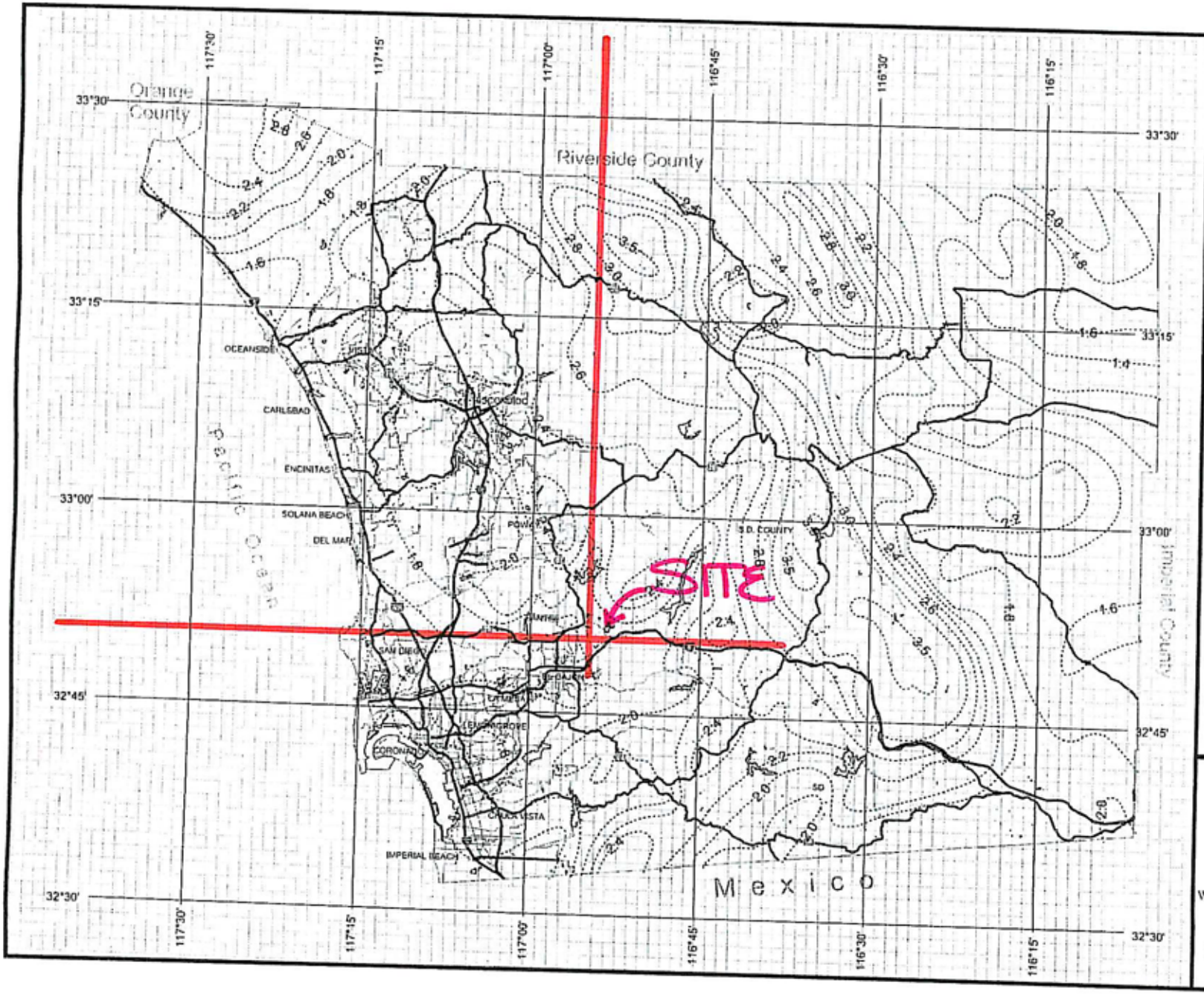
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

3-1



County of San Diego Hydrology Manual

Rainfall Isopluvials

10 Year Rainfall Event - 6 Hours

Isopluvial (inches)

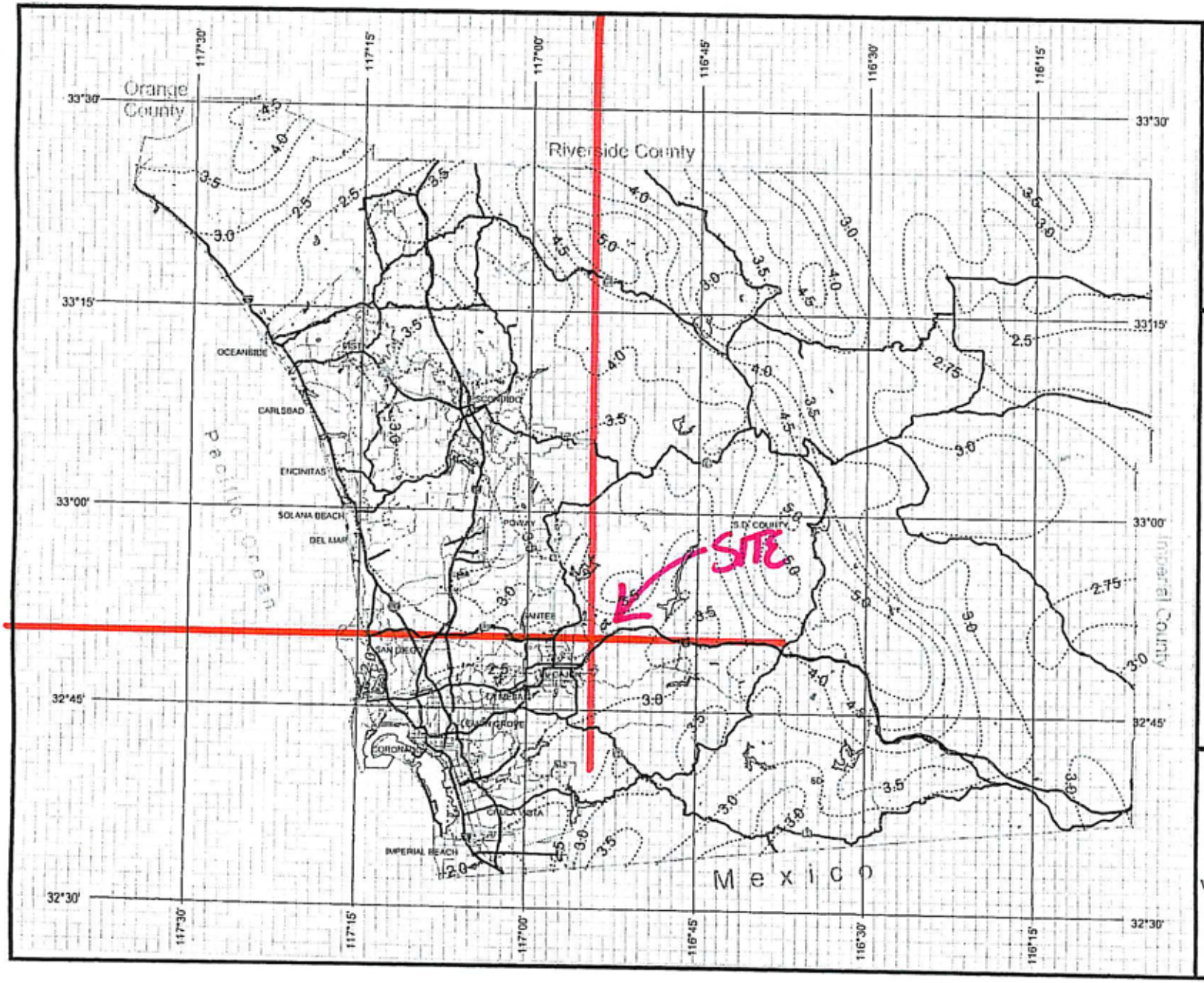
1.85"

DPW GIS

SanGIS

N W E S

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

2.7"

DPW GIS

SanGIS

N W E S

3 0 3 Miles

APPENDIX C

Existing Condition Hydraulic Calculations

Los Coches TPM - Exist Los Coches Rd. Gutter [100-YR STORM]

Project Description

Solve For	Spread

Input Data

Channel Slope	0.01890	ft/ft
Discharge	3.42	ft^3/s
Gutter Width	1.50	ft
Gutter Cross Slope	0.08	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.013	

Results

Spread	8.71	ft
Flow Area	0.83	ft^2
Depth	0.27	ft
Gutter Depression	0.09	ft
Velocity	4.12	ft/s

Exist Cond - Curb Inlet @ Los Coches Ct. [100 YR STORM]

Project Description

Solve For	Curb Opening Length

Input Data

Discharge		8.44	ft^3/s
Spread		7.39	ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.08	ft/ft
Road Cross Slope		0.02	ft/ft
Opening Height		0.67	ft
Curb Throat Type	Inclined		
Local Depression		10.00	in
Local Depression Width		10.00	ft
Throat Incline Angle		90.00	degrees

Results

Curb Opening Length	4.00	ft
Depth	0.40	ft
Gutter Depression	0.09	ft
Total Depression	0.93	ft

Exist Cond 18" RCP SD @ Los Coches Ct [100-YR STORM]

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.14500	ft/ft
Diameter	1.50	ft
Discharge	8.44	ft^3/s

Results

Normal Depth	0.47	ft
Flow Area	0.47	ft^2
Wetted Perimeter	1.78	ft
Top Width	1.39	ft
Critical Depth	1.13	ft
Percent Full	31.2	%
Critical Slope	0.00776	ft/ft
Velocity	17.94	ft/s
Velocity Head	5.00	ft
Specific Energy	5.47	ft
Froude Number	5.44	
Maximum Discharge	43.03	ft^3/s
Discharge Full	40.00	ft^3/s
Slope Full	0.00646	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	31.18	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Exist Cond 18" RCP SD @ Los Coches Ct [100-YR STORM]

GVF Output Data

Normal Depth	0.47	ft
Critical Depth	1.13	ft
Channel Slope	0.14500	ft/ft
Critical Slope	0.00776	ft/ft

APPENDIX D

Proposed Condition Hydraulic Calculations

Los Coches TPM - Prop Los Coches Rd. Gutter [100 YR STORM]

Project Description

Solve For	Spread

Input Data

Channel Slope	0.01890	ft/ft
Discharge	5.54	ft^3/s
Gutter Width	1.50	ft
Gutter Cross Slope	0.08	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.013	

Results

Spread	10.70	ft
Flow Area	1.22	ft^2
Depth	0.31	ft
Gutter Depression	0.09	ft
Velocity	4.56	ft/s

Prop Condition - Curb Inlet @ Los Coches Ct. [100 YR STORM]

Project Description

Solve For	Spread		

Input Data

Discharge		10.56	ft^3/s
Gutter Width		1.50	ft
Gutter Cross Slope		0.08	ft/ft
Road Cross Slope		0.02	ft/ft
Curb Opening Length		4.00	ft
Opening Height		0.67	ft
Curb Throat Type	Inclined		
Local Depression		10.00	in
Local Depression Width		10.00	ft
Throat Incline Angle		90.00	degrees

Results

Spread	7.68	ft
Depth	0.45	ft
Gutter Depression	0.09	ft
Total Depression	0.93	ft

Prop Cond 18" RCP SD @ Los Coches Ct. [100-YR STORM]

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.14500	ft/ft
Diameter	1.50	ft
Discharge	10.91	ft^3/s

Results

Normal Depth	0.54	ft
Flow Area	0.57	ft^2
Wetted Perimeter	1.92	ft
Top Width	1.44	ft
Critical Depth	1.27	ft
Percent Full	35.7	%
Critical Slope	0.01027	ft/ft
Velocity	19.27	ft/s
Velocity Head	5.77	ft
Specific Energy	6.31	ft
Froude Number	5.41	
Maximum Discharge	43.03	ft^3/s
Discharge Full	40.00	ft^3/s
Slope Full	0.01079	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	35.69	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Prop Cond 18" RCP SD @ Los Coches Ct. [100-YR STORM]

GVF Output Data

Normal Depth	0.54	ft
Critical Depth	1.27	ft
Channel Slope	0.14500	ft/ft
Critical Slope	0.01027	ft/ft

Los Coches Trapezoidal Channel [MAX SLOPE]

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.02900	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	0.50	ft
Discharge	0.50	ft^3/s

Results

Normal Depth	0.26	ft
Flow Area	0.34	ft^2
Wetted Perimeter	2.17	ft
Top Width	2.08	ft
Critical Depth	0.21	ft
Critical Slope	0.07460	ft/ft
Velocity	1.47	ft/s
Velocity Head	0.03	ft
Specific Energy	0.30	ft
Froude Number	0.64	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.26	ft
Critical Depth	0.21	ft
Channel Slope	0.02900	ft/ft
Critical Slope	0.07460	ft/ft

Los Coches Trapezoidal Channel [MIN SLOPE]

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.01000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	0.50	ft
Discharge	0.35	ft^3/s

Results

Normal Depth	0.29	ft
Flow Area	0.39	ft^2
Wetted Perimeter	2.30	ft
Top Width	2.21	ft
Critical Depth	0.18	ft
Critical Slope	0.07829	ft/ft
Velocity	0.90	ft/s
Velocity Head	0.01	ft
Specific Energy	0.30	ft
Froude Number	0.38	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.29	ft
Critical Depth	0.18	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.07829	ft/ft

Los Coches -Trapezoidal Channel [MAX FLOW]

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.02300	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	0.50	ft
Discharge	0.53	ft^3/s

Results

Normal Depth	0.29	ft
Flow Area	0.39	ft^2
Wetted Perimeter	2.30	ft
Top Width	2.21	ft
Critical Depth	0.22	ft
Critical Slope	0.07403	ft/ft
Velocity	1.37	ft/s
Velocity Head	0.03	ft
Specific Energy	0.31	ft
Froude Number	0.58	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.29	ft
Critical Depth	0.22	ft
Channel Slope	0.02300	ft/ft
Critical Slope	0.07403	ft/ft

Los Coches Trapezoidal Channel [MIN FLOW]

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.050	
Channel Slope	0.02700	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	0.50	ft
Discharge	0.13	ft^3/s

Results

Normal Depth	0.14	ft
Flow Area	0.13	ft^2
Wetted Perimeter	1.39	ft
Top Width	1.34	ft
Critical Depth	0.10	ft
Critical Slope	0.08988	ft/ft
Velocity	1.00	ft/s
Velocity Head	0.02	ft
Specific Energy	0.16	ft
Froude Number	0.57	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.14	ft
Critical Depth	0.10	ft
Channel Slope	0.02700	ft/ft
Critical Slope	0.08988	ft/ft

Los Coches 4" SD @ 1%

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.01000	ft/ft
Diameter	0.33	ft
Discharge	0.25	ft^3/s

Results

Normal Depth	0.28	ft
Flow Area	0.08	ft^2
Wetted Perimeter	0.78	ft
Top Width	0.23	ft
Critical Depth	0.28	ft
Percent Full	85.9	%
Critical Slope	0.01019	ft/ft
Velocity	3.20	ft/s
Velocity Head	0.16	ft
Specific Energy	0.44	ft
Froude Number	0.97	
Maximum Discharge	0.26	ft^3/s
Discharge Full	0.24	ft^3/s
Slope Full	0.01077	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	85.88	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Los Coches 4" SD @ 1%

GVF Output Data

Normal Depth	0.28	ft
Critical Depth	0.28	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.01019	ft/ft

Los Coches 2-4" SD @ 1.5%

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.01500	ft/ft
Diameter	0.33	ft
Discharge	0.24	ft^3/s

Results

Normal Depth	0.23	ft
Flow Area	0.06	ft^2
Wetted Perimeter	0.64	ft
Top Width	0.31	ft
Critical Depth	0.27	ft
Percent Full	68.5	%
Critical Slope	0.00966	ft/ft
Velocity	3.84	ft/s
Velocity Head	0.23	ft
Specific Energy	0.46	ft
Froude Number	1.50	
Maximum Discharge	0.32	ft^3/s
Discharge Full	0.29	ft^3/s
Slope Full	0.00993	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	68.54	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Los Coches 2-4" SD @ 1.5%

GVF Output Data

Normal Depth	0.23	ft
Critical Depth	0.27	ft
Channel Slope	0.01500	ft/ft
Critical Slope	0.00966	ft/ft

Los Coches 2-4" SD @ 2%

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.02000	ft/ft
Diameter	0.33	ft
Discharge	0.27	ft^3/s

Results

Normal Depth	0.22	ft
Flow Area	0.06	ft^2
Wetted Perimeter	0.63	ft
Top Width	0.31	ft
Critical Depth	0.29	ft
Percent Full	67.2	%
Critical Slope	0.01141	ft/ft
Velocity	4.41	ft/s
Velocity Head	0.30	ft
Specific Energy	0.52	ft
Froude Number	1.75	
Maximum Discharge	0.37	ft^3/s
Discharge Full	0.34	ft^3/s
Slope Full	0.01257	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	67.24	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Los Coches 2-4" SD @ 2%

GVF Output Data

Normal Depth	0.22	ft
Critical Depth	0.29	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.01141	ft/ft

Los Coches - 6-inch PVC Retaining Wall Pipe

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.20000	ft/ft
Diameter	0.50	ft
Discharge	0.42	ft^3/s

Results

Normal Depth	0.14	ft
Flow Area	0.04	ft^2
Wetted Perimeter	0.55	ft
Top Width	0.45	ft
Critical Depth	0.33	ft
Percent Full	27.6	%
Critical Slope	0.00938	ft/ft
Velocity	9.50	ft/s
Velocity Head	1.40	ft
Specific Energy	1.54	ft
Froude Number	5.33	
Maximum Discharge	2.70	ft^3/s
Discharge Full	2.51	ft^3/s
Slope Full	0.00560	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	27.64	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Los Coches - 6-inch PVC Retaining Wall Pipe

GVF Output Data

Normal Depth	0.14	ft
Critical Depth	0.33	ft
Channel Slope	0.20000	ft/ft
Critical Slope	0.00938	ft/ft

LOS COCHES TPM
SIZING PROPOSED DETENTION BASIN

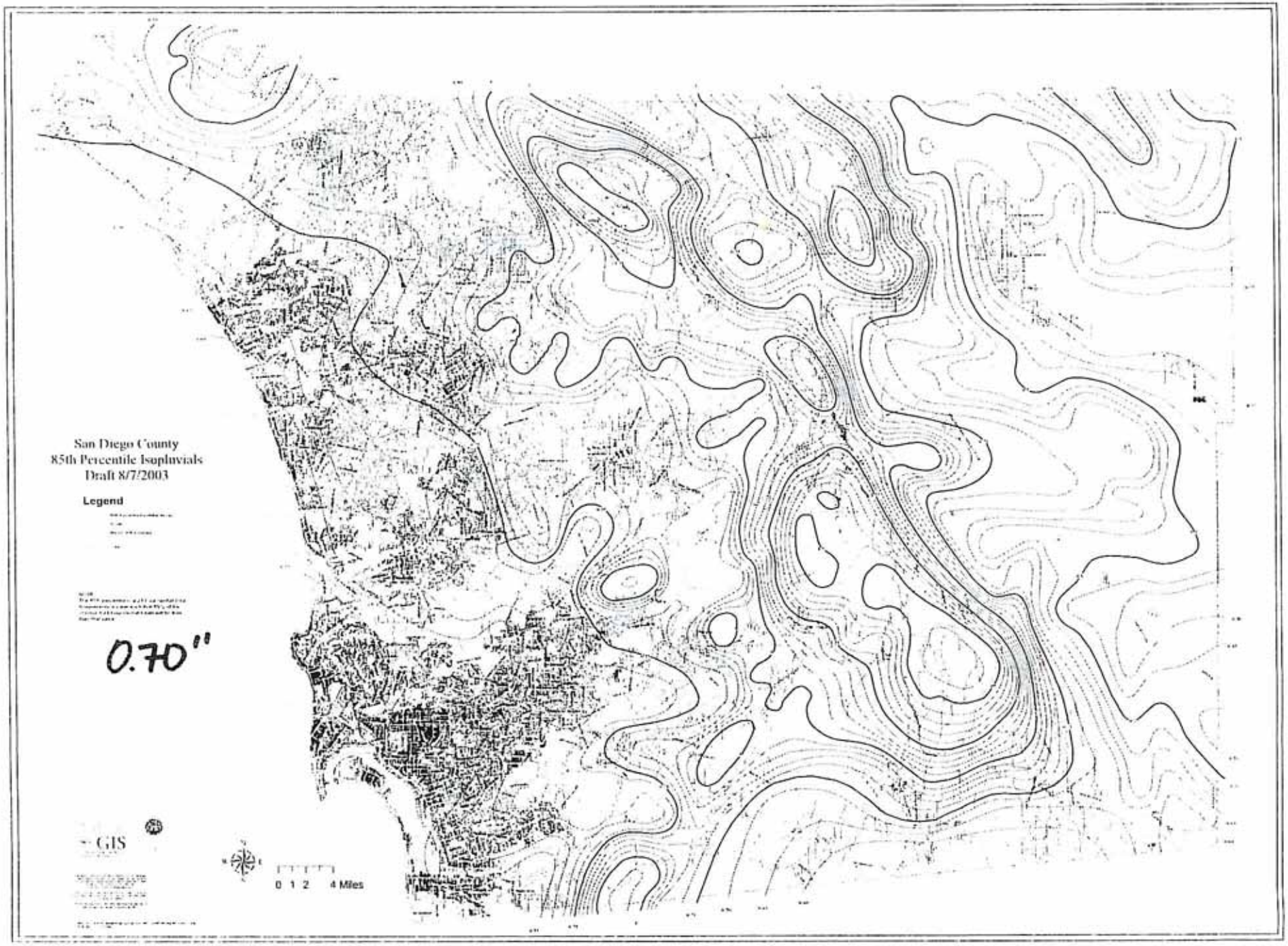
Per the California Stormwater Quality Association (CASQA) *Stormwater Best Management Practice (BMP) Handbook – New Development and Redevelopment SE-2 Detention Basin* fact sheets, the volume of a Detention Basin is the product of the contributing areas and 85 percent of the annual runoff for the proposed site. The total drainage area contributing to proposed detention basin is 0.42 acres or 18213 square feet (sq.ft.). Per San Diego County 85th Percentile Isopluvials Draft 8/7/2006 for the proposed site is 0.7 inches or 0.0583 feet.

Volume (V) = Area * 85% Annual Runoff
V = 0.18213 sq ft * 0.0583 ft
V = 1062.4 cubic feet

Also, option 2 of the Detention Basin fact sheet states that detention basins shall have at least a capacity equivalent to 3,600 cubic feet (cu.ft.) of storage per acre draining into the proposed detention basin. Therefore, 0.42 acres shall have 1512 cu.ft. of storage. Since 1512 cu.ft. is greater than 1062.4 cu.ft, the storage capacity of the proposed detention basin shall be V=1512 cubic feet.

Per the Detention Basin fact sheet, the length of the proposed detention basin shall be twice the width and the depth shall be no less than 3 feet. For the volume of 1512 cu.ft, determined above, the detention basin shall be of the following dimensions:

Length = 32 feet
Width = 16 feet
Depth = 3 feet


San Diego County
85th Percentile Isopluvials
Draft 8/7/2003
Legend
0.70"
GIS
0 1 2 4 Miles