

# BALCERAK DESIGN

LANDSCAPE ARCHITECTURE • URBAN FORESTRY

608 Beaver Street Santa Rosa, CA 95404 (707)573-8234

## Drainage Review for 52 Fremont Road, San Rafael

The existing property is currently an undeveloped lot. The development proposal is to construct a single-family residence, attached garage, driveway and associated improvements. The property slopes towards Marquard Avenue with an average slope of approximately 40%.

This report has been prepared to compare the runoff from the existing site and the runoff that would occur based on the development proposal. The methods described with in the County of Marin Hydrology Manual have been used to determine the runoff.

The Rational Method ( $Q=CiA$ ) was used to determine the existing and proposed runoff. The runoff for the Existing Condition is 0.41 cfs and the runoff for the Proposed Condition is 0.39 cfs. This demonstrates that the runoff would not be increased.

Refer to the attached calculations.



# 1/3 52 FREMONT RD SAN RAFAEL DRAINAGE STUDY

PER THE MARIN HYDROLOGY MANUAL

DETERMINE THE TIME OF CONCENTRATION FOR THE EXISTING CONDITION

$$T_c = \frac{1.8(1.1-C)\sqrt{L}}{\sqrt[3]{S(100)}} + 5 \text{ min}$$

WHERE C = Runoff Coefficient  
L = Longest Run  
S = Average Slope

FROM THE DRAINAGE EXHIBIT - EXISTING (ATTACHED)

$$\begin{aligned} C &= 0.7 \\ L &= 142 \text{ ft} \\ S &= .36 \text{ ft/ft} \end{aligned}$$

$$\therefore T_c = \frac{1.8(1.1-0.7)\sqrt{142}}{\sqrt[3]{.36(100)}} + 5 \text{ min}$$

$$= 2.6 \text{ min} + 5 \text{ min} = 7.6 \text{ min OR } \underline{\underline{8 \text{ min}}}$$

DETERMINE ZONE FROM MAP V: ZONE B

DETERMINE  $I_{60}$  FROM MAP I = 1.2" / hr

USE CHART K ZONE B TO FIND THE CORRECT CURVE USING THE  $I_{60}$  AND 1 HOUR INTERSECT (ATTACHED)

FOLLOW THIS CURVE TO FIND  $T_c$  FOR 8 min = 3.35" / hr

CALCULATE THE RUNOFF FOR THE EXISTING CONDITION

$Q = C \cdot i \cdot A$  WHERE  
Q = Runoff Quantity  
C = Runoff Coefficient  
i = Rainfall Intensity  
A = Area in Acre

$$\begin{aligned} \text{USE } C &= 0.7 \\ i &= 3.35 \\ A &= 0.1765 \end{aligned}$$

$$\begin{aligned} Q &= 0.7(3.35)(0.1765) \\ &= \underline{\underline{0.41 \text{ cfs}}} \end{aligned}$$

FIND Q

TO DETERMINE THE TIME OF CONCENTRATION FOR THE PROPOSED CONDITION THE SITE HAS BEEN DIVIDED INTO THREE DRAINAGE BASINS, SEE THE DRAINAGE EXHIBIT - PROPOSED (ATTACHED)

TO DETERMINE THE  $T_c$  FOR BASIN A BEGIN WITH THE FOOT AREA TO FIND THE RUNOFF QUANTITY

USE  $Q = C \cdot i \cdot A$

2/3

$$\begin{aligned} \text{Roof } C &= 0.9 \\ \text{8 min } i &= 3.35 \text{ in/hr} \\ \text{Roof } A &= 0.0160 \text{ ac} \end{aligned} \quad \therefore Q = 0.9 (3.35) (0.0160) = \underline{0.048 \text{ cfs}}$$

THE ROOF RUNOFF IS DIRECTED TO THE FLOW THROUGH PLANTER, SEE DETAIL (ATTACHED) THE DETAIL SHOWS .5' DEEP RESERVOIR - DUE TO THE POLE A VOID SPACE OF 30% IS USED TO DETERMINE HOW MUCH WATER CAN BE STORED PRIOR TO RUNOFF EXITING THE PERFORATED PIPE. THE FLOW THROUGH PLANTER IS  $28 \text{ ft}^2$

$$\text{USE } \text{time} = \frac{\text{Volume}}{\text{Rate}} \quad \text{Volume} = 28 (.5) (.3) = 4.2 \text{ ft}^3$$

$$\therefore \text{time} = \frac{4.2}{0.048} = \underline{1.5 \text{ min}}$$

DUE TO THE STEEP SLOPE AND SHORT DISTANCES, AND TO BE CONSERVATIVE THE TRAVEL TIME FROM THE ROOF TO THE FLOW THROUGH PLANTER AND THE TIME FROM THE FLOW THROUGH PLANTER TO THE CURB IS ASSUMED TO BE ZERO.

TO DETERMINE THE TIME OF CONCENTRATION FOR BASIN B USE THE KIRPICH FORMULA

$$T_c = \frac{0.0078 L^{0.77}}{S^{0.385}} \quad \text{WHERE } T_c = \text{Time of Concentration (min)}$$

$$L = \text{Length (ft)}$$

$$S = \text{Slope (ft/ft)}$$

FROM THE DRAINAGE EXHIBIT - PROPOSED  $L = 57 \text{ ft}$   
 $S = 0.088 \text{ ft/ft}$

$$\therefore T_c = \frac{0.0078 (57^{0.77})}{0.088^{0.385}} = \underline{0.4 \text{ min}}$$

TO DETERMINE THE TIME OF CONCENTRATION FOR BASIN C USE  $Q = CiA$  TO FIND QUANTITY OF RUNOFF

TO FIND  $i$  SUM UP THE TIME OF CONCENTRATION FROM THE INITIAL  $T_c + T_c$  OF BASIN A +  $T_c$  OF BASIN B

$$\therefore 8 \text{ min} + 1.5 \text{ min} + 0.4 \text{ min} = 9.9 \text{ min}$$

FIND  $i$  FOR 9.9 min FROM CHART K ZONE B =  $3.00 \text{ in/hr}$

3/3

CALCULATE THE RUNOFF FROM THE ROOF IN BASIN C USE  $Q = CIA$

$$\begin{aligned} \text{ROOF } C &= 0.9 \\ 9.9 \text{ min } i &= 3.00 \text{ in/hr} \\ \text{ROOF } A &= 0.0234 \text{ ac} \end{aligned} \quad \therefore Q = 0.9(3.00)(0.0234) = \underline{0.06 \text{ cfs}}$$

CALCULATE THE VOID SPACE IN THE FLOW THROUGH PLANTER IN BASIN C - THE AREA OF THE PLANTER IS  $41 \text{ ft}^2$

$$\therefore \text{Volume} = 41(1.5)(1.3) = 6.15 \text{ ft}^3$$

$$\text{USE } \text{time} = \frac{\text{volume}}{\text{rate}} \quad \text{WHERE volume} = 6.15 \text{ ft}^3 \\ \text{rate} = 0.06 \text{ cfs}$$

$$\begin{aligned} \text{time} &= \frac{6.15}{0.06} \\ &= \underline{1.7 \text{ min}} \end{aligned}$$

THE TOTAL  $T_c$  IS THE SUM OF THE INITIAL  $T_c$  + THE THREE BASIN AREAS

$$T_c = 8 \text{ min} + 1.5 \text{ min} + 0.4 \text{ min} + 1.7 \text{ min} = 11.6 \text{ min}$$

USE CHART K ZONE B TO FIND  $i$  FOR  $11.6 \text{ min} = \underline{2.80 \text{ in/hr}}$

USE  $Q = CIA$  TO FIND THE RUNOFF OF THE PROPOSED CONDITION

$$\begin{aligned} \text{FIND WEIGHTED } C: \quad C &= \frac{0.7(4083) + 0.9(3046)}{7129} \\ C &= \underline{0.79} \end{aligned}$$

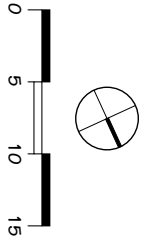
TOTAL SITE AREA IS  $0.1765 \text{ ac}$

$$\begin{aligned} \therefore Q &= 0.79(2.80)(0.1765) \\ &= \underline{0.39 \text{ cfs}} \end{aligned}$$

EXISTING CONDITION RUNOFF IS  $0.41 \text{ cfs}$  THE PROPOSED CONDITION RUNOFF IS  $0.39 \text{ cfs}$  - RUNOFF IS NOT INCREASED

STUDY AREA IS 0.1765 ACRE

**DRAINAGE EXHIBIT - EXISTING**  
**APN: 012-043-12**  
**52 FREMONT ROAD - SAN RAFAEL**



Point 1  
Ei: 142.5'



Longest Run - 142'  
Slope -  $50.5' / 142' = .36$

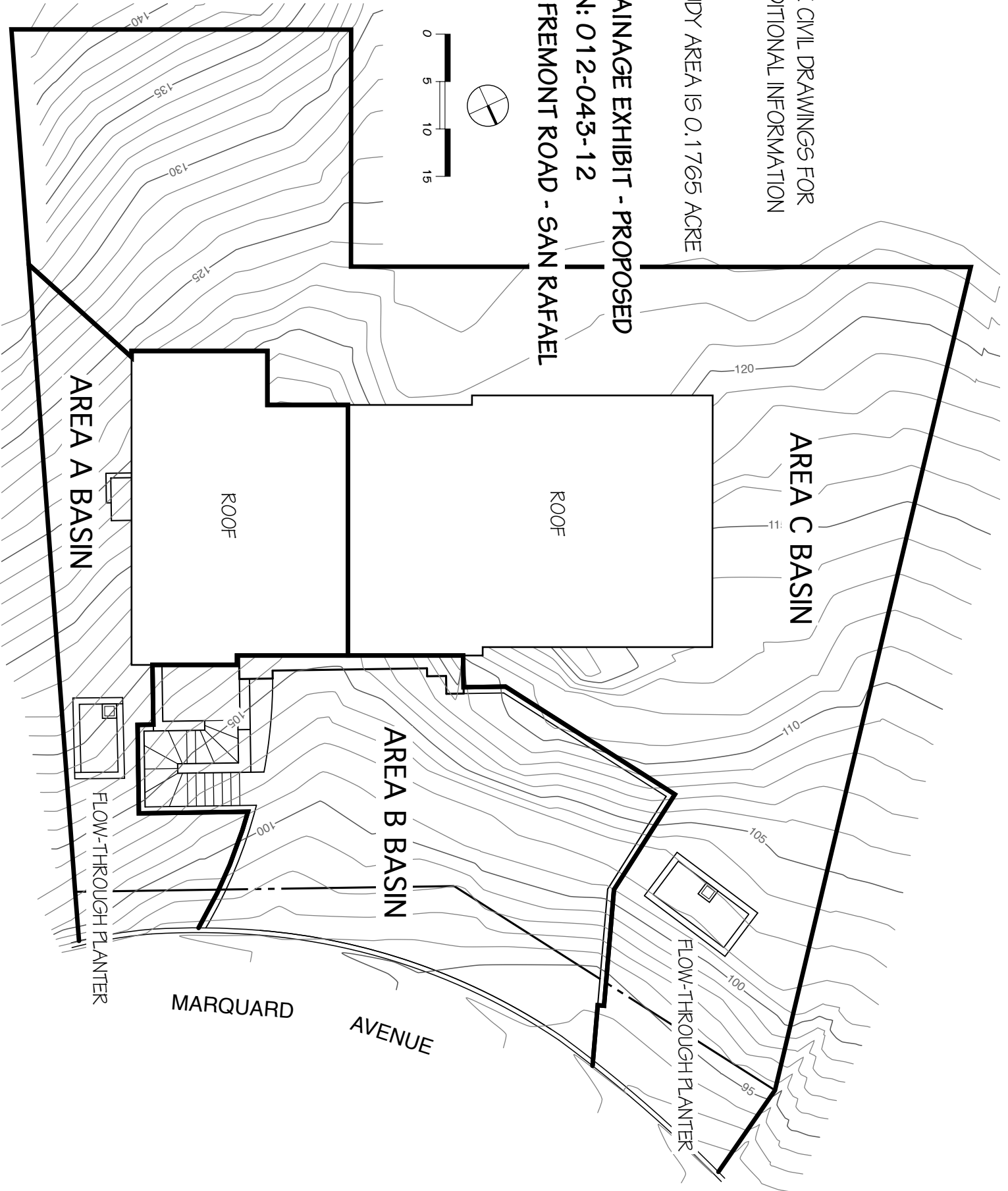
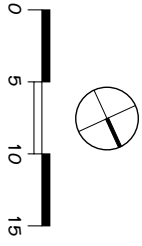
MARQUARD AVENUE

Point 2  
Ei: 92.0'

SEE CIVIL DRAWINGS FOR  
ADDITIONAL INFORMATION

STUDY AREA IS 0.1765 ACRE

**DRAINAGE EXHIBIT - PROPOSED**  
**APN: 012-043-12**  
**52 FREMONT ROAD - SAN RAFAEL**



**NOTE:**

SURFACE AREA OF THE BIO-TREATMENT SOIL SHALL EQUAL 4% OF THE AREA OF THE SITE THAT DRAINS TO TREATMENT MEASURE, UNLESS SIZING CALCULATIONS ARE SUBMITTED DEMONSTRATING THAT PROVISION C.3 REQUIREMENTS ARE MET USING A SMALLER SURFACE AREA

DI FILLED WITH DRAIN ROCK TO ACT AS ENERGY DISSIPATER, SEE UTILITY PLAN FOR ADDITIONAL INFORMATION

DRAIN LINE, SEE UTILITY PLAN FOR ADDITIONAL INFORMATION

CLEANOUT WITH CAP AT FIN. GRADE (SEE MUNICIPAL STANDARD DRAWING) BEGINNING OF LINE

BIO-TREATMENT SOIL (BSM) MIX PER SPECS.

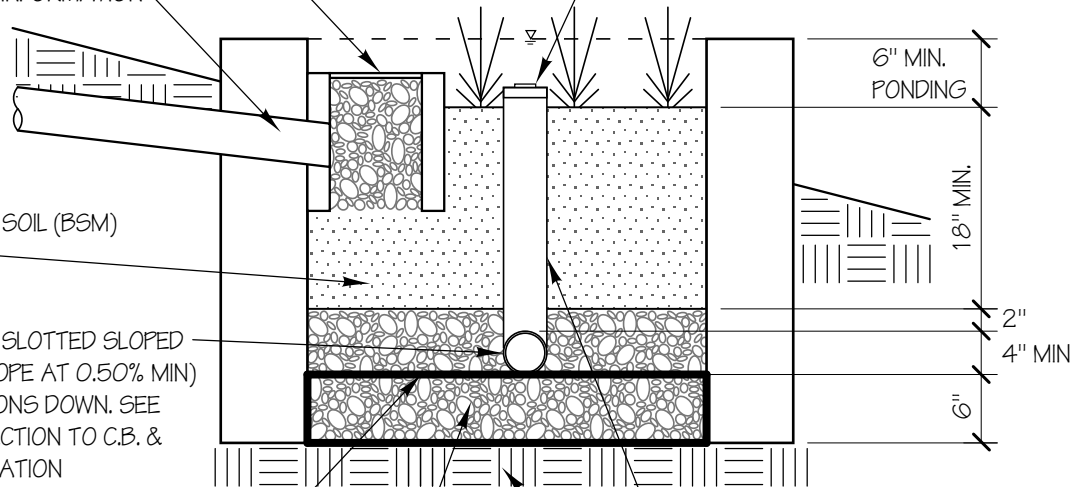
PERFORATED OR SLOTTED SLOPED UNDERDRAIN (SLOPE AT 0.50% MIN) WITH PERFORATIONS DOWN. SEE PLAN FOR CONNECTION TO C.B. & FOR INVERT ELEVATION

12" MIN OF CLASS II PERMEABLE ROCK PER CALTRANS SPECIFICATIONS

6" RESERVOIR (VOID SPACE IS .3 OF THE TOTAL VOLUME)

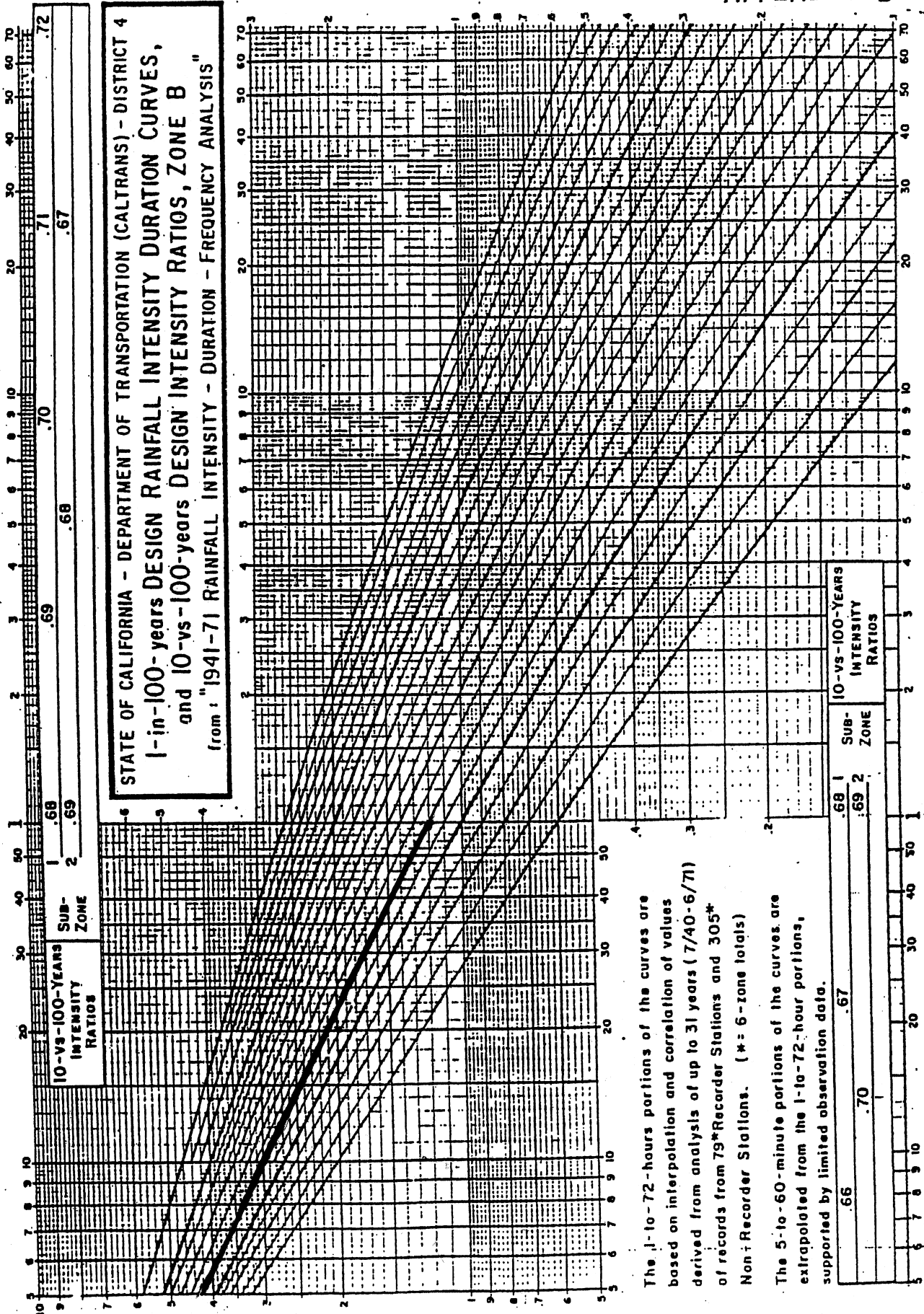
UNDERDRAIN CLEANOUT WITH RIM TO FIN. GRADE. SEE UTILITY PLAN FOR LOCATION AND INVERT

NATIVE SOIL DO NOT COMPACT



# FLOW-THROUGH PLANTER DETAIL

NOT TO SCALE



STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION (CALTRANS) - DISTRICT 4  
 1-in-100-years DESIGN RAINFALL INTENSITY DURATION CURVES,  
 and 10-vs-100-years DESIGN INTENSITY RATIOS, ZONE B  
 from: "1941-71 RAINFALL INTENSITY - DURATION - FREQUENCY ANALYSIS"

The 1-10-72-hour portions of the curves are based on interpolation and correlation of values derived from analysis of up to 31 years (7/40-6/71) of records from 79\*Recorder Stations and 305\* Non-Recorder Stations. (\* = 6-zone totals)

The 5-10-60-minute portions of the curves are extrapolated from the 1-10-72-hour portions, supported by limited observation data.

10-VS-100-YEARS INTENSITY RATIOS	SUB-ZONE	10-VS-100-YEARS INTENSITY RATIOS
.66	1	.68
.67	2	.69
.70		