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# CEQA PRELIMINARY DRAINAGE STUDY

**For**

# TM 5469

San Diego County DPLU Case Number TM 5469RPL Log 05-02-043 ER 05-02-043

At

3061 Ridge Creek Drive

APN 105-310-2200

**In The**

**Unincorporated San Diego County Community Of Fallbrook**

**Prepared For**

Leising Family Trust UTD April 12,1999
And
McConnell Family Trust 1989
1260 Via Vista
Fallbrook, CA. 92028
(760) 703-8694

Initial Submittal November 2005
Revised March 6, 2006
Revised April 11, 2006
Revised August 2, 2006
Revised November 27, 2006
Revised March 21, 2007
**Revised August 6, 2007**

**Prepared By**

Jeffrey N. Wilson ______________________ C57740 Expires 12-31-07

**For**
**Acal Engineering & Surveying, Inc.**
**145 North Melrose Drive, Suite 200; Vista CA 92083**
**(760) 724-7674; Fax (760) 724-0940**

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## List of Tables, Charts and Figures — Location

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## List of Tables, Charts and Figures — Location

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APPENDIX E



APPENDIX F



APPENDIX G

**Executive Summary of Hydrologic Conditions**

The pre-developed condition flow pattern has been maintained for the post-developed condition. The site has been divided into seven (7) outfalls (or Confluence Points) labeled CP1 to CP7. The eventual downstream receiving water for all outfalls is a tributary to Live Oak Creek. There is a portion of the tributary on the east and west on the site, with convergence to the south. Upon visual inspection, there is no evidence of erosion in this tributary in the areas surrounding this site.

For the entire 33-acre site, there will be a 3.2 cfs increase in the Post-Developed Condition. Runoff is outlet at seven (7) points throughout the property. Outfall point 1 actually has a negative differential $Q_{100}$ (-2.8 cfs). Outfall Points 2, 3, & 7 are less than 1 cfs. Outfall Points 4, 5 and 6 are less than 2 cfs, each draining directly to the tributary.

The $Q_{100}$ of the creek has been evaluated at confluence points directly downstream of the site. The point in the tributary at which Outfall 1 and Outfall 2 enter (to the south of the southerly property line), has a $Q_{100}$ of 203.9 cfs. The actual differential $Q_{100}$ for the Post-Developed condition is a decrease (-2.8 + 0.9 cfs) of -1.9 cfs for this confluence point. This Point of confluence is shown as Point A on Exhibit 1 within this report.

Outfalls 3 through 7 drain to the west and then directly to the existing tributary on the westerly side of the site. The increase in $Q_{100}$ varies between 0.2 cfs at Outfall 7 and 1.8 cfs for Outfall 6, for a total increase in $Q_{100}$ of 5 cfs. The $Q_{100}$ for the confluence point of the creek downstream of these Outfalls is increased from 239.6 cfs in the pre-developed condition, to 244.6 cfs in the post-developed condition. This Point of confluence is shown as Point B on Exhibit 1 within this report. This represents a 2% increase in flow at the 100-year level and is deemed insignificant, as there is no historical evidence of flooding or erosive conditions within this receiving water or in surrounding properties.

Outfalls 3 through 7 each sheet flow westerly across an existing driveway and into the tributary to the west. This is the historical drainage pattern. As the drainage pattern and sheet flow condition will be maintained, there will be no concentration of flow to the offsite properties. Existing structures are not in danger of being effected by this development, as they are not within the existing drainage pattern.

Outfall 8 is where the tributary offsite water crosses through the northwest property corner and underneath Ridge Creek Drive (formerly Dip Drive). There is no increase in storm water from the off site improvements to the private road, Ridge Creek Drive. The additional 2,200 square feet of asphalt to the Ridge Creek Drive (550 feet by 4 feet) generates approximately 2/10 CFS more runoff to a total of 4.2 CFS, from the 100-year event. This compares to approximately 4 cfs from the100-year event. This additional storm water out falls to Outfall 8. The pre-developed runoff at CP8 is about 161.1 CFS. The post-developed runoff is 161.3 CFS (0.12 percent increase). The total tributary area to Outfall 8 90.7 acres, the additional impervious area of 2200 square feet is an increase of 0.05 percent. This increase is also deemed insignificant.

There will be no divergence of flow or significant increase in velocity or flow due to the development of this project. Therefore this project is not expected to cause flooding to down stream properties. All runoff will follow in the same historical drainage pattern and the pre-developed Q's have been essentially maintained in the post-developed condition.

SUMMARY Q100 POST ONSITE REV17.xls
Revised "C" = 0.39 and
Revised Initial Tc = Ti
Ti= 11.9 min

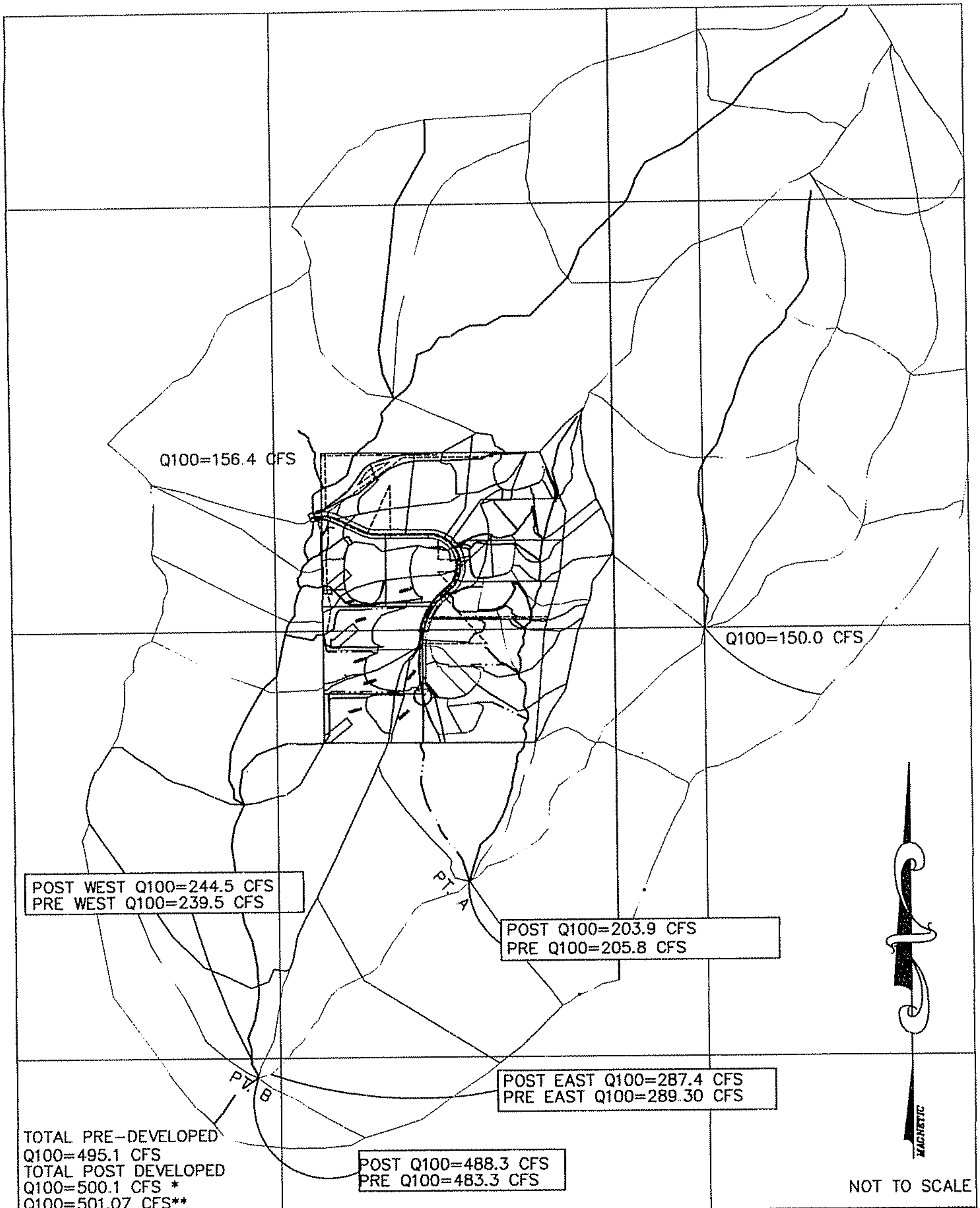
| OUT FALL PT | PRE Area AC | POST Area AC | △ Area Ac | PRE Len Ft | POST Len Ft | PRE "C" | POST "C" | PRE Tc Min | POST Tc Min | PRE "I" In/Hr | * POST "I" In/Hr | PRE Q100 CFS | POST Q100 CFS | △ Runoff CFS | Notes and Locations | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 18.58 | 18.98 | 0.40 | 1672.0 | 1285.0 | 0.35 | 0.39 | 19.0 | 34.5 | 3.90 | 2.65 | 28.90 | 26.10 | -2.80 | * | Eastern Watershed |
| 2 | 1.35 | 1.35 | 0.00 | 465.0 | 263.0 | 0.35 | 0.54 | 13.0 | 14.3 | 4.99 | 4.69 | 2.40 | 3.30 | 0.90 | ** | Southern Watershed |
| 3 | 2.45 | 2.26 | -0.19 | 602.0 | 648.0 | 0.35 | 0.39 | 14.9 | 15.0 | 4.56 | 4.54 | 3.91 | 4.20 | 0.29 | ** | West Watershed SubBasin |
| 4 | 4.91 | 4.05 | -0.86 | 961.0 | 735.0 | 0.35 | 0.39 | 20.0 | 15.1 | 3.77 | 4.53 | 6.47 | 7.70 | 1.23 | *** | West Watershed SubBasin |
| 5 | 3.12 | 3.25 | 0.13 | 933.0 | 655.0 | 0.35 | 0.39 | 19.4 | 21.1 | 3.83 | 3.65 | 4.20 | 5.70 | 1.50 | *** | West Watershed SubBasin |
| 6 | 3.34 | 3.54 | 0.20 | 946.0 | 796.0 | 0.35 | 0.39 | 18.9 | 31.4 | 3.91 | 2.94 | 4.57 | 5.80 | 1.23 | *** | West Watershed SubBasin |
| 7 | 4.07 | 4.39 | 0.32 | 1020.0 | 1132.0 | 0.35 | 0.39 | 19.4 | 36.3 | 3.71 | 2.57 | 5.48 | 5.70 | 0.22 | ** | West Watershed SubBasin |
| Total | 37.82 | 37.82 | 0.00 | | | | | | | | | 55.93 | 58.50 | 2.57 | | Q100 Excess Runoff Total |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | 4.47 | | Q100 Excess West Runoff |
| | | | | | | | | | | | | | | -1.90 | | Q100 Excess East Runoff |

NOTES

* NO EXCESS RUN OFF

** AMOUNT OF EXCESS RUN OFF LESS THAN 1 CFS IS NEGLIABLE

*** AMOUNT OF EXCESS RUN OFF >1 CFS BUT < 2 CFS INSIGNIFICANT




# CONFLUENCE EXHIBIT

# TM 5469

* CONFLUENCE EQUATIONS NOT USED ** CONFLUENCE EQUATIONS USED

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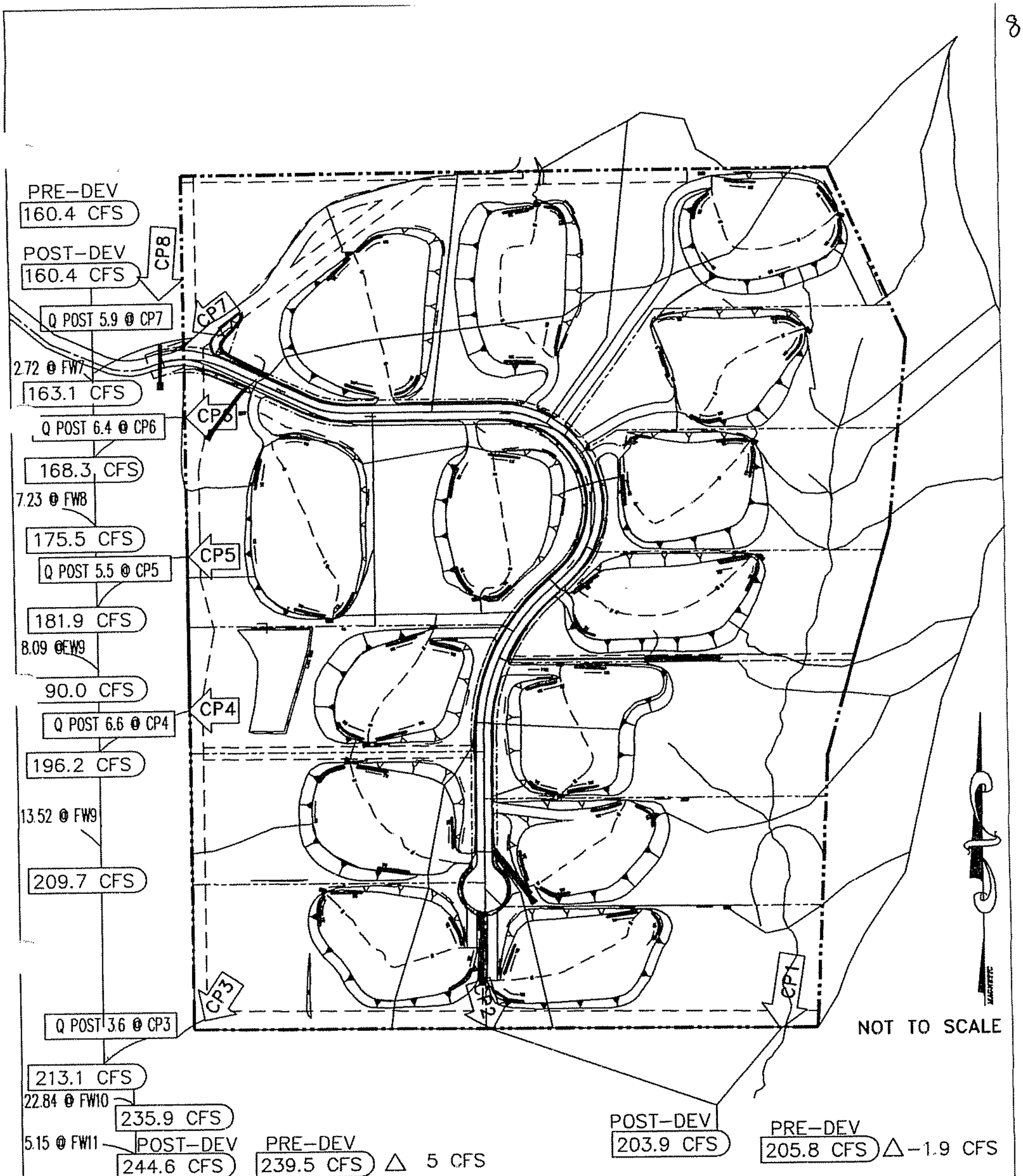
EXHIBIT NO. 1




# POST-DEVELOPEMENT EXCESS RUN OFF (Q100)

# TM 5469

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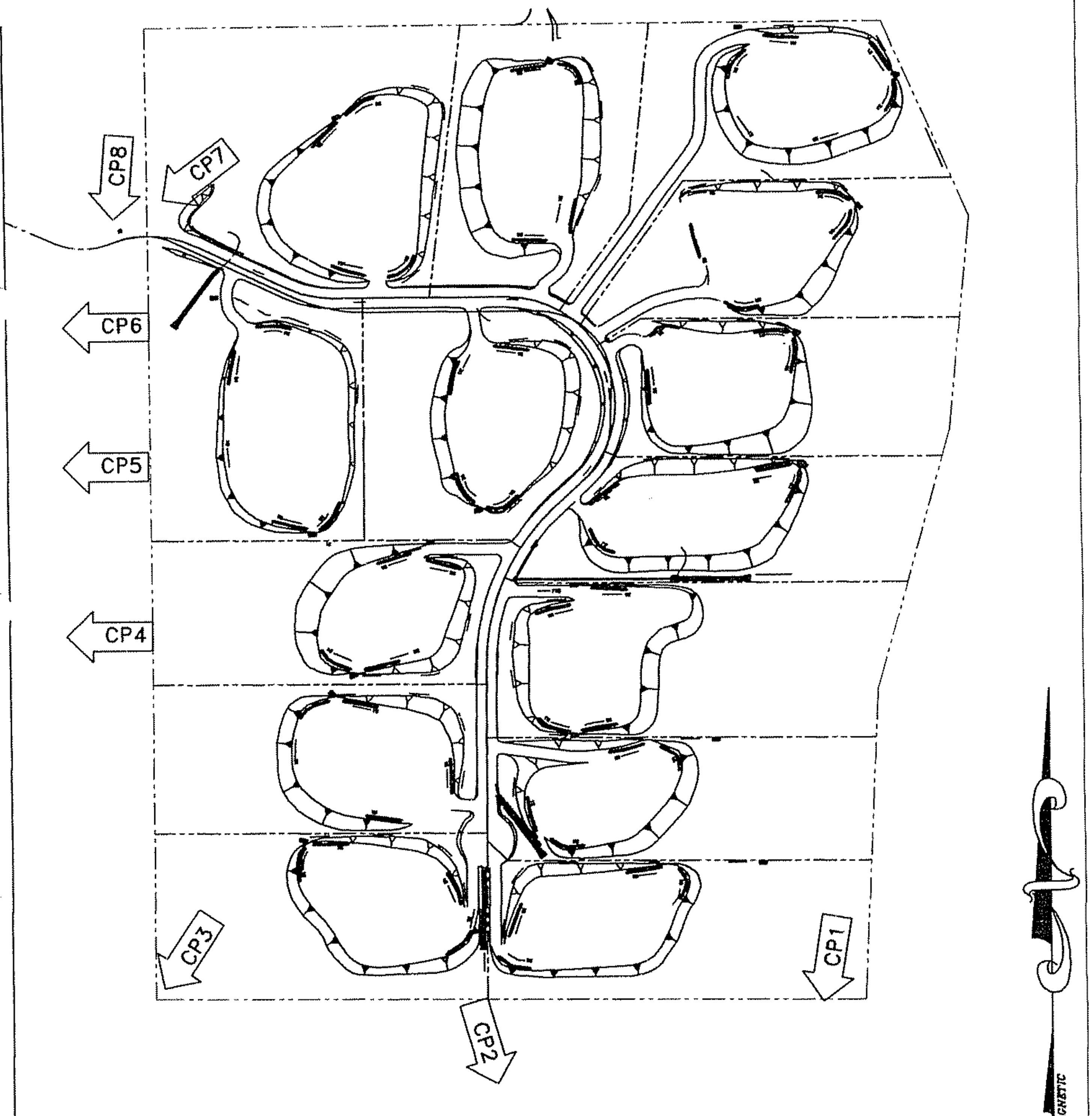
EXHIBIT NO. 2




NOT TO SCALE

PRE DEVELOPED OUTFALL LOCATIONS & POST DEVELOPED OUTFALL LOCATIONS

TM 5469 E:\PROJECTS\RIDGE_CREEK\JUL2007\OUTFALL_LOCATION_EXHIBIT.dwg

EXHIBIT NO. 3

# Declaration of Responsible Charge

I hereby declare that I am the civil engineer of work for this

***Preliminary Drainage Study***

That I have exercised responsible charge over this

***Preliminary Drainage Study***

As defined in Section 6703 of the Business and Professions code, and that the design is consistent with current design.

I understand that the check of project drawings, specifications and technical studies by the county of San Diego is confined to a review only and does not relieve me, as engineer of work of my responsibilities for project design.

REGISTERED PROFESSIONAL ENGINEER
JEFFREY N. WILSON
No. 67740
Exp 12-31-07
CIVIL
STATE OF CALIFORNIA

**Jeffrey N. Wilson** | 12 Aug 2007 **DATE**

**R.C.E. C057740** | **EXP. 12-31-07**

# Drainage Study Statement

This CEQA preliminary drainage study has been prepared for the discretionary review of Tentative Map 5469. This study defines the pre-development hydrology to the level of detail shown on the 200-scale county topography maps. It addresses post-development hydrology to the level of detail shown tentative parcel map.

This study is not intended as final and upon preparation of the final map and the preparation of Ridge Creek Drive improvement plans it should be reviewed. And this study should be revised if any necessary changes are found that will significantly alter or modify the project's design or drainage discharge characteristics.

The plans and specifications in this preliminary drainage analysis are not for construction purposes. There are only preliminary hydraulic calculations in the document. The storm drain systems are tentatively sized based on the preliminary grading plan. An adequate field survey and cross section data will be collected during the final preparation of the improvement plans for Ridge Creek Drive. Detailed hydrology and hydraulic calculations in conjunction with the survey data will be done at that time. This study was done using current acceptable engineering practices, good engineering judgment, published technical manuals and profession experience.

# Off Site Stormwater Facilities Statement

This preliminary drainage study does not evaluate the capacity of existing off-site improvements outside of the proposed projects hydrologic impact, specifically the private easement road, known as Ridge Drive, which is used as the primary access for TM 5469. Since the proposed project is entirely downstream and therefore results in no hydraulic impact to Ridge Drive, the hydraulic capacity of the easement road and its culverts crossing have not been analyzed. Any future flooding problems, including potential loss of access and cost to repair the road in the event of storm damage, are the responsibility of the private road easement owners and its users.

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# SECTION 1

1.0

## SECTION 1.0 INTRODUCTION

Project Over View 1.10
This document provides preliminary hydrologic and hydraulic technical data and design support for the preliminary grading plans required by Tentative Parcel Map 5469RPL. The focus of this drainage study is a 33-acre parcel that is situated between two drainage courses (Project Area) Tentative Parcel Map 5469RPL proposes to subdivide the parcel into 14-lots. The area tributary to the confluence point of these drainage courses is about 400 acres (Study Area).

The study area includes the project's 33 acres, 93 acres due north from the site and 9 acres along the eastern boundary of the site, and 265 acres down stream from the project site. The land use is best characterized as large residential agriculture estates.

Propose 1.20
This hydrology and hydraulics report is in support of the preliminary grading and improvement plans. The document will provide the preliminary calculations required for verifying the capacity of any existing storm drain and related infrastructure. This study will also provide initial technical data for the design of both temporary and permanent post construction storm water pollution prevention devices.

Scope 1.30
The scope of this study includes the following:

1- Determine if the proposed development lies within any designated flood plain as defined by the Federal Emergency Management Agency (FEMA).
2- Determine the pre-development (existing) 100-year tributary peak runoff from the study area and the project area.
3- Determine the post-development (proposed) 100-year tributary peak runoff from the study area and the project area.
4- Provide an exhibit that delineates the 100-year flood line of any natural channels that cross any lots with tributary watersheds in excess of twenty-five (25) acres.
5- Provide a Summary Drainage Table for post-development conditions, showing the following basin information at all out fall points for the 100-year storm events

   Length, Nodal Elevations, Slope, Area, Runoff Coefficient "C" Time of Concentration

   Basin runoff rate, Peak runoff rate, and Intensity
6- Provide a narrative description for each out fall point.
7- Determine if there are pre-development drainage conditions that may adversely impact the contiguous properties
8- Determine if the post-development conditions will have an impact on down stream properties due to any significant change of the peak flow characteristics that can not be mitigated
9- Address local drainage facilities receiving additional runoff due to the proposed development and identify any runoff contribution that would exceed their capacity

Project Description 1.30

The McConnell Family 1989 Trust and the Leising Family Trust UTD April 12, 1999 has retained Acal Engineering and Surveying to prepare and submit to the County of San Diego documents for the subdivision and development of APN 105-310-2200. This hydrology study is in support of those documents. The development includes grading 14 separate building pads for 14 residential parcels and approximately 1400 lineal feet of private road.

The layout of the site is designed to minimize the use of impervious areas. The access road ending with a cul-de-sac is the shortest practicable. This design reduces to the maximum extent practical the surface area that comes in contact with storm water run off. The on site street and associated improvements use the County of San Diego's minimum width criteria. The streets will have a graded width of 28 feet and a paved width of 24-feet with a low mountable ac curb. The graded road will be super elevated. The road will drain two percent from the southerly edge of pavement to the northerly edge where the ac curb will be. To the maximum extent practicable, all of proposed private driveways will be constructed to drain into landscaped areas to promote infiltration and reduce surface water run off,

Project Location 1.31

The project is located in the unincorporated community of Fallbrook (See Appendix A). The 33-acre site is approximately 3 miles due east of downtown Fallbrook and a mile west of Interstate 15. Access to the project area is from East Mission Road and Live Oak Park Road. Specifically, Ridge Creek Drive is six tenths of a mile east of Live Oak Park along Ridge Drive. The 1360' by 1020' parcel is located on the south side of Ridge Creek Drive. The street address for APN 105-310-2200 is 3061 Ridge Creek Drive. The site can be described as being a portion of the NE1/4 of the SE1/4 of Section 21, Township 9 South, Range 3 West; San Bernardino Base Meridian. The site can be found on the USGS Quadrangle sheet is entitled "Temecula". The geographic position of the middle of the project is Latitude: 33° 22" 30" North. Longitude; 117° 11' 30" West

Project Area Description 1.32

The rectangular shaped parcel covers nearly 33 acres of rolling terrain that was used for cultivation of strawberries and tomatoes. Approximately 95-percent of the project area has been previously disturbed. The parcel has an east-west dimension of nearly 1138 at it's widest and a dimension of 1357 feet north to south. The parcel has a maximum elevation of over 960 feet near the northeast corner. The elevation of the southeast corner is about 807. The site has a southern exposure with historical drainage patterns trending north to south. The site is bounded on both the west and the east by a natural drainage channels. These slope to the south from 5-percent to nearly 20-percent. The average slope of the property is 14.96-percent. Ten-percent of the site has slopes in excess of twenty five-percent. There are several structures on this parcel, including two large packing shed and two residential dwellings. The site has been fallow for the last few years

Pre-Developed Drainage Facilities 1.33

There are three storm drain facilities in and around this project area. (See Appendix A, Existing Storm Drain Facilities Exhibit). All three are part of the western drainage course. There is a 36" culvert that crosses underneath Ridge Creek Drive with a slope of about 4-percent. It is close to the project entrance at the northwest property corner. This exit or discharge point is CP-8. The upstream entrance of the 36-inch culvert is a thin projecting edge and the outlet was at one time also. Currently, it is overgrown and has undercut part of the bank. The second structure is located about 2000 feet south of CP-8, and about 650 feet past the southern project boundary. This drainage structure conveys storm water underneath a private road. It is situated between Camino Alisos and Arroyo Pacific. It consists of concrete headwall and a 36-inch diameter corrugated metal pipe (CMP) and a 24-inch CMP. The inverts of both pipes are the same and the slope is about five-percent. The third facility, 550 feet downstream from the culverts, is a small pond with a surface area of about three-quarter-acre (33,000 SF); locally know as "Goodman's Pond". The pond's earth filled dam is the road fill from Los Alisos Drive. The road fill was used to bridge the drainage course and now it is the dam. There are two 24-inch corrugated metal pipes (CMP) that allow some water to pass. There also is an emergency spillway section (W=15 Feet) on Los Alisos Drive. This spillway is about 2 feet above the top of the culverts, (four feet above the inverts). This spillway will be the trial point of insignificant impact.

Hydrologic Description 1.34

The site is entirely with in the San Luis Rey Watershed, Hydrologic Unit 903. Specifically it is in the Lower San Luis Rey Hydrologic Area, (HA 903.12) and entirely in the Bonsall Hydrologic Sub-Area (HSA 903.12). The CWA 303(d) List: Pacific Ocean and the Lower San Luis Rey River are impacted. This tributary area of this project covers approximately 33 Acres or 0.052 Square Miles. This is about 0 0094 percent of the total San Luis Rey watershed.

Flood Zone Information 1.34

| **Flood Panel Information** | | **Flood Zone Information** | |
|---|---|---|---|
| FIPS | Code 6 | FEMA Code | 161 |
| FEMA Community Panel | 060284 | **Floodplain Information** | |
| Full Panel | 175F | FEMA | Zone X |
| FIS Date | 19-JUN-97 | | |

Zone "X" is defined as an area that the flood elevations have not yet been determined.

Project Area Soil Description 1.35

The soils underlying this project have been identified from the San Diego County Soil Survey (See Appendix A, Soil Map Exhibit). The three most predominant soils are Vista Sandy Loam with slopes between 9% and 15% (FvD); Fallbrook Sandy Loam with slopes between 9%, 15% (FaD2), Placentia Sandy Loam with thick surface with slopes between 2% and 9%(PeC), and there is some Placentia Sandy Loam with slopes between 2% and 9% (PfC). The parent material for all three soils is Residium Weathered from Granodiorite. The drainage courses on both sides of the project site have been classified as Steep Gullied Land (StG).

The run off coefficients are based on land use and soil type. These local soil types were determined to be in the Hydrologic Soil Group "D" (San Diego County Soil Survey). Typically, Hydrologic Soil Group "D" soils are shallow and underlain by dense or nearly impervious materials. This soil group also has very low infiltration rates when thoroughly wetted. The value of the runoff coefficient (C) was taken from Table 3-1 (Page 3-6). Good engineering judgment was used when choosing the values presented in Table 3-1. No adjustments were made to these.

The identified soils have surface soils that are easily eroded. The parent material of the lower soil horizons is weathered granite. These deep soils are moderately resistance to erosion.

Pre-Developed Land Use and Zoning 1.36

The existing land use of the property is Low Density Residential 1.0 DU/Ac (1 dwelling unit per acre). The former land use was agriculture. That zoning was A-70.

Pre-Developed Coefficient of Runoff 1.37

From Table 3.1, SDCO HM using the NRCS Element, "Undisturbed Natural Terrain, Permanent Open Space Hydrological Soil Group "D"; The Coefficient of Run Off, **C=0.35**

Post Development Land Use and Zoning 1.38

The current land use of the property is Low Density Residential 0.5 DU/Ac (1 dwelling unit per two acres). The project proposes to create 14 single-family residences.

Post Development Coefficient of Runoff 1.39

From Table 3.1, SDCO HM using Low Density Residential (1.0 DU / Ac or less) Hydrological Soil Group "D" the Value for the Coefficient of Run Off, **C=0.39.** This coefficient was calculated by using the following formula.

Site is 0.5 DU/Acre with 6% or less impervious surfaces
5000/87120 = 5.7% >> 6.0% Impervious surface
60% of 0.35 >> 0.41 = 0.06 = 0.36 ~ .4
Therefore, C = 0.39

It will be applied uniformly in the Post-developed hydrologic models for the proposed parcels. The constant value of C=0.39, was adjusted and accounts for Impervious area such as driveways, rooftops and concrete flat work. The C-value used in the modeling of any basin with a large percentage of asphalt was weighted as shown below

| | |
|---|---|
| Basin CP1_E6 | C= 0.442 |
| Basin CP2S_1A | C= 0.590 |
| Basin CP2S_1B | C= 0.520 |

Proposed Storm Drain Facilities 1.40

There are two drainage systems proposed for this project, one within the project boundary (On Site) and the other is located along and under Ridge Creek Drive (Off Site). The off site system is located 50 feet before the project entrance (north west corner). The on site system is comprised of three separate sub-systems (Sub-system A, B and C). Sub-system A is located at Ridge Creek Drive Station 2+00, Sub-system B is located between Ridge Creek Drive Station 10+00 and 11+00, and Sub-system C is located at the end of Ridge Creek Drive Station 15+12.

Proposed Off Site Facilities 1.41

This proposed system conveys storm water from the off site areas north of the project area (Basins FW-1 through FW-5) through the northwest corner of the site (Out Fall point CP-8) and from the On Site basins CP7W_1A to CP7W_3B (Out Fall point CP-7). It also will collect and treat to the most practicable extent possible run off from a portion of Ridge Drive and from the new (widened) portion of Ridge Creek Drive. (See Off Site Drainage Exhibit No. 1) The off site system will include a Type G-1 (SDR D8) n with 2 ft by 3 ft grated inlet per SDR D-11, D-13 and D-15. The inlet will be fitted with a "Kristar" type of filter (See the SWMP). The catch basin will be installed on the north side of the road directly over the existing 36" culvert. The existing 60 foot long pipe is in good condition with a good amount of existing "Rip-Rap" and concrete at the down stream end. Some of the existing rocks are about 3-feet in diameter. This portion of Ridge Creek Drive is to be improved to a full width of 24-feet The existing pipe will be protected in place; the slope of the storm drain is approximately 4 percent. It should be noted that the capacity of this existing storm drain has been checked and acceptable. However when this project is nearing the final approval an adequate field survey should be done. This survey should accurately locate both horizontal and vertical coordinates of this culvert. It should collect channel cross section data at both ends of the pipe and as well as at 50 feet and 100 feet up stream and down stream. Detailed hydrology and hydraulic calculations in conjunction with the survey data should be done during the final preparation of the improvement plans for Ridge Creek Drive

Proposed On Site Facilities 1.42

Sub-system A is located at approximately Ridge Creek Drive Station 2+00. These facilities convey storm water from basins CP6W_1A to 1C, CP6W_2A to 2C (Out Fall point CP-6). The proposed structures include a modified D-22 (Concrete Spillway), D-40 Energy Dissipater and a 100 ft x 3 ft "Bio-Swale" treatment swale (See the SWMP)

Sub-system B is located in the dip section between Ridge Creek Drive Station 10+00 and 11+00. These facilities convey storm water from basin CP1_E6 to the easterly drainage course (Out Fall point CP-1). The proposed structures include a D-2 (Type B-1) curb inlet, 12-inch storm drain, a D-9 (Type A) clean out, a D-30 Headwall, a D-40 Energy Dissipater and a 100 ft x 3 ft "Bio-Swale" treatment swale (See the SWMP)

Sub-system C is located at the Cul-De-Sac end of Ridge Creek Drive. Station 15+12. These facilities convey storm water from basin CP2S_1A to 1C to the south (Out Fall point CP-2). The proposed structures include D-22 (Asphalt Spillway), D-40 Energy Dissipater and a series of two detention / treatment basins (See the SWMP). The basins will each have capacity of between 1250 cubic feet to 1300 cubic feet of storage. The total depth including storm water, sediment and free board is 4 feet, with the bottom dimensions set at 10 feet by 18 feet. Side slopes will be 3 horizontal to 1 vertical (See the SWMP).

Project Area Outfall Descriptions 1 50

There are eight distinct places where the storm water runoff leaves or flows through the project site. The locations of these drainage outfalls, discharge or concentration points (CP) will not be moved. They will be perpetuated. The total on site project area is 37.8± acres. Five of the outfalls are situated adjacent to the drainage course near the west boundary; two are on the southern boundary and one is where it flows through the northwest corner. The eastern portion of the project site drains a bit more than 18 acres to a point on the south boundary, near the southeast corner. This is identified as CP1. The other southern boundary outfall, located midway on the south boundary is designated as CP2 (1.5 acres). Outfall points, CP3–CP7 are along the west boundary with 17.95 acres, with outfall point CP8 being on the north end of culvert crossing under Ridge Creek Drive. This is where run off flows through the northwest corner. (See Basin exhibits in Appendix A). Both drainage courses trend to the south and are roughly parallel to the east and west property lines.

Outfall CP1 Description 1.51

The eastern watershed encompasses approximately 19 acres. Nine of the nineteen (47%) acres of this watershed are located off site on the east side of the drainage course. The land use of this area is single family residential on large 2-acre parcels. The storm water from this area sheet flows across the easterly property line. This historic pattern will be continued. Four of the eleven (21%) remaining acres of the watershed will be in a protected "Open Space" easement. The remaining 6-acres (32%) will be impacted to the minimum extent practicable.

This existing drainage course originates near the northeast corner of the project. The elevation is around 954 MSL. The first 300 feet has a uniform slope of about 8-percent with a mixture of grass covering the ground. The first section is best described as a grassy swale. The reach has side slopes with ratios averaging 10:1. After this point the slope becomes steeper there is pronounced stream bank erosion. The surface run off is flowing through a deep gully. The gully has very steep sides with portions with nearly vertical. The steep sides are irregularly interrupted by smaller finger gullies. The pace of the erosion has been very slow. This is evident due to the density of plant coverage. The vegetation after this point consists of native costal sage scrub and chaparral plants. The plant cover is about 70-80 percent. The upper soil is a course sandy loam (Disintegrated or Decomposed Granite), while the deeper soil horizons are weathered less and more resistive to erosion. CP-1 is located on the south property line about 50 feet west of the southeastern corner. The slope of this drainage course when it exits the site at discharge point CP-1 is approximately 6.4 percent. The westerly side slope is over 29-percent and the east side is over 37-percent. This point of discharge has an elevation of 807 MSL and 120 feet away at the top of the west bank (Lot No. 9) having an elevation of around 832 MSL. The discharge point is 1,266 feet from the top of the drainage basin. There are five points along the 900 feet of the steep gullied drainage course that surface run off becomes concentrated and drops into the gullied drainage course

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Outfall CP2 Description 1.52
The slope of this drainage course at this outfall point is approximately 8.6 percent. The ground cover is short non-native grasses. This swale is bounded by a citrus grove on the west. The existing drainage swale has side slopes less than 10:1 and the width is about 12 feet. The run off is conveyed in this swale about 550 feet south of CP-2. The lower reach of the swale is an access road for the citrus grove. At the bottom, the swale flattens out and the storm water sheet flows for about fifty feet crossing Los Alisos Drive. The flows down the existing stream bank. The stream bank is completely covered with a dense growth of native shrubs, including Toyon or Christmas Berry, Poison Oak and Cottonwood and Oak trees. There it enters the easterly drainage course

Outfall CP3 Description 1.53
This discharge point is at the southwest corner of the project. This corner area has a 15' by 10' sump about one-foot deep. It appears that normal cultivating practices, such as plowing and creating furrows pushed the soil up along the boundary. The existing ground is void of any vegetation due to weed abatement. The majority of the project area has been plowed allowing rainwater to infiltrate. There has been no evidence of erosion in the area. If any excess storm water cannot infiltrate (due saturation), the water would pond to a depth of less than 1 foot. At that point it would drain across the south and west property lines off site. Then trend overland via an existing shallow landscaped brow ditch (W=2 ft D=8") toward Arroyo Pacifica, a private road then into the drainage course. The drainage course is approximately 285 feet west of CP3. The proposed development will perpetuate the existing and historical flow path. However the depth of any excess storm water as well as its velocity will be controlled by the placement of two swales and riprap at the discharge point.

Outfall CP4 Description 1.54
The excess storm water exist the project and trends westerly through the previously described landscaped area across private driveway through the second half of the landscape area into the west drainage course. The proposed development will perpetuate the existing and historical flow path. However the flow depth of any excess storm water as well as its velocity will be controlled by the placement of riprap at the discharge point.

Outfall CP5 Description 1.55
The excess storm water exist the project and trends westerly through the previously described landscaped area across private driveway through the second half of the landscape area into the west drainage course. There is an existing 10-12 inch steel pipe that currently accepts some storm water allowing it to go under the driveway. But the majority of the flow crosses over the driveway. The proposed development will perpetuate the existing and historical flow path. However the flow depth of any excess storm water as well as its velocity will be controlled by the placement of riprap at the discharge point.

Outfall CP6 Description 1.56
The excess storm water exist the project and trends westerly through the previously described landscaped area across private driveway through the second half of the landscape area into the west drainage course. The proposed development will perpetuate the existing and historical flow path. However the depth of any excess storm water as well as its velocity will be controlled by the placement of riprap at the discharge point

Outfall CP7 Description 1.57
The majority of the runoff follows the existing Ridge Creek Drive along the inside edge (south side of the road) of the asphalt then continues south through the landscaped area then over the bank and into the drainage course. The balance of the basin's run off follows its historic flow path overland to the landscaped area. The post development run off will be directed and controlled using vegetated swales and riprap

Outfall CP8 Description 1.58
The upper far west drainage basins cover 90.7 acres that are directly tributary to CP-8. At this outfall the storm water flows through an existing 36-inch culvert The majority of the runoff comes from off site from the existing Ridge Drive area before it enters the project site. At a point about 250 feet northeast of CP-8 the western drainage course enters the site. The slope of the drainage course flattens out from 5 percent to around 2 percent. There is evidence at this point that run off from previous storm events has transported a lot of sediments. There is a large deposit of sand here. It is apparent that sediments drop out of suspension at this point. This flat 250-foot reach has several low areas that are filled with sand. This sand is evidence of that erosion is occurring off site, as well as ongoing movement downstream.

Study Area Outfall Description 1.59
The outfall point for the study area, totaling approximately 340 Acres is CP9. This is also the point of insignificant impact. This outfall point is south and east of Los Alisos Drive. The stream banks in this area are well maintained and landscaped covered with a lush grass and shrubs.

Current Erosion Status at Outfall Points 1.60
The project's current soil erosion situation over all is stable. The ground is contour tilled using a disc harrow on a monthly basis. This practice has prevented the movement of sediments. There has been no noticeable soil transportation near outfall points CP1 to CP7.

The eastern drainage course has been eroding at a slow pace for a very long time. The erosion is evident in the steep sides with weathered hard rock on its bottom. It is over 30 feet depth at CP1. According to the San Diego Soil Survey, the soil in this drainage course is classified as "Steep Gullied Land" (See appendix A, Soil Map Exhibit). This area is protected as open space.

The slope of the western drainage course flattens out when it crosses the northwest corner. The slope goes from over 5 percent to near 2 percent. There is evidence at this point that run off from previous storm events has transported sediments. This flatter area near the culvert inlet has large deposits of sand. It is apparent that sediments drop out of suspension at this point. This flat 250-foot reach has several low areas that are filled with sand. This sand is evidence of that erosion is occurring off site and upstream from this proposed "Protected Open Space".

It should be noted that the tributary area to CP8 is proposed "Protected Open Space" and the area adjacent down stream is off site and cannot be modified either. These designations will perpetuate the ongoing natural processes. This project will to the maximum extent practical to minimize any impacts to this area, while maintaining the historical flow paths as well as the historical run off amounts.

# SECTION 2

2.0

## HYDROLOGY SECTION 2.00

### Hydrologic Method 2.10

The Modified Rational Method (MRM) for junction analysis was used to determine the peak run off rate from the required storm events

### Topography 2.11

The project area (on site) topography was compiled by photogrammetric methods supplemented with a field survey. The study area topography (off site) was taken from the San Diego County Ortho-Topographic maps, 442-1707, 442-1713 438-1707 and 438-1713.

### On Site Maps 2.12

The proposed on-site tributary watershed for this project was electronic copy of the Preliminary Grading Plan (50 Scale).

### Runoff Intensity – Duration Curve 2.13

The intensity-duration information was calculated using the Figure 3.1, Figure 3.3 and Table 3.2 from the San Diego County Hydrology Manual". These charts are located in Appendix A. The data charts are generated using the formula shown below was used to calculate the intensity.

Intensity, $I = 7.44 (P^6) D^{-0.645}$

### Hydrologic Calculation Methods 2.20

The Modified Rational Method (MRM) 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 small drainage structures. The MRM is recommended for analyzing the runoff response from drainage areas up to approximately one square mile in size. The MRM was applied using any design storm frequency of 100-year and 10-year. The design storm frequency is based on the type of project and specific local requirements.

A procedure has been developed that converts the 6 hour and 24-hour precipitation isopluvial map data to an Intensity-Duration curve that can be used for the rainfall intensity in the MRM formula as shown The MRM is applicable to a 6-hour storm duration because The procedure uses Intensity-Duration design charts that are hosed on a 6-hour storm duration.

The Rational Method formula, Q=CIA, where, Q = Peak rate of flow in cubic feet per second

C = Runoff Coefficient  I = Rainfall Intensity  A = Basin Area.

At the junction point, the peak Q, Tc, I, for each independent drainage systems are calculated by the Rational Method. Then using the junction equation, with T1 < T2 and the following

Q1, T1, I1 correspond with the stream with the shortest Tc

Q2, T2, I2 correspond with the longer Tc

QT1 = Q1 +[T1/T2] x Q2  and QT2 = Q2 + {I2/I1] x Q1

Q (p) = Q peak is the larger of QT1 or QT2

**Hydrologic Drainage Patterns Discussion** **2.300**

The project as shown on the Tentative Map 5469 and the preliminary grading plans will not significantly alter drainage patterns within the project boundaries or the surrounding area. Runoff from the project site may be concentrated at the existing outfalls, but those points are the historic outfall locations.

**Impervious Cover ........................................ 2.31**
The project will add approximately 99,525 square feet of imperious area (6.9% of the total project area) in the form rooftops, patios, driveways, guest parking and the private road. Because of the increase in imperious area resultant increases have been calculated
Theoretically, the typical subdivision and development of any site will cause an increase in runoff due to the increase in impervious surfaces. This project is not a typical subdivision. The reasons include but not limited to, the site's rural location, large lots with two acres a minimum as is the some what limited building coverage and the amount of open space areas required.

**Peak Runoff........................................ 2.32**
The results of the hydrology study are summarized and are shown on the following tables.
In general, the entire 33-acre site, there will be a 3.2 CFS increase in Post-Developed Condition. Runoff is outlet at seven points throughout the property. The eastern half of the project the peak runoff does not change, Outfall point 1 actually has a negative differential $Q_{100}$ (-2.8 CFS)
The western portion will be subject to an increase in runoff. Outfall Points 2, 3, & 7 are less than 1 CFS. Outfall Points 4, 5 and 6 are less than 2 CFS, each draining directly to the creek.

**Erosion and or Sedimentation........................................ 2.33**
The construction of the project will neither significantly increase nor contribute to stream bank erosion down stream from the seven on site outfall points and the off site outfall point.

In addition, this development neither significantly increases nor contributes to the transportation of soil sediments downstream from of outfall point.

**Hydrologic Results Summary** **2.400**

A table summarizing the differences between the Pre-developed data and the Post-developed data and results from the 100-year 6-hour storm event is on Table No. 1 on page 8

The Pre-developed 100-year 6-hour storm event spread sheets showing the results are in Appendix B. The Post-developed 100-year 6-hour storm event results are Appendix C

**Hydrologic Results: Outfall Discussion** **2.500**

There are nine subbasins within the eastern watershed that drain toward outfall point CP No. 1. Runoff from this area flows through a natural drainage course. A large portion of this natural drainage course is in an open space easement including the outfall. The 100-year storm event runoff at this point is 26.1 CFS. The pre-developed runoff is 28.9 CFS, at this outfall. The negative change in storm water runoff is negligible and requires no mitigation.

There is no significant diversion of acreage from the pre-developed condition, 18.58 acre, verses 18.98 post developed acres, a difference of 0.4 acre. A possible reason for the some of the differences in basin area could be from the method used to calculate the areas. The areas were calculated using drafting software. The existing and historical flow paths are maintained. The project does not alter any flow paths on or off site, there fore no increase in siltation or in erosion is expected

Impacts at CP No. 1 and Suggested Mitigations 2.501

This project when completed will neither significantly increase nor contribute to stream bank erosion down stream of discharge point CP-1. In addition, this development neither significantly increases nor contributes to the transportation of additional soil sediments downstream from of outfall point CP-1.

**Proposed Improvements at CP No. 1** **2.502**

There are no proposed improvements at outfall point CP No. 1. The building pads (Lot No. 3 to Lot No. 9) adjacent to this drainage course will have a combination of permanent Best Management Practices (BMP) and proposed runoff management facilities constructed. The runoff management facilities include appropriate grading of the pads such that the runoff is directed away from on site structures, storm drains, and at least two vegetated swales on each pad.

CP No. 2 2.510

Three drainage basins, CP2S_1A, CP2S_1B, CP2S_1C, drain to this outfall. The 100-year storm event runoff at this point is 3.3 CFS. The pre-developed runoff is 2.4 CFS, at this outfall, an increase of 0.9 CFS. There is no diversion of acreage from the pre-developed drainage basin, 1.35-acre. The existing and historical flow paths are maintained. The project does not alter any flow paths on or off site, there fore no increase in siltation or in erosion is expected.

**Impacts at CP No. 2 and Suggested Mitigations** **2.511**

The grading plan incorporated in Tentative Map 5469 will not cause an adverse impact in the quantity or the quality flow. The increase in the peak flow from a 100-year storm event is 0.9 CFS. The small amount of excess runoff (0.90 CFS) is insignificant. However, insignificant, the proposed improvements will provide more than enough mitigation at this outfall.

**Proposed Improvements at CP No. 1** **2.512**

At the end of the proposed Cul-de-Sac an asphalt concrete spillway (SDRSD D-22), will direct and control the storm water to a least a 10-foot long rock energy dissipater (SDRSD D-40). A grass swale will control and convey the runoff south to the subdivision boundary.

**Hydrologic Results: Outfall Points Discussion (continued)** **2.500**

CP No. 3 .......................................................................................................... 2.520

Two drainage basins, CP3W_1A, CP3W_1B drain to this outfall. The 100-year storm event runoff at this point is 4.2 CFS. The pre-developed runoff is 3.9 CFS, at this outfall, an increase of 0.3 CFS. The decrease is basin area (0.19 acre) is not a significant diversion of acreage. The existing and historical flow paths are maintained. The project does not alter any flow paths on or off site, there fore no increase in siltation or in erosion is expected.

**Impacts at CP No. 3 and Suggested Mitigations** **2.521**

**The small amount of excess runoff (0.3 CFS) is insignificant. There are no adverse impacts expected from the excess runoff of 0.3 CFS. Although no mitigations are required the proposed improvements will provide more than enough mitigation at this outfall.**

**Proposed Improvements at CP No. 3** **2.522**

There are no proposed improvements at outfall point CP No. 3. The building pads (Lot No. 10 and portions of Lot No. 11) within this drainage basin will have a combination of permanent Best Management Practices (BMP) and runoff management facilities (RMF) constructed. The runoff management facilities include appropriate grading of the pads such that the runoff is directed away from on site structures to pervious areas, rock energy dissipater (SDRSD D-40) and at least two vegetated swales on each pad. The overall effect of these BMP devises will mitigate the small increase of storm water.

CP No. 4 2.530

Two drainage basins, CP4W_1A, CP4W_1B drain to this outfall. The 100-year storm event runoff at this point is 7.7 CFS. The pre-developed runoff is 6.47 CFS, at this outfall. This excess storm water runoff (1.23 CFS) is insignificant. The decrease is basin area (0.86 acre) is not a significant diversion of acreage. The reason for insignificance is because the western portion of the project has five outfall points on the westerly subdivision boundary. All five are within 1065 feet of each other. These all flow and merge with the same drainage course The total tributary area of the western outfall points (CP-3, CP-4, CP-5, CP-6 and CP-7) is 17.89 acres pre-development and 17.49 acres post-development (0.4 acre). The existing and historical flow paths are maintained. The project does not alter any flow paths on or off site, there fore no increase in siltation or in erosion is expected.

**Impacts at CP No. 4 and Suggested Mitigations** **2.531**

**The small amount of excess runoff (1.23 CFS) is insignificant. There are no adverse impacts expected from the excess runoff of 1.23 CFS. Although no mitigations are required the proposed improvements will provide more than enough mitigation at this outfall.**

**Proposed Improvements at CP No. 4** **2.532**

There are no proposed improvements specifically at outfall point CP No. 4. However, the portions of each building pad on Lot No. 11 and Lot No. 12 that are within this drainage basin will have a combination of permanent BMP's and RMF's constructed. The RMF's include appropriate grading of the pads such that the runoff is directed away from on site structures to pervious area, rock energy dissipaters (SDRSD D-40) and at least two vegetated swales on each pad. The overall effect of these BMP devises will mitigate the small increase of storm water.

**Hydrologic Results: Outfall Points Discussion (continued)** **2.500**

**CP No. 5** **2.540**

Four drainage basins, CP5W_1A, CP5W_1B CP5W_1C and CP5W_1D drain to this outfall The 100-year storm event runoff at this point is 5.7 CFS. The pre-developed runoff is 4.2 CFS, at this outfall, an increase of 1.5 CFS. The increase in area from 3.12 acres to 3.25 acres (0.13 acre) is not a significant diversion of acreage. The existing and historical flow paths are maintained The project does not alter any flow paths on or off site, there fore no increase in siltation or in erosion is expected

**Impacts at CP No. 5 and Suggested Mitigations** **2.541**

**The small amount of excess runoff (1.5 CFS) is insignificant. There are no adverse impacts expected from the excess runoff of 1.50 CFS. The small change in the basin size is not a significant diversion of acreage. Although no mitigations are required the proposed improvements will provide more than enough mitigation at this outfall**

**Proposed Improvements at CP No. 5** **2.542**

There are no proposed improvements specifically at outfall point CP No. 5. However, the portions of each building pad on Lot No. 11, Lot No. 12, Lot No. 13, and Lot No. 14, that are tributary to this outfall point will have a combination of permanent BMP's and RMF's constructed. The RMF's include appropriate grading of the pads such that the runoff is directed away from on site structures to pervious area, rock energy dissipaters (SDRSD D-40) and at least two vegetated swales on each pad. The overall effect of these BMP devises will mitigate the small increase of storm water.

**CP No. 6** **2.550**

Seven drainage basins, CP6W_1A, to CP6W_1C, CP5W_2A to CP6W_2B and CP6W_3A to CP6W_3B drain to this outfall. The 100-year storm event runoff at this point is 6.4 CFS. The pre-developed runoff is 4.57 CFS, at this outfall, an increase of 1.83 CFS. The increase in area from 3.34 acres to 3.54 acres (0.20 acre) is not a significant diversion of acreage. The existing and historical flow paths are maintained. The project does not alter any flow paths on or off site, there fore no increase in siltation or in siltation or in erosion is expected.

Impacts at CP No. 6 and Suggested Mitigations 2.551

**The small amount of excess runoff (1.83 CFS) is insignificant. There are no adverse impacts expected from the excess runoff of 1.83 CFS. The small change in the basin size is not a significant diversion of acreage. Although no mitigations are required the proposed improvements will provide more than enough mitigation at this outfall**

**Proposed Improvements at CP No. 6** **2.445**

There are no proposed improvements specifically at outfall point CP No. 6. However, the portions of each building pad on Lot No. 1, to Lot No. 5, and Lot No. 13, and Lot No. 14, that are tributary to this outfall point will have a combination of permanent BMP's and RMF's constructed. The RMF's include appropriate grading of the pads such that the runoff is directed away from on site structures to pervious area, rock energy dissipaters (SDRSD D-40) and at least two vegetated swales on each pad. The overall effect of these BMP devises will mitigate the small increase of storm water.

**Hydrologic Results: Outfall Points Discussion (continued)** **2.500**

CP No. 7 2.560
Six drainage basins, CP7W_1A, C7W_1B, CP7W_2A, CP7W_2B and CP7W_3A, CP7W_3B drain to this outfall. The 100-year storm event runoff at this point is 5.7 CFS. The pre-developed runoff is 5.48 CFS, at this outfall, an increase of 0.22 CFS. The increase in area from 4.07 acres to 4.39 acres (0.32 acre) is not a significant diversion of acreage. The existing and historical flow paths are maintained. The project does not alter any flow paths on or off site, there fore no increase in siltation or in siltation or in erosion is expected.

Impacts at CP No. 7 and Suggested Mitigations 2.561
**The small amount of excess runoff (0.22 CFS) is insignificant. There are no adverse impacts expected from the excess runoff of 0.22 CFS. The small change in the basin size is not a significant diversion of acreage. Although no mitigations are required the proposed improvements will provide more than enough mitigation at this outfall**

**Proposed Improvements at CP No. 7** **2.562**
There are no proposed improvements specifically at outfall point CP No. 7. However, the portions of each building pad on Lot No. 1, to Lot No. 3, that are tributary to this outfall point will have a combination of permanent BMP's and RMF's constructed. The RMF's include appropriate grading of the pads such that the runoff is directed away from on site structures to pervious area, rock energy dissipaters (SDRSD D-40) and at least two vegetated swales on each pad. The overall effect of these BMP devises will mitigate the small increase of storm water.

CP No 8 2.570
**The area tributary to CP8 remains the same for both pre-development and post-development conditions. The total storm water from the 100-year event amounts to 161.3 CFS. This runoff flows through the northwest corner of the site, confluences with runoff from CP7 then flows through an existing culvert. The small amount of excess runoff 0.22 CFS is insignificant. There are no adverse impacts to the culvert expected from the 161.5 CFS of runoff CFS. There is not any significant diversion of acreage. Although, no mitigations are required, the proposed improvements on Lots No. 1 through Lot No. 3 will provide more than enough mitigation at this outfall**

Impacts at CP No. 8 and Suggested Mitigations 2.571
The small amount of excess runoff (0.22 CFS) is insignificant. There are no adverse impacts expected from the excess runoff to the areas in and around the culvert. The existing and historical flow paths are maintained. The project does not alter any flow paths on or off site. There will not be an increase in siltation, in sediment transport and soil and bank erosion.

**Proposed Improvements at CP No. 8** **2.572**
There could be improvements to this area around the culvert. When this project is nearing the final approval an adequate field survey should be done. This survey should accurately locate both horizontal and vertical coordinates of this culvert. It should collect channel cross section data at both ends of the pipe and as well as at 50 feet and 100 feet up stream and down stream. Detailed hydrology and hydraulic calculations in conjunction with the survey data should be done during the final preparation of the improvement plans for Ridge Creek Drive.

## Hydrologic Scope Conclusions 2.600

Addressing the scope of the study, it was determined that the proposed development does not lie within any designated flood plain as defined by the Federal Emergency Management Agency

The pre-development (existing) 100-year tributary peak runoff from the study area and the project area was determined (See Results Summary)

The post-development (proposed) 100-year tributary peak runoff from the study area and the project area was determined (See Results Summary)

It was determined that there is a drainage basin greater than 25 Acres to the north of the project. The storm water, and the historical flow path will be maintained,

The 100-year flood line of the natural channel that crosses the northwest project corner, tributary watershed over ninety (90.7) acres has been delineated (See Exhibit No.2 in Appendix A)

A summary table has been provided for post-development conditions. (See Section No. 1.50)

A narrative description for each out fall point has been provided (See Section No. 2.700)

There are no are pre-development drainage conditions that may adversely impact the contiguous properties

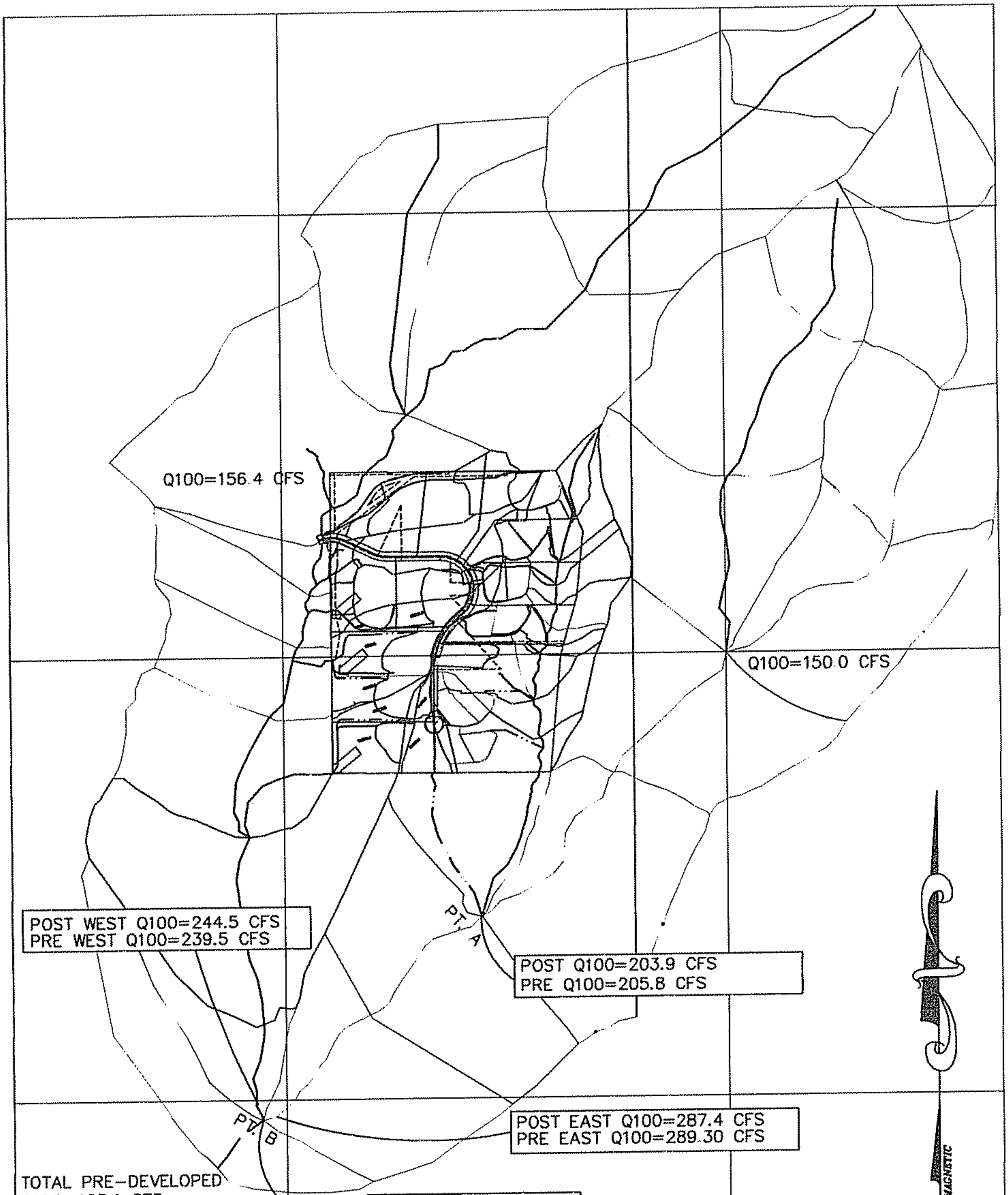
There no post-development conditions that will have an impact on down stream properties due to any significant change of the peak flow characteristics

There are no local drainage facilities that receive additional and significant runoff due to the proposed development

## Summary and Conclusions 2.601

This proposed improvements neither significantly increases nor contributes to stream bank erosion down stream from all eight of the outfall points. This is accomplished using wide and long vegetated swales and energy dissipaters. The project does impact a large portion of each lot These septic areas cannot be developed and will have some type of ground cover.

In addition, this development neither significantly increases nor contributes to the transportation of soil sediments downstream from of outfall point. The leach field areas with a ground cover will catch and retain a large portion any soil particles or sediments that are transported overland.




# CONFLUENCE EXHIBIT

# TM 5469

* CONFLUENCE EQUATIONS NOT USED ** CONFLUENCE EQUATIONS USED

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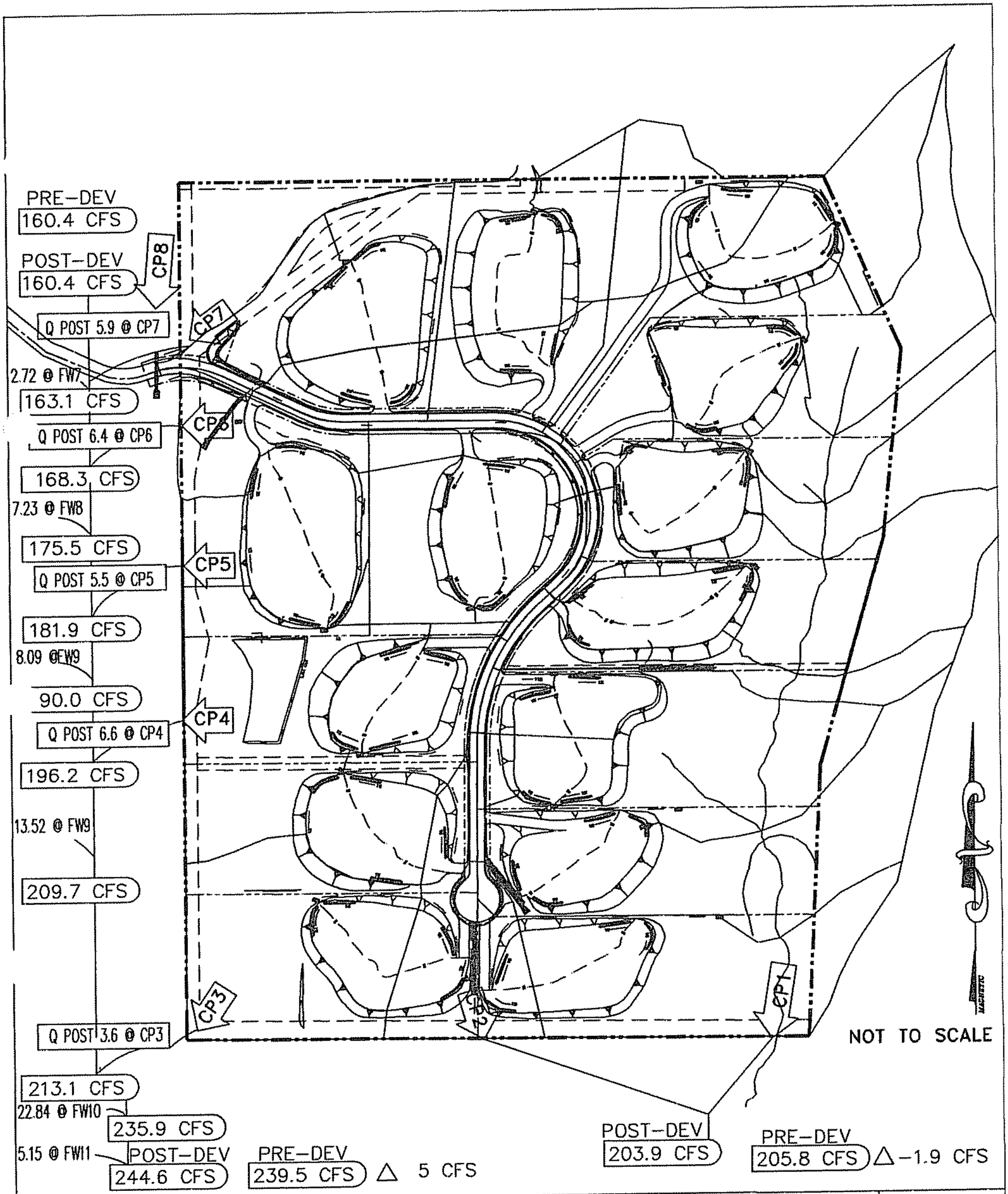
EXHIBIT NO. 1




# POST-DEVELOPEMENT EXCESS RUN OFF (Q100)

TM 5469

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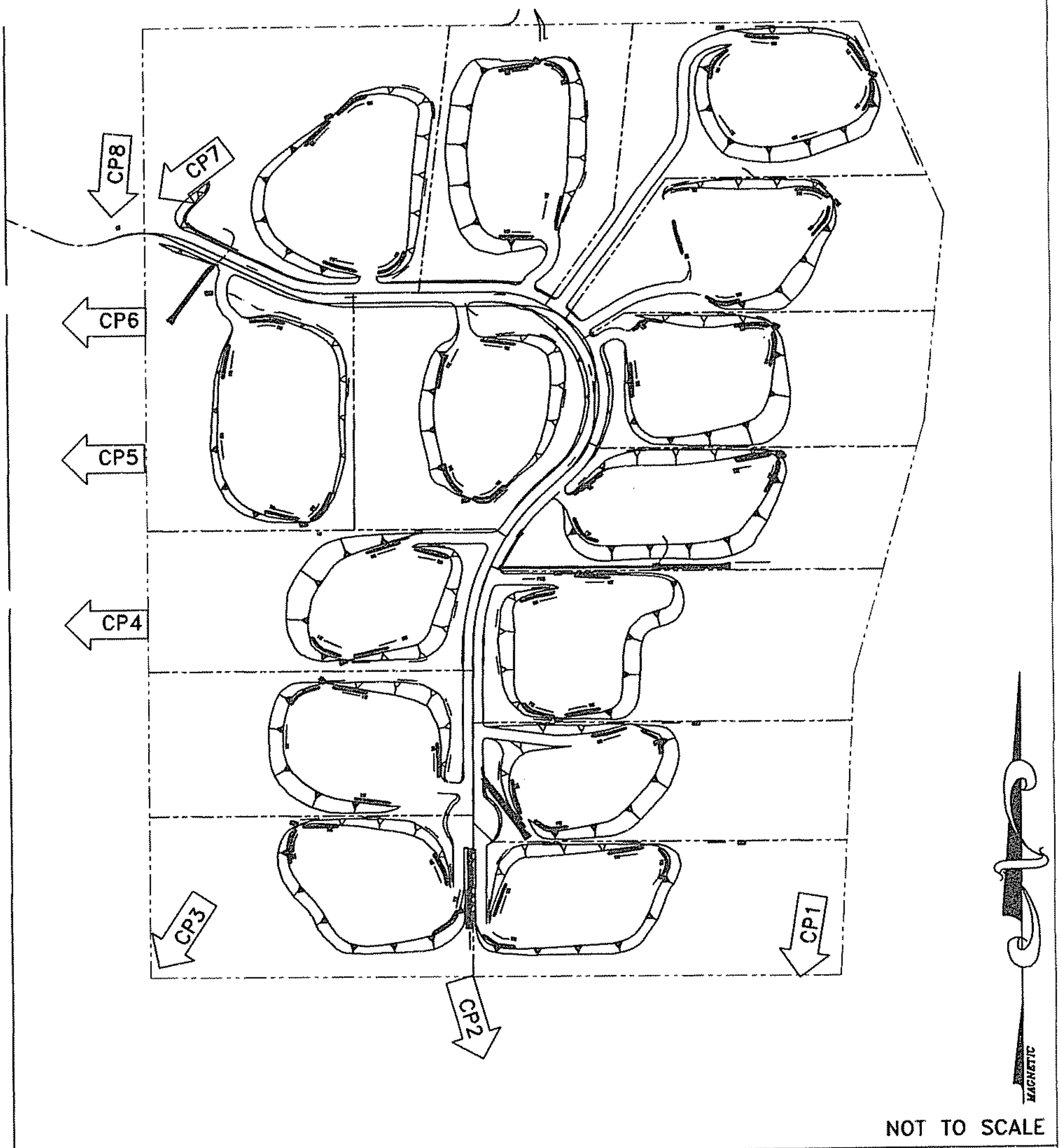
EXHIBIT NO. 2




NOT TO SCALE

PRE DEVELOPED OUTFALL LOCATIONS & POST DEVELOPED OUTFALL LOCATIONS

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EXHIBIT NO. 3

SUMMARY Q100 POST ONSITE REV17.xls
Revised "C" = 0.39 and
Revised Initial Tc = Ti
Ti= 11.9 min

| OUT FALL PT | PRE Area AC | POST Area AC | △ Area Ac | PRE Len Ft | POST Len Ft | PRE "C" | POST "C" | PRE Tc Min | POST Tc Min | PRE "I" In/Hr | * POST "I" In/Hr | PRE Q100 CFS | POST Q100 CFS | △ Runoff CFS | Notes and Locations | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 18.58 | 18.98 | 0.40 | 1672.0 | 1285.0 | 0.35 | 0.39 | 19.0 | 34.5 | 3.90 | 2.65 | 28.90 | 26.10 | -2.80 | * | Eastern Watershed |
| 2 | 1.35 | 1.35 | 0.00 | 465.0 | 263.0 | 0.35 | 0.54 | 13.0 | 14.3 | 4.99 | 4.69 | 2.40 | 3.30 | 0.90 | ** | Southern Watershed |
| 3 | 2.45 | 2.26 | -0.19 | 602.0 | 648.0 | 0.35 | 0.39 | 14.9 | 15.0 | 4.56 | 4.54 | 3.91 | 4.20 | 0.29 | ** | West Watershed SubBasin |
| 4 | 4.91 | 4.05 | -0.86 | 961.0 | 735.0 | 0.35 | 0.39 | 20.0 | 15.1 | 3.77 | 4.53 | 6.47 | 7.70 | 1.23 | *** | West Watershed SubBasin |
| 5 | 3.12 | 3.25 | 0.13 | 933.0 | 655.0 | 0.35 | 0.39 | 19.4 | 21.1 | 3.83 | 3.65 | 4.20 | 5.70 | 1.50 | *** | West Watershed SubBasin |
| 6 | 3.34 | 3.54 | 0.20 | 946.0 | 796.0 | 0.35 | 0.39 | 18.9 | 31.4 | 3.91 | 2.94 | 4.57 | 5.80 | 1.23 | *** | West Watershed SubBasin |
| 7 | 4.07 | 4.39 | 0.32 | 1020.0 | 1132.0 | 0.35 | 0.39 | 19.4 | 36.3 | 3.71 | 2.57 | 5.48 | 5.70 | 0.22 | ** | West Watershed SubBasin |
| Total | 37.82 | 37.82 | 0.00 | | | | | | | | | 55.93 | 58.50 | 2.57 | | Q100 Excess Runoff Total |
| | | | | | | | | | | | | | | 4.47 | | Q100 Excess West Runoff |
| | | | | | | | | | | | | | | -1.90 | | Q100 Excess East Runoff |

NOTES

* NO EXCESS RUN OFF

** AMOUNT OF EXCESS RUN OFF LESS THAN 1 CFS IS NEGLIABLE

*** AMOUNT OF EXCESS RUN OFF >1 CFS BUT < 2 CFS INSIGNIFICANT

TM 5 RPL
Drainage Basin
Q(wq)
Impervious Analysis

| DRAINAGE | DRAINAGE | DRAINAGE | Impervious | Impervious | Impervious | Impervious | Impervious | Percent | Qwq | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|
| BASIN | BASIN | BASIN | Pavement | Driveways | Roof/Patios | Area | Area | Impervious | CIA | |
| ID | AREA | SF | Areas | Areas | Areas | Total | Total | Area(sf) | (1)(0.2)Ap | |
| DB | BA1 | BA2 | | | | IP1 | IP2 | PIA | Q | |
| NO. | Acres | SQFT | Sq Ft | Sq Ft | Sq Ft | Sq Ft | AC | percent | CFS | |
| CP1_E1 | 1.43 | 62291 | 0 | 800 | 2000 | 2800 | 0.064 | 0.045 | 0.013 | |
| CP1_E2 | 1.46 | 63598 | 0 | 0 | 0 | 0 | 0.000 | 0.000 | 0.000 | OPEN SPACE AREA |
| CP1_E3 | 1.85 | 80586 | 0 | 800 | 4000 | 4800 | 0.110 | 0.060 | 0.022 | |
| CP1_E4 | 2.16 | 94090 | 0 | 800 | 4000 | 4800 | 0.110 | 0.051 | 0.022 | |
| CP1_E5 | 3.09 | 134600 | 4676 | 800 | 4000 | 9476 | 0.218 | 0.070 | 0.044 | |
| CP1_E6 | 1.62 | 70567 | 16700 | 1600 | 2000 | 20300 | 0.466 | 0.288 | 0.093 | |
| CP1_E7 | 2.29 | 99752 | 0 | 0 | 2000 | 2000 | 0.046 | 0.020 | 0.009 | |
| CP1_E8 | 2.90 | 126324 | 5600 | 2080 | 4000 | 11680 | 0.268 | 0.092 | 0.054 | |
| CP1_E9 | 2.18 | 94961 | 0 | 0 | 4000 | 4000 | 0.092 | 0.042 | 0.018 | |
| | 18.98 | | | | | | | | **0.275** | **Qwq at OUTFALL CP1** |
| CP2S_1A | 0.21 | 9148 | 0 | 1050 | 0 | 1050 | 0.024 | 0.115 | 0.005 | |
| CP2S_1B | 0.14 | 6582 | 4701 | 1050 | 0 | 5751 | 0.132 | 0.874 | 0.026 | |
| CP2S_1C | 1.00 | 43560 | 2000 | 0 | 1333 | 3333 | 0.077 | 0.077 | 0.015 | |
| | 1.35 | | | | | | | | **0.047** | **Qwq at OUTFALL CP2** |
| CP3W 1A | 0.52 | 22651 | 0 | 800 | 2666 | 3466 | 0.080 | 0.153 | 0.016 | |
| CP3W 1B | 1.74 | 75794 | 0 | 0 | 0 | 0 | 0.000 | 0.000 | 0.000 | LANDSCAPED AREA |
| | 2.26 | | | | | | | | **0.016** | **Qwq at OUTFALL CP3** |
| CP4W 1A | 1.82 | 79279 | 0 | 1600 | 8000 | 9600 | 0.220 | 0.121 | 0.044 | |
| CPW4 1B | 2.23 | 97139 | 0 | 0 | 0 | 0 | 0.000 | 0.000 | 0.000 | LANDSCAPED AREA |
| | 4.05 | | | | | | | | **0.044** | **Qwq at OUTFALL CP4** |

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RIDGE CREEK DRIVE
FALLBROOK CA

TM 5 RPL
Drainage Basin
Q(wq)
Impervious Analysis

| DRAINAGE BASIN ID DB NO. | DRAINAGE BASIN AREA BA1 Acres | DRAINAGE BASIN SF BA2 SQFT | Impervious Pavement Areas Sq Ft | Impervious Driveways Areas Sq Ft | Impervious Roof/Patios Areas Sq Ft | Impervious Area Total IP1 Sq Ft | Impervious Area Total IP2 AC | Percent Impervious Area(sf) PIA percent | Qwq CIA (1)(0.2)Ap Q CFS | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|
| CP5W 1A | 1.03 | 44867 | 0 | 800 | 4000 | 4800 | 0.110 | 0.107 | 0.022 | |
| CP5W 1B | 0.80 | 34848 | 0 | 0 | 0 | 0 | 0.000 | 0.000 | 0.000 | LANDSCAPED AREA |
| CP5W 1C | 1.09 | 47480 | 0 | 480 | 0 | 480 | 0.011 | 0.010 | 0.002 | |
| CP5W 1D | 0.33 | 14375 | 0 | 800 | 4000 | 4800 | 0.110 | 0.334 | 0.022 | |
| | 3.25 | | | | | | | | **0.046** | **Qwq at OUTFALL CP5** |
| CP6W_1A | 0.87 | 37897 | 1678 | 7440 | 0 | 9118 | 0.209 | 0.241 | 0.042 | |
| CP6W_1B | 0.82 | 35719 | 2151 | 1440 | 0 | 3591 | 0.082 | 0.101 | 0.016 | |
| CP6W_1C | 0.61 | 26572 | 3190 | 3290 | 0 | 6480 | 0.149 | 0.244 | 0.030 | |
| CP6W_2A | 0.48 | 20909 | 4916 | 800 | 0 | 5716 | 0.131 | 0.273 | 0.026 | |
| CP6W_2B | 0.29 | 12632 | 2188 | 1520 | 0 | 3708 | 0.085 | 0.294 | 0.017 | |
| CP6W_2C | 0.45 | 19602 | 0 | 0 | 0 | 0 | 0.000 | 0.000 | 0.000 | LANDSCAPED AREA |
| | 3.52 | | | | | | | | **0.131** | **Qwq at OUTFALL CP6** |
| CP7W 1A | 0.29 | 12632 | 0 | 0 | 2000 | 2000 | 0.046 | 0.158 | 0.009 | |
| CP7W 1B | 0.77 | 33541 | 0 | 1600 | 0 | 1600 | 0.037 | 0.048 | 0.007 | |
| CP7W 2A | 0.47 | 20473 | 0 | 0 | 0 | 0 | 0.000 | 0.000 | 0.000 | LANDSCAPED AREA |
| CP7W 2B | 1.05 | 45738 | 0 | 0 | 3000 | 3000 | 0.069 | 0.066 | 0.014 | |
| CP7W 3A | 1.14 | 49658 | 0 | 0 | 1320 | 1320 | 0.030 | 0.027 | 0.006 | |
| CP7W 3B | 0.67 | 29185 | 6500 | 0 | 1320 | 7820 | 0.180 | 0.268 | 0.036 | |
| | 4.39 | | | | | | | | **0.072** | **Qwq at OUTFALL CP7** |
| Total | **37.800** | | | | | | | | **0.631** | **Qwq For Site** |
| Total | **37.80** | **1647052** | **54300** | **29550** | **53639** | **137489** | **3.156** | **0.135** | **0.631** | **Calculated Total Qwq CFS** |
| | Column | Column | Column | Column | Column | Column | Column | Column | | |
| | Total | Total | Total | Total | Total | Total | Total | Average | | |
| | basin area | basin area | Area of AC | Approx AC | approx | impervious | impervious | impervious | | |
| * | acres | square feet | Pavement | Driveway | 4000 sf Home | square feet | acres | acres per | | |
| | | | square feet | square feet | Per Lot | | | basin | | |

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# SECTION 3

3.0

HYDRAULIC SECTION 3.000

Hydraulics Analysis Methods 3.100

The velocity calculations were performed using "FlowMaster" software. "FlowMaster" uses the data to calculate the water surface elevation. These are on the right side of the irregular channel worksheet. The irregular channel is a conveyance element lacking symmetry, consisting of two or more connected line segments. When calculating composite roughness, FlowMaster uses the Horton and Lotter equations. The Horton composite roughness equation is used for solving closed top irregular channels such as custom arches or Cunnette conduit sections. This equation is also applied in certain specific situations to open channels where steep banks or wide flat floodplains are encountered (see note below). The Lotter equation is applied for open, irregular channels such as natural floodplains. Both methods are based on Manning's conveyance equations.

Hydraulics Calculations 3.200

The FlowMaster worksheets and related reference information are in Appendix D

Calculations for Proposed Storm Drain Facilities 3.300

There are two drainage systems proposed for this project, one within the project boundary (On Site) and the other is located along and under Ridge Creek Drive (Off Site). The off site system is located 50 feet before the project entrance (north west corner). The on site system is comprised of three separate sub-systems (Sub-system A, B and C). Sub-system A is located at Ridge Creek Drive Station 2+00, Sub-system B is located between Ridge Creek Drive Station 10+00 and 11+00, and Sub-system C is located at the end of Ridge Creek Drive Station 15+12.

Proposed Off Site Facilities 3.310

This proposed system conveys storm water from the off site areas north of the project area (Basins FW-1 through FW-5) through the northwest corner of the site (Out Fall point CP-8) and from the On Site basins CP7W_1A to CP7W_3B (Out Fall point CP-7). It also will collect and treat to the most practicable extent possible run off from a portion of Ridge Drive and from the new (widened) portion of Ridge Creek Drive. (See Off Site Drainage Exhibit No. 1) The off site system will include a grated inlet (typical SDR D8) n with 2 ft by 2 ft grated inlet (typically per SDR D-11, D-13 and D-15. The inlet will be fitted with a "Kristar" type of filter (See the SWMP). The catch basin will be installed on the north side of the road directly over the existing 36" culvert. The existing 60 foot long pipe is in good condition with a good amount of existing "Rip-Rap" and concrete at the down stream end. Some of the existing rocks are about 3-feet in diameter. This portion of Ridge Creek Drive is to be improved to a full width of 24-feet. The existing pipe will be protected in place; the slope of the storm drain is approximately 4 percent. It should be noted that the capacity of this existing storm drain has been checked and acceptable. However when this project is nearing the final approval an adequate field survey should be done. This survey should accurately locate both horizontal and vertical coordinates of this culvert. It should collect channel cross section data at both ends of the pipe and as well as at 50 feet and 100 feet up stream and down stream. Detailed hydrology and hydraulic calculations in conjunction with the survey data should be done during the final preparation of the improvement plans for Ridge Creek Drive.

See Appendix D, Figure 2-5 from San Diego Drainage Design Manual for Grate Capacity Calculations

Proposed On Site Facilities 3.311

Sub-system A is located at approximately Ridge Creek Drive Station 2+00. These facilities convey storm water from basins CP6W_1A to 1C, CP6W_2A to 2C (Out Fall point CP-6). The proposed structures include a modified D-22 (Concrete Spillway), D-40 Energy Dissipater and a 100 ft x 3 ft "Bio-Swale" treatment swale (See the SWMP)

Sub-system B is located in the dip section between Ridge Creek Drive Station 10+00 and 11+00. These facilities convey storm water from basin CP1_E6 to the easterly drainage course (Out Fall point CP-1). The proposed structures include a D-2 (Type B-1) curb inlet, 12-inch storm drain, a D-9 (Type A) clean out, a D-30 Headwall, a D-40 Energy Dissipater and a 100 ft x 3 ft "Bio-Swale" treatment swale (See the SWMP)

Sub-system C is located at the Cul-De-Sac end of Ridge Creek Drive Station 15+12. These facilities convey storm water from basin CP2S_1A to 1C to the south (Out Fall point CP-2). The proposed structures include D-22 (Asphalt Spillway), D-40 Energy Dissipater.

Hydraulics Results Data Table 3.320

Off Site Storm Drain System

Existing 36" Culvert at CP8

| Q (YR) | Size | FLOW | DEPTH | SLOPE | VELOCITY | COMMENTS |
|---|---|---|---|---|---|---|
| CFS | Inches | CFS | Feet | FT/FT | FPS | |
| 100 | 36 | 133.4 | 2.97 | 0.04 | 18.9 | 144.5 max |
| 100 | 36 | 149.1 | 2.98 | 0.05 | 21.10 | 160.4 max |
| 100 | 37.7 | 162 | 3.12 | 0.04 | 21.2 | Sized for 162 cfs |
| 100 | 36.5 | 154.6 | 3.10 | 0.05 | 22.37 | Sized for 162 cfs |
| 100 | 39 | 162 | 2.4 | 0.04 | 22.7 | 177.6 max |
| 100 | 39 | 184.6 | 3.25 | 0.05 | 22.3 | 198.6 max |

On Site Storm Drain Sub-System A
Sub-system A is located at approximately Ridge Creek Drive Station 2+00 conveys storm water to outfall CP6.

The proposed structures include
Modified D-22 (Concrete Spillway)
D-40 Energy Dissipater
"Bio-Swale" 100 ft x 3 ft treatment swale (See the SWMP)

On Site Storm Drain Sub-System B
Located in the dip section between Ridge Creek Drive Station 10+00 and 11+00. These facilities convey storm water from basin CP1_E6 to the easterly drainage course (Out Fall point CP-1).
The proposed structures include
D-2 (Type B-2) curb inlet, Part A, L= 12 ft
12-inch storm drain, Part B
D-9 (Type A) clean out,
D-30 Headwall,
"Bio-Swale" 100 ft x 3 ft treatment swale (See the SWMP) Part C
D-40 Energy Dissipater Part D

On Site Storm Drain Sub-System C
Located at the Cul-De-Sac end of Ridge Creek Drive, Station 15+12 These facilities convey storm water from basin CP2S_1A to 1C to the south to Out Fall point CP-2
The proposed structures include
D-22 (Asphalt Spillway)
D-40 Energy Dissipater

HYDRAULICS (continued) 3.320

Off Site Storm Drain Ridge Creek Culvert Rip-Rap Sizing
Recommended Rock Data Table
Using Figure 5-14 SD County Drainage Manual from Caltrans RSP Layer Method
And V=22 FPS

Minimum Weight =700 pounds,
= Going up to next standard Size
= 1000 pounds or use ½ ton Rock for outside layer
Outside Layer = ½ ton

Using Figure 5-6 SD County Drainage Manual from Caltrans RSP Layer Method
Inner Layer No. 1 Backing
Fabric "B"

| | | | |
|---|---|---|---|
| ½ ton Class | D50=2.3 ft | W50=1000 lbs | *Thickness= 3.40 ft |
| Backing Class | D50=1.0 ft | W50=75 lbs | *Thickness= 1.80 ft |

Total Thickness
See Appendix D, Sizing Worksheets Calculations
On Site Storm Drain Subsystem B Rip-Rap Sizing
Recommended Rock Data Table
Using Table 7.1 SD County Drainage Design Manual and V=4.31 FPS
From table Velocity 6-7 fps

| | | | |
|---|---|---|---|
| No. 3 Class | D50=0.4 ft | W50=2.2 lbs | * Thickness = 0.5 ft |
| | D95=0.2 ft | W95=1.0 lbs | * Thickness = 0.5 ft |
| | D05=0.7 ft | W50=25 lbs | * Thickness 0.5ft |

Total Thickness

Filter Blanket DG filter (Per San Diego Green Book) 1 ft

Use SDRSD D-40 Type 1 Total Thickness = 2 feet L= 10 feet W= 3 feet Min

On Site Storm Drain Subsystem C Rip-Rap Sizing
Recommended Rock Data Table
Using Table 7.1 SD County Drainage Design Manual and V=4.31 FPS
From table Velocity 6-7 fps
Recommended Rock Data Table
Using Table 7.1 SD County Drainage Design Manual and V=4.31 FPS
From table Velocity 6-7 fps

| | | | |
|---|---|---|---|
| No. 3 Class | D50=0.4 ft | W50=2.2 lbs | * Thickness = |
| | D95=0.2 ft | W95=1.0 lbs | * Thickness = |
| | D05=0.7 ft | W50=25 lbs | * Thickness = |

Gradation Total Thickness

Filter Blanket DG filter (Per San Diego Green Book) 1 ft

Use SDRSD D-40 Type 1 Total Thickness = 2 feet L= 10 feet W= 3 feet Min

Recommended Rip Rap Selection Table (From the Green Book)

| Velocity | Rock | Rip Rap | Opt 1 | Opt 2 | Opt 3 | Lower |
|---|---|---|---|---|---|---|
| Ft/sec | Class | Thickness | | Sec 200 | Sec 400 | Layer |
| (1) | (2) | "T" | (4) | (4) | (5) | (6) |
| 6-7 | No. 3 | 6" | 3/16" | C2 | DG | - |
| 7-8 | No. 2 | 1.0' | ¼" | B3 | DG | - |
| 8-9.5 | Facing | 1.4' | 3/8" | - | DG | - |
| 9.5-11 | Light | 2.0' | ½" | - | ¾" to 1-1/2" PB | - |
| 11-13 | ¼ t | 2.7' | ¾" | - | ¾" to 1-1/2" PB | SAND |
| 13-15 | ½ t | 3.4' | 1" | - | ¾" to 1-1/2" PB | SAND |
| 15-17 | 1 t | 4.3' | 1-1/2" | - | Type B | SAND |
| 17-20 | 1 t | 5.4' | 2" | - | Type B | SAND |

(1) Average velocity in pipe or bottom velocity in Energy Dissipater which ever is greater
(2) If Selected riprap and filter blanket class no available use next size up
(3) Minimum filter blanket is 1 foot or "T" which ever is less
(4) Specifications for Public Works Construction (Green Book)
(5) DG is Disintegrated Granite PB is process miscellaneous base material Type B bedding material
(6) Sand 75% retained in #200 sieve

Hydraulics Vegetated Swales 3.330

Grass Swales:

Grass Swales should be considered wherever site conditions and climate allow vegetation to be established and where flow velocities are not high enough to cause scour. Vegetated areas provide treatment of rainfall and reduce the overall impervious surface. Swales have two design goals: 1) maximize treatment, 2) provide adequate hydraulic function for flood routing, adequate drainage and scour prevention. Treatment is maximized by designing the flow of water through the swale to be as shallow and long as site constraints allow. No minimum dimensions are required for treatment purposes, as this could exclude swales from consideration at some sites. To maximize treatment efficiency, strips should be designed to be as long (in the direction of flow) and as flat as the site will allow. No minimum lengths or maximum slopes are required for treatment purposes. The area to be used for the strip should be free of gullies or rills that can concentrate overland flow and cause erosion. Bio filtration Grassy Swales have two design goats: 1) to meet treatment criteria under Water Quality Flow IWQF) conditions. And second to provide adequate hydraulic function for flood routing and scour prevention for larger storm events. Treatment Is Maximized By Designing The Swale To Be As Gently Sloped Arid As Long As The Site Constraints Allow. For swale to be designated as a Treatment BMP, criteria relating depth, velocity, and Hydraulic Residence Time (HRT) as presented in the formula below must be met:

HRT / (depth velocity) ≥ C) Where:

| | |
|---|---|
| HRT | Hydraulic Residence Time during WQF, Minutes ≥ 5 minutes)<br>Travel time in swale (not related to time of concentration) |
| Depth | Depth of flow of WQF (varies with velocity selected, up to 0.5 ft |
| Velocity | Velocity of WQF (varies with velocity selected. up to 1.0 fps<br>Use geosynthetic reinforcement if velocity exceeds 3.9 fps<br>Q=CIA, Where Intensity is for 10-year 6-hour rain event<br>Area is tributary to swale |
| Slope | 1% to 2% preferred (0.25% minimum 6% maximum |
| C | A constant: 20 for US customary units |
| Z | A constant: 1:4 or flatter nits |
| BW | 0.0 ft –10 ft. Maximum bottom width |

Per Section G.8.1.3 of San Diego County Storm Water Ordinance "All drainage from all new roof areas should be directed to a vegetated area not less than 15 feet wide in the direction of run off" "All drainage from all new impervious areas should be directed to a vegetated area not less than 15 feet wide in the direction of run off"

The swales will be constructed to a minimum length of 80-feet. The initial length will be 100 feet, with a width of ten feet. The sides will have slope ratio of 5(H) to 1(V) or 20 percent. The depth will be one foot. The recommended grass varieties shall include at a minimum the following list:

| Common Name- | Scientific Name |
|---|---|
| 1) Tall Fescue | Fesque arundinacea |
| 2) Common Bermuda Grass | Cynodon dactylon |
| 3) Hybrid Bermuda Grass | Cynodon ssp |
| 4) Rye Grass | Lollium ssp |
| 5) Perennial Rye Grass | Lollium ssp |
| 6) Chewings Fesque | Fesque rubra commulata |
| 7) Hard Fesque | Fesque longifolia |

The velocity of the water shall be kept below 7 feet per second (FPS) and the depth of flow shall be less than 1 foot.

Hydraulics Results Summary Table for Q (10) and Water Quality Flow Q (wq) 3.331

| Lot No. | Area | Slope | Q10 | V10 | Q10 | Q wq | | NOTES |
|---|---|---|---|---|---|---|---|---|
| Swale | Acre | Ft/ft | CFS | FPS | Depth | CFS * | | |
| Lot No 1 | | | | | | | | |
| Lot No 3 | | | | | | | | |
| Lot No 4 | | | | | | | | |
| Lot No 5 | | | | | | | | |
| Lot No 6 | | | | | | | | |
| Lot No 7 | | | | | | | | |
| Lot No 8 | | | | | | | | |
| Lot No 9 | | | | | | | | |
| Lot No. 10 | | | | | | | | |
| Lot No 11 | | | | | | | | |
| Lot No 12 | | | | | | | | |
| Lot No 13 | | | | | | | | |
| Lot No 14 | | | | | | | | |

Notes:
"*" -Calculated Values Shown
"**"-Design Values Shown Calculated Values Rounded Up
Water Quality (Qwq) discharge data is from building pads and slopes areas that are tributary and directed toward Grass Swales and are not necessarily the same values at the discharge points (CP)

## Maximum Permissible Velocity

Generally accepted velocity values for storm water run off in channels lined with erodible soils of fine sands or sand loams with sand transportation range from 1.5 fps to 2.0 fps.
Generally accepted velocity values for storm water run off in channels lined with erodible soils of fine sands or sand loams without sand transportation range from 2.5 fps to 2.5 fps
Generally accepted velocity values for storm water run off in barren and easily erodible of fine sands or sandy loam soils range from 1 5 fps to 1 7 fps

Maximum Permissible Velocity For Channels Lined With Uniform Stands Of 6-Inches Or Thicker Grass

| Vegetated Swales Maintained and Planted Primarily With | Slope Range Percent | Erosion Resistant Soil FPS | Easily Eroded Soil FPS |
|---|---|---|---|
| Bermuda Grass | 0% - 5% | 8 | 6 |
| Bermuda Grass | 5% - 10% | 7 | 5 |
| Bermuda Grass | Over 10% | 6 | 4 |
| | | | |
| Grass Mixture | 0% - 5% | 5 | 4 |
| Grass Mixture | 5% - 10% | 4 | 3 |

Hydraulics Results Summary 3.332

| Lot No. | Area | Slope | Q100 | V100 | Q100 | NOTES |
|---|---|---|---|---|---|---|
| Swale | Acre | Ft/ft | CFS | FPS | Depth | VELOCITY CHECKS |
| Lot No 1 | | | | | | |
| Lot No 3 | | | | | | |
| Lot No 4 | | | | | | |
| Lot No 5 | | | | | | |
| Lot No 6 | | | | | | |
| Lot No 7 | | | | | | |
| Lot No 8 | | | | | | |
| Lot No 9 | | | | | | |
| Lot No. 10 | | | | | | |
| Lot No 11 | | | | | | |
| Lot No 12 | | | | | | |
| Lot No 13 | | | | | | |
| Lot No 14 | | | | | | |

Notes 1)"N"-Denotes Swale Located On North Side Of Lot
"S" -Denotes Swale Located On South Side Of Lot
"*"- Calculated Values Shown
"**"-Design Values Shown Calculated Values Rounded Up
Water Quality (Qwq) discharge data is from building pads and slopes areas that are tributary and directed toward Grass Swales and are not necessarily the same values at the described discharge points (CP)

Maximum Permissible Velocity

Generally accepted velocity values for storm water run off in channels lined with erodible soils of fine sands or sand loams with sand transportation range from 1.5 fps to 2.0 fps

Generally accepted velocity values for storm water run off in channels lined with erodible soils of fine sands or sand loams without sand transportation range from 2.5 fps to 2.5 fps

Generally accepted velocity values for storm water run off in barren and easily erodible of fine sands or sandy loam soils range from 1.5 fps to 1.7 fps

Maximum Permissible Velocity For Channels Lined With Uniform Stands Of 6-Inches Or Thicker Grass

| Vegetated Swales Maintained and Planted Primarily With | Slope Range Percent | Erosion Resistant Soil FPS | Easily Eroded Soil FPS |
|---|---|---|---|
| Bermuda Grass | 0% - 5% | 8 | 6 |
| Bermuda Grass | 5% - 10% | 7 | 5 |
| Bermuda Grass | Over 10% | 6 | 4 |
| | | | |
| Grass Mixture | 0% - 5% | 5 | 4 |
| Grass Mixture | 5% - 10% | 4 | 3 |

## Hydraulics Conclusions 3.4

The exact slope of the existing culvert is unknown, but it is between 4 and 5 percent. The analysis ran a variety of calculations. The existing culvert is marginally acceptable, however, these are preliminary calculations. When this project is nearing the final approval an adequate field survey should be done. This survey should accurately locate both horizontal and vertical coordinates of this culvert. It should collect channel cross section data at both ends of the pipe and as well as at 50 feet and 100 feet up stream and down stream. Detailed hydrology and hydraulic calculations in conjunction with the survey data should be done during the final preparation of the improvement plans for Ridge Creek Drive.

The proposed street improvements associated with this project in conjunction the storm drain facilities adequately handles and disposes of all surface waters originating above or within the site and all the surface water that may flow onto the project site from adjacent properties. The proposed energy dissipaters reduce the velocity of all surface waters as they exit the site to a level that is non-erosive. The gradation and depth of the "Rip-Rap" as well the length of the aprons are specified to control the velocity of the post development, 100-year storm event peak run off.

See Appendix F for references material in support of these results

## Hydrologic Results Summary

### Outfall point Velocity Comparison Table No. [ ]

| OUT FALL ID | PRE V100 FT/SEC | PRE Q100 CFS | POST V100 FT/SEC | POST Q100 CFS | MAXIMUM* PERMISSIBLE FT/SEC | OUTFALL AREA SOIL ** AND GROUND COVER NOTES |
|---|---|---|---|---|---|---|
| CP1 | 6.41 | 29 | 6.22 | 25.7 | 8 to 10 | Weather Granite (DG) |
| CP2 | 3.05 | 2.4 | 5.26 | 1.90 | 10 + | Rap-Rap (Detention Basin) |
| CP3 | 2.39 | 3.91 | 2.34 | 3.60 | 1.7 to 3.0 | Grass over Sandy Loam (DG) |
| CP4 | 2.39 | 6.47 | 2.40 | 6.60 | 1.7 to 3.0 | Grass over Sandy Loam (DG) |
| CP5 | 1.50 | 4.20 | 1.67 | 5.50 | 1.7 to 3.0 | Grass over Sandy Loam (DG) |
| CP6 | 1.79 | 4.57 | 1.94 | 6.40 | 1.7 to 3.0 | Grass over Sandy Loam (DG) |
| CP7 | 4.29 | 5.48 | 6.22 | 5.90 | 10+ | Asphalt Pavement |
| | | | | | | |
| | | | | | | |
| | | | | | | |

* MAXIMUM PERMISSIBLE FOR BARE GROUND

** MAXIMUM PERMISSIBLE FOR GRASS COVER W/ SLOPE 5% OR LESS 5 FT/SEC TO 8 FT/SEC

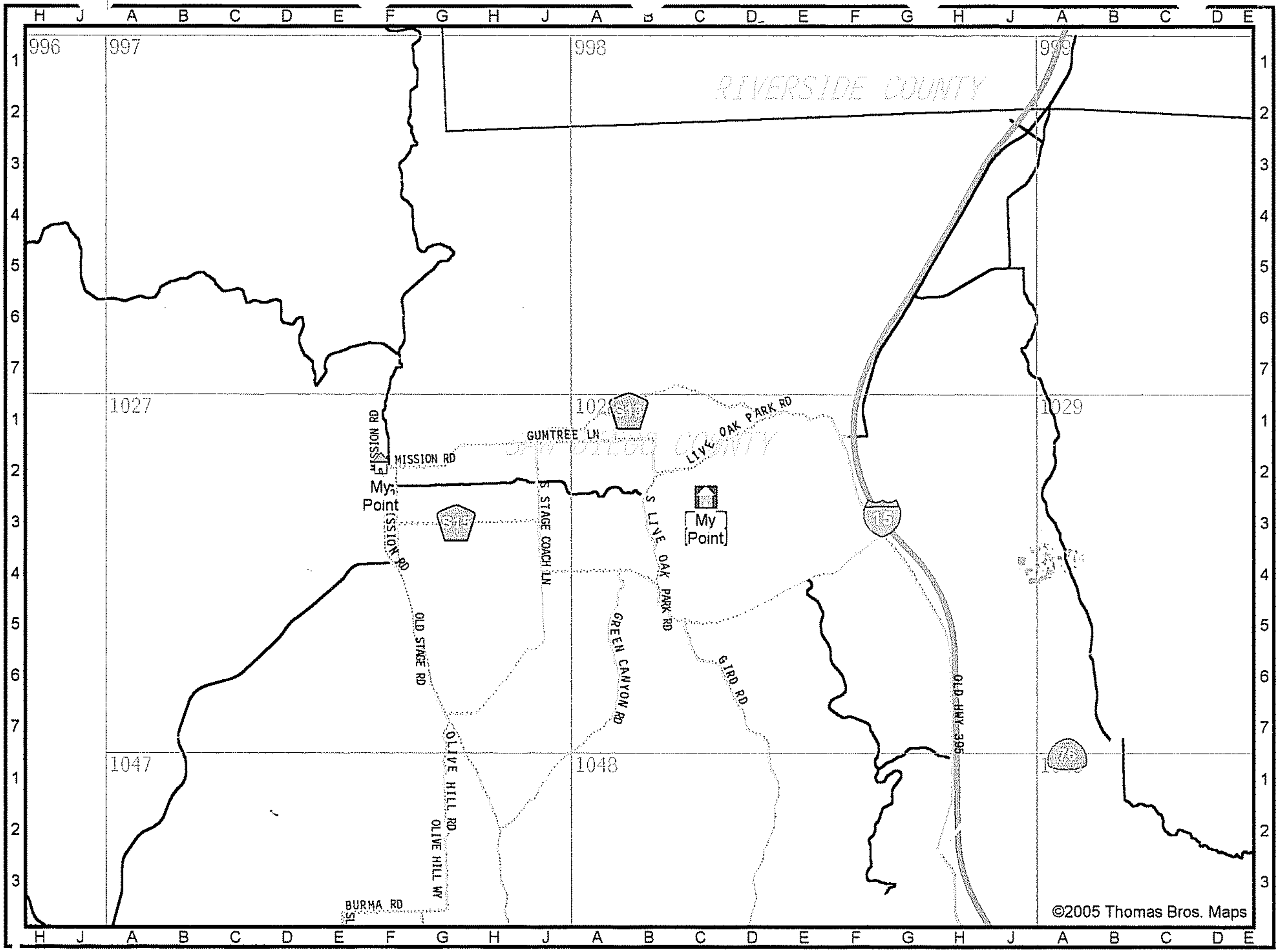
# SECTION 4

**4.0**

# APPENDIX A

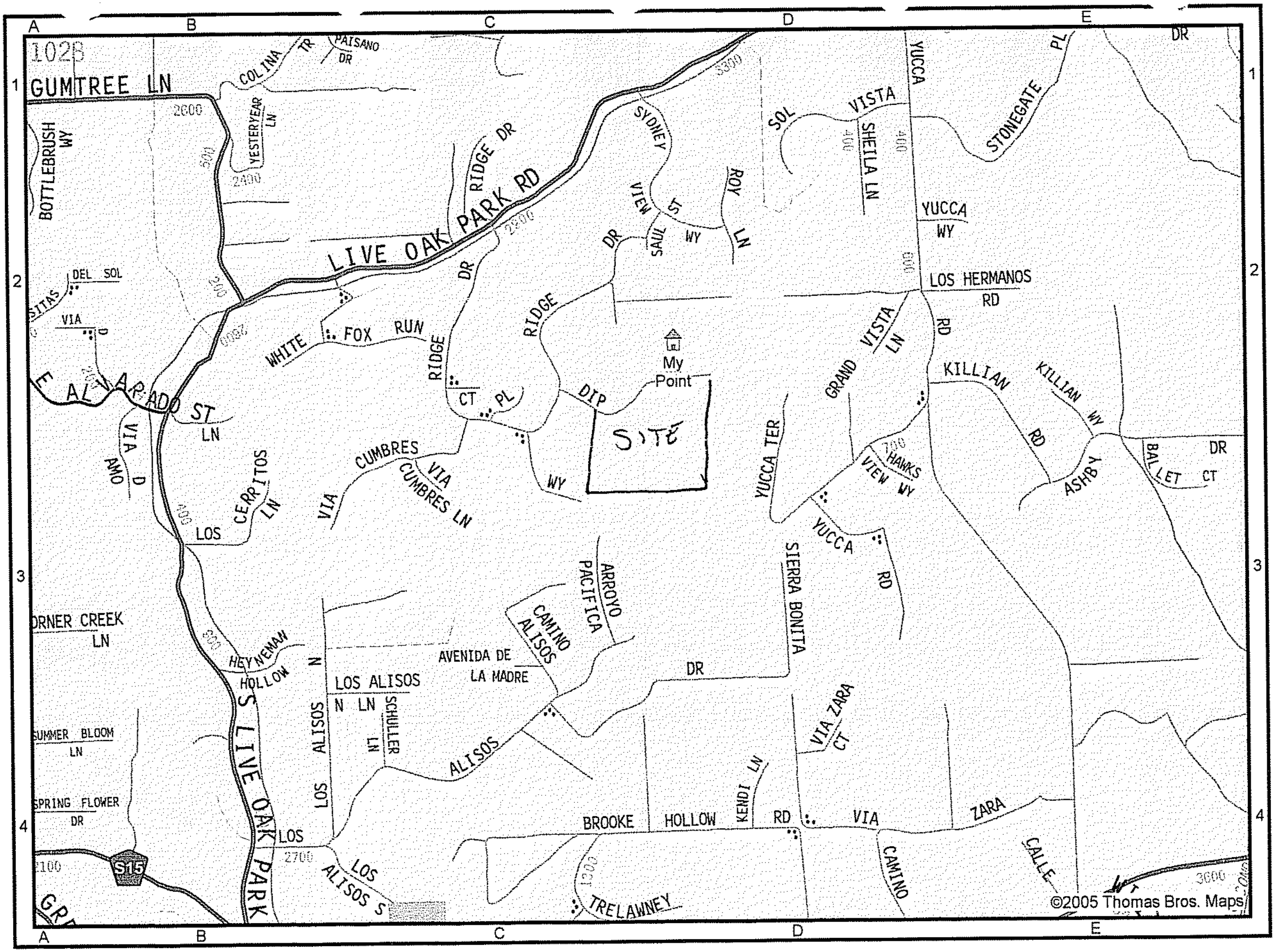
4.1

## SITE DESCRIPTIONS EXHIBITS




*My Point: 1027F2*

# LOCATION MAP




My Point: 1028D2

**VICINITY MAP**

**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



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# REDI!

Query | Geomail | Help
Map | Locate | Report

Set map scale or zoom factor

○ +4X ○ +2X ◉ Pan ○ -2X ○ -4X

Set scale bar to ______ feet

Zoom to

Current Map

Reference Layers

- [x] Roads
- [x] Road Names
- [ ] Railroads
- [ ] Transit
- [ ] Traffic volume
- [ ] Airports
- [ ] Elevation
- [ ] Cities
- [x] Parcels
- [ ] Plan Areas
- [ ] Re-use
- [ ] Water Features
- [ ] Flood plains
- [ ] Watersheds

Base Map

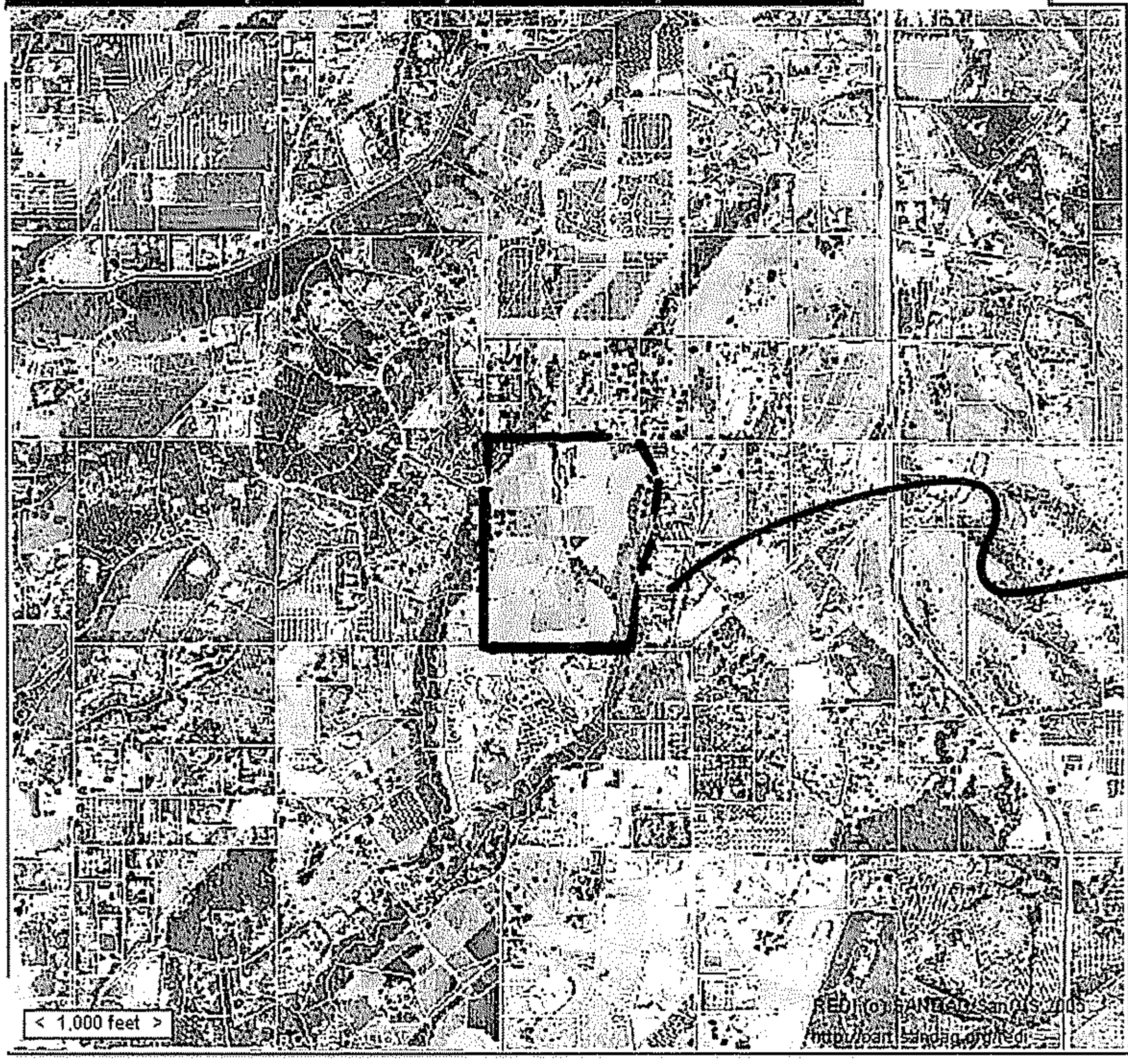
○ None ○ Terrain ◉ Photo

Layers in red do not display at this scale.

Update Map

33

EMPLOYMENT LANDS | OWNERSHIP | EXISTING USE | PLANNED USE | NONE




LEGEND

Reference Layers

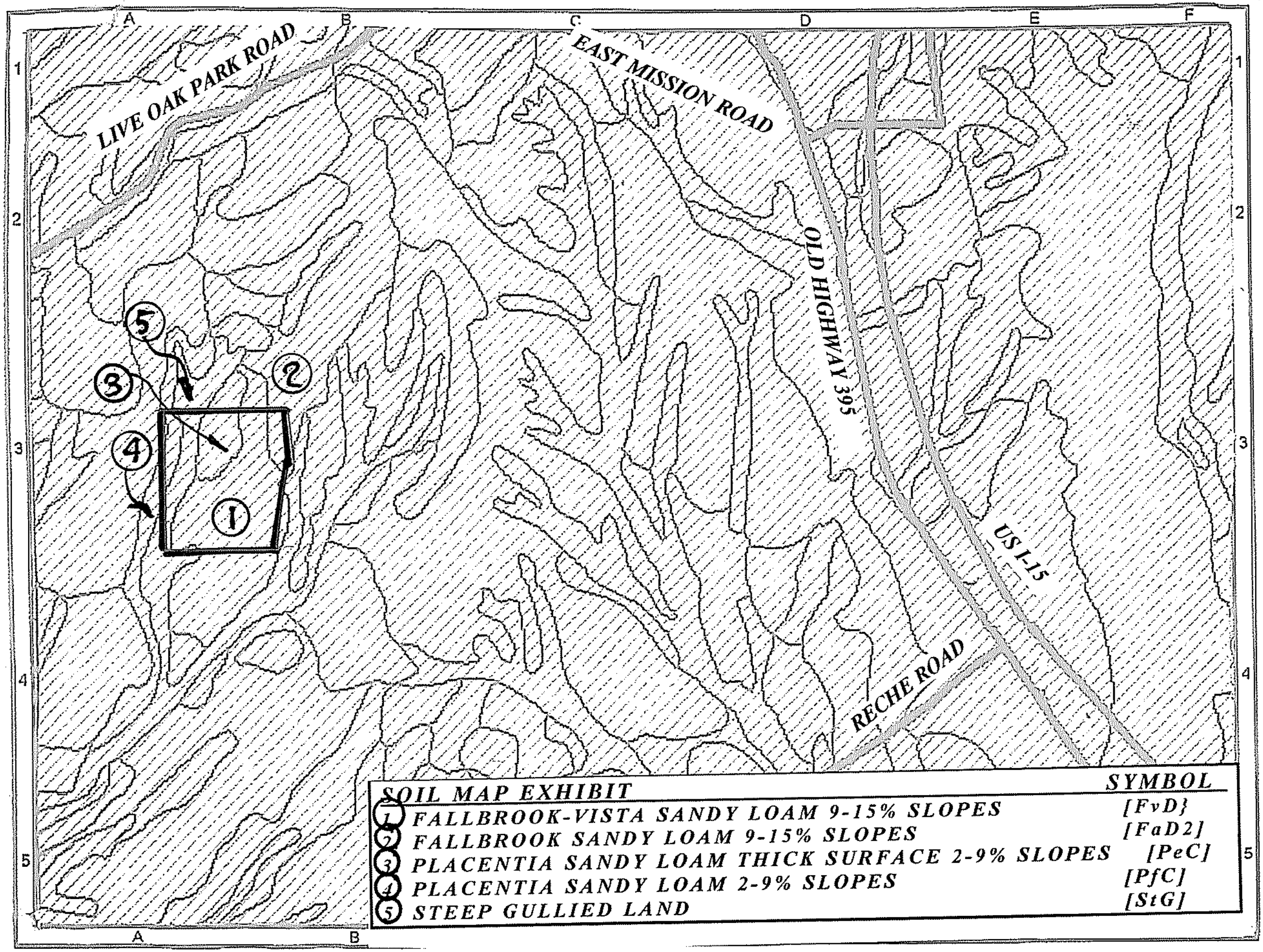
Parcels

Roads

Questions or comments about REDI? Click here.

SANDAG **AERIAL VIEW EXHIBIT** SanGIS

51



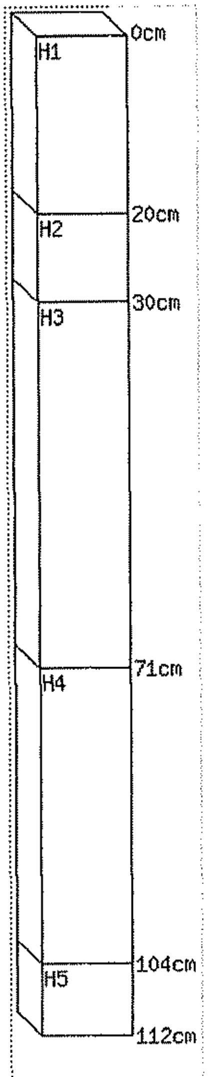

My Point: 1028D2

52

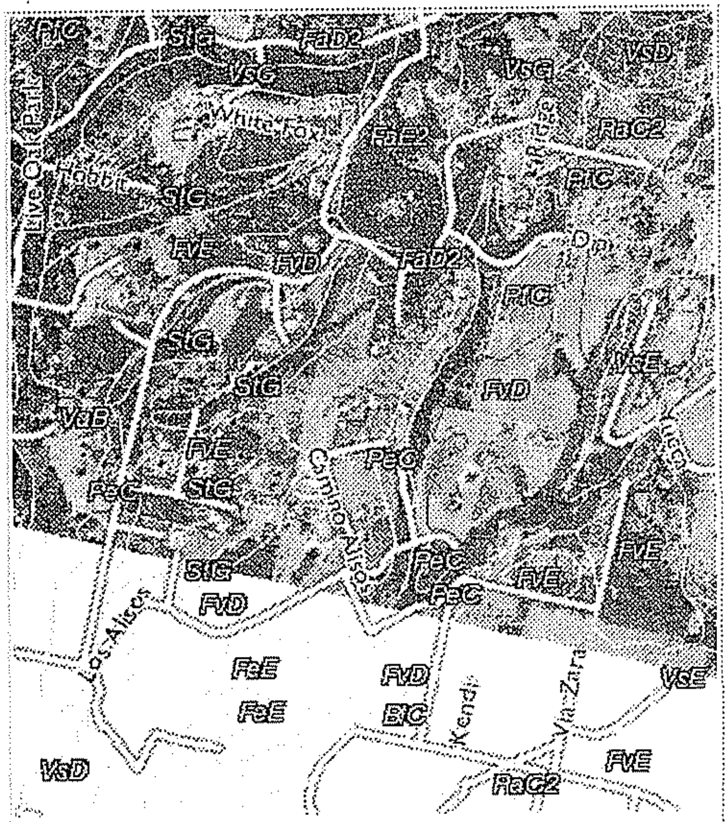
53

California Soil Resource Lab

## Soil Taxonomy




Typical profile




Queried map unit outlined in blue.

| | |
|---|---|
| Order: | *Alfisols* |
| Suborder: | *Xeralfs [Map of Suborders]* |
| Greatgroup: | *Haploxeralfs* |
| Subgroup: | *Typic Haploxeralfs* |
| Family: | *TYPIC HAPLOXERALFS, FINE-LOAMY, MIXED, THERMIC* |
| Phase: | *Fallbrook-Vista sandy loams, 9 to 15 percent slopes* ① ② |
| Soil Series: | *FALLBROOK (Link to Official Series Description)* |
| Data: | *[Lab Data] [Nitrate Groundwater Pollution Hazard Index]* |

## Land Classification

| | |
|---|---|
| Storie Index | *54* |
| Land Capability Class [non-irrigated] | *4-e0* |
| Land Capability Class [irrigated] | *4-e0* |

## Soil Suitability Ratings

| | |
|---|---|
| *Waste Related* | *Engineering* |
| *Urban/Recreational* | *Irrigation* |
| *Wildlife* | *Runoff* |

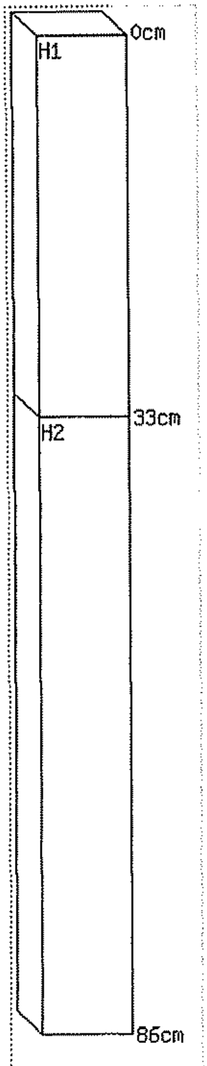
## Erosion

| | |
|---|---|
| Wind Erodibility Group | *3* |
| Wind Erodibility Index | *86* |
| T Erosion Factor | *4* |
| Runoff | *High* |
| Drainage | *Well drained* |
| Parent Material: | *residuum weathered from granodiorite* |

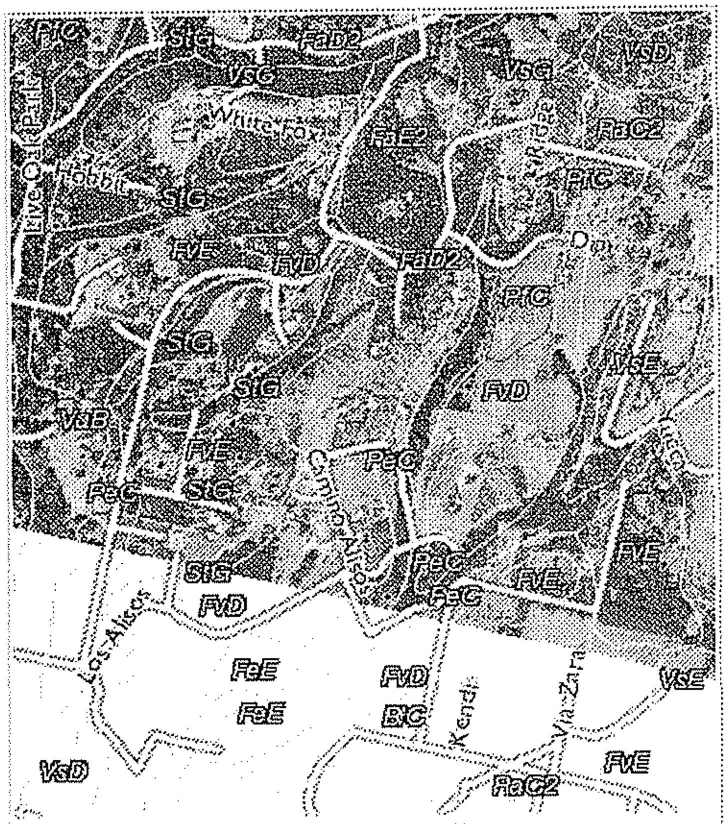
## Geomorphology

California Soil Resource Lab

## Soil Taxonomy



Typical profile



Queried map unit outlined in blue.

| | |
|---|---|
| **Order:** | *Alfisols* |
| **Suborder:** | *Xeralfs [Map of Suborders]* |
| **Greatgroup:** | *Natrixeralfs* |
| **Subgroup:** | *Typic Natrixeralfs* |
| **Family:** | *TYPIC NATRIXERALFS, FINE, MONTMORILLONITIC, THERMIC* |
| **Phase:** | *Placentia sandy loam, thick surface, 2 to 9 percent slo pes* |
| **Soil Series:** | *PLACENTIA (Link to Official Series Description)* |
| **Data:** | *[Lab Data] [Nitrate Groundwater Pollution Hazard Index]* |

③ ④

## Land Classification

| | |
|---|---|
| **Storie Index** | *60* |
| **Land Capability Class [non-irrigated]** | *4-e0* |
| **Land Capability Class [irrigated]** | *3-e0* |

## Soil Suitability Ratings

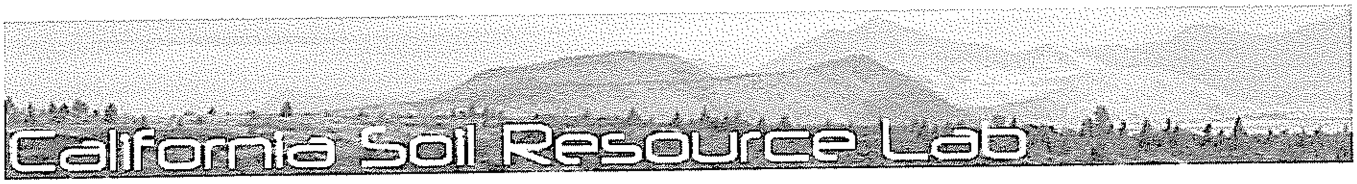
| | |
|---|---|
| *Waste Related* | *Engineering* |
| *Urban/Recreational* | *Irrigation* |
| *Wildlife* | *Runoff* |

## Erosion

| | |
|---|---|
| **Wind Erodibility Group** | *3* |
| **Wind Erodibility Index** | *86* |
| **T Erosion Factor** | *2* |
| **Runoff** | *Very high* |
| **Drainage** | *Moderately well drained* |
| **Parent Material:** | *alluvium derived from granite* |

## Geomorphology

55




## Map Unit Composition

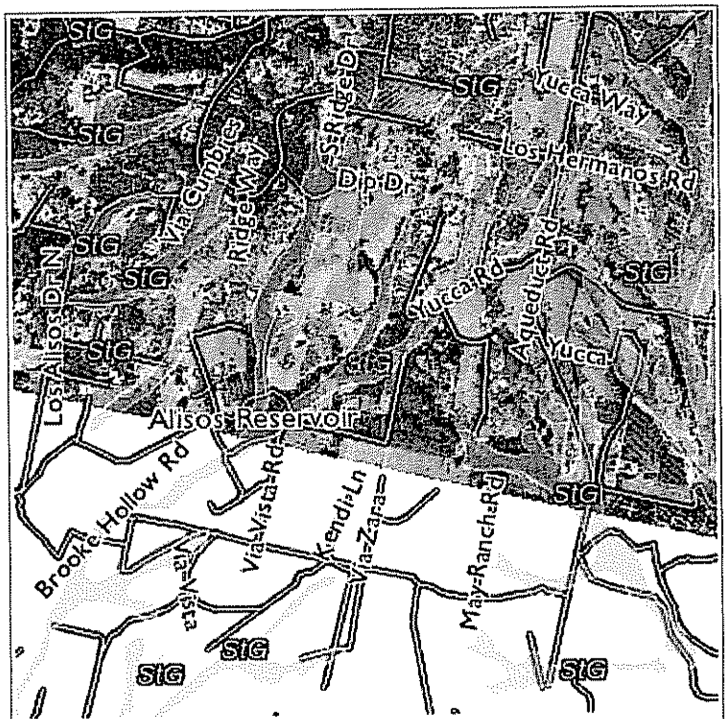
Map units consist of 1 or more soil types. commonly referred to as "components"

| Component Name | % of Map Unit | Component Type | Horiz |
|---|---|---|---|
| *Soil Type 1* ***STEEP GULLIED LAND*** | *85* | *Major Soil Type* | |
| *Soil Type 2* ***UNNAMED*** | *1* | *Inclusion* | |

*Note: links to horizon data marked with a * are approximate.*

---

## Map Unit Data *What is a Map Unit?*




Queried map unit polygons in yellow, queried point in red.

Cartographic information about this map unit

| | | |
|---|---|---|
| **Map Unit Name:** | *Steep gullied land* | (5) |
| **Map Unit Type:** | *Consociation* | |
| **Map Unit Symbol:** | *StG* | |
| **Map Unit Acres:** | *91 acres (7072ac. total in survey area)* | |

## Map Unit Aggregated Data

Generalized soils information within this map unit.

| | |
|---|---|
| **Farmland Class:** | *Not prime farmland* |
| **Available Water Storage (0-100cm):** | *cm* |
| **Max Flood Freq:** | *None* |
| **Drainage Class:** | |
| **Hydric Conditions:** | *Partially hydric* |
| **Min Water Table Depth:** | *n/a* |
| **Raw Map Unit Data** | *click here* |

## Map Unit Notes

Miscellaneous notes recorded by NRCS staff about this map unit.

## Adjacent Soil Polygons

Links to the soil polygons touching the currently selected polygon

**1** *Fallbrook sandy loam, 15 to 30 percent slopes, eroded*

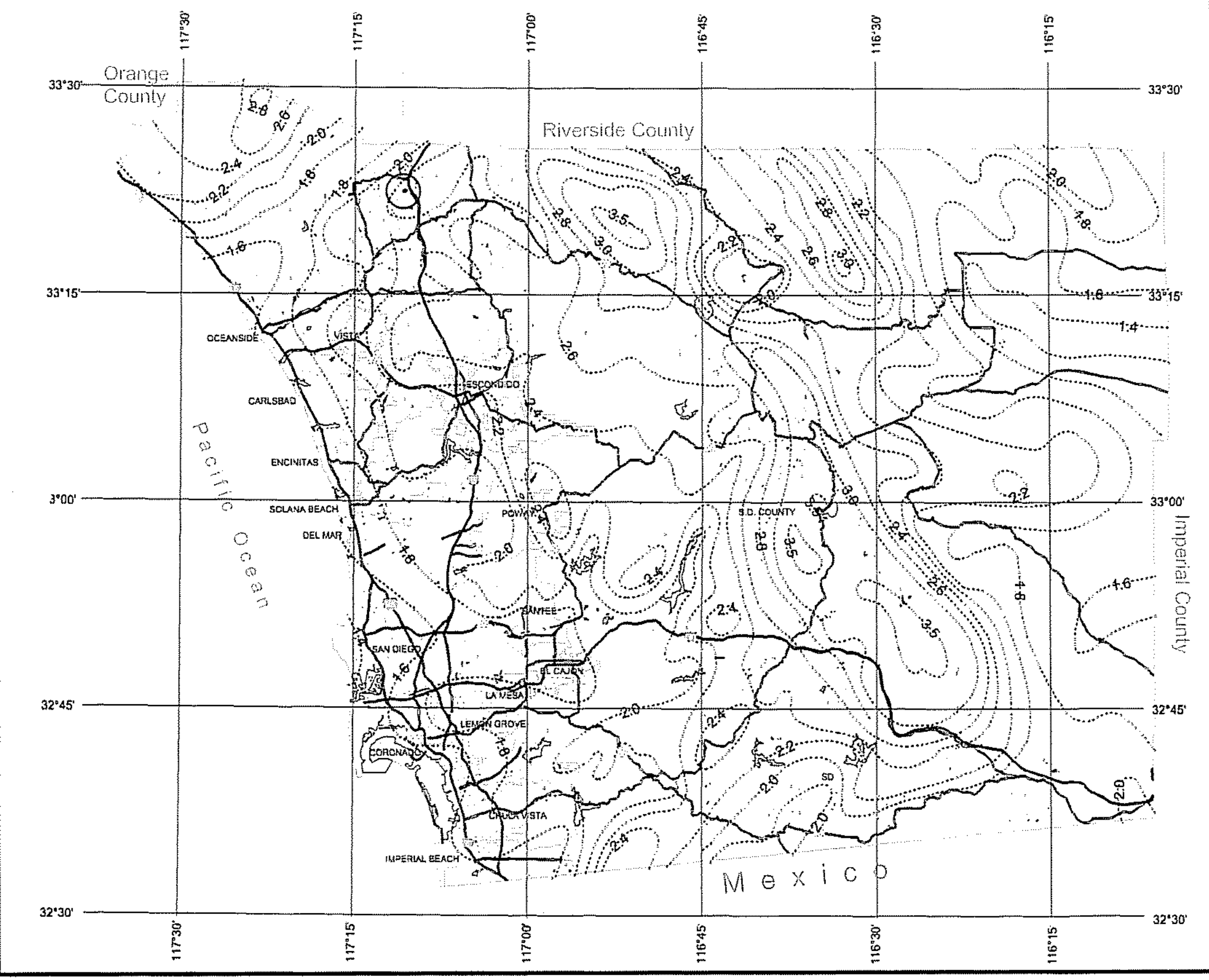
# County of San Diego Hydrology Manual

*Rainfall Isopluvials*

**10 Year Rainfall Event - 6 Hours**

Isopluvial (inches)

**P(6) 10 = 2.4 Inches**




DPW GIS

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3 0 3 Miles

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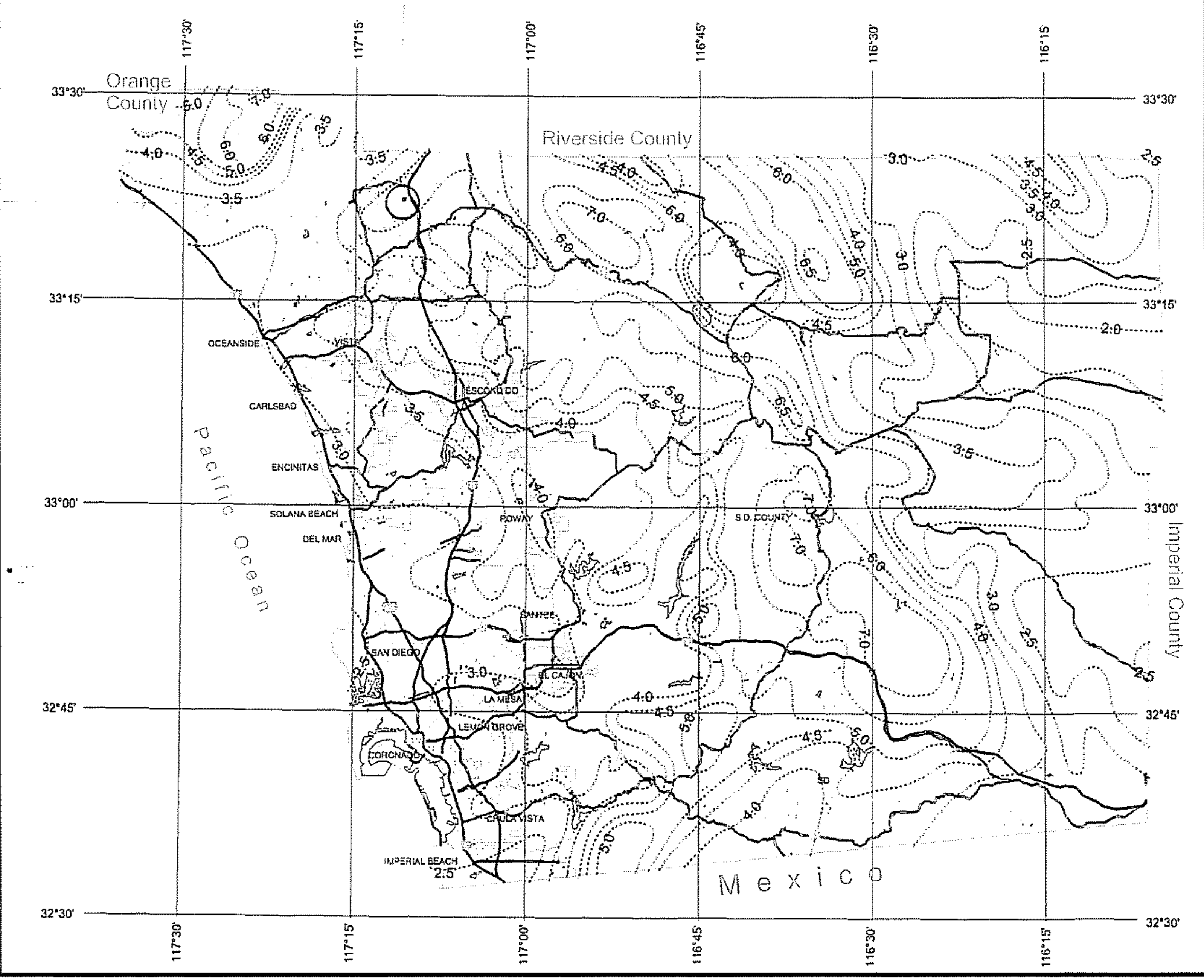


# County of San Diego Hydrology Manual

*Rainfall Isopluvials*

**10 Year Rainfall Event - 24 Hours**

........ Isopluvial (Inches)

**P(24) 10 = 4.0 Inches**

DPW GIS

SanGIS

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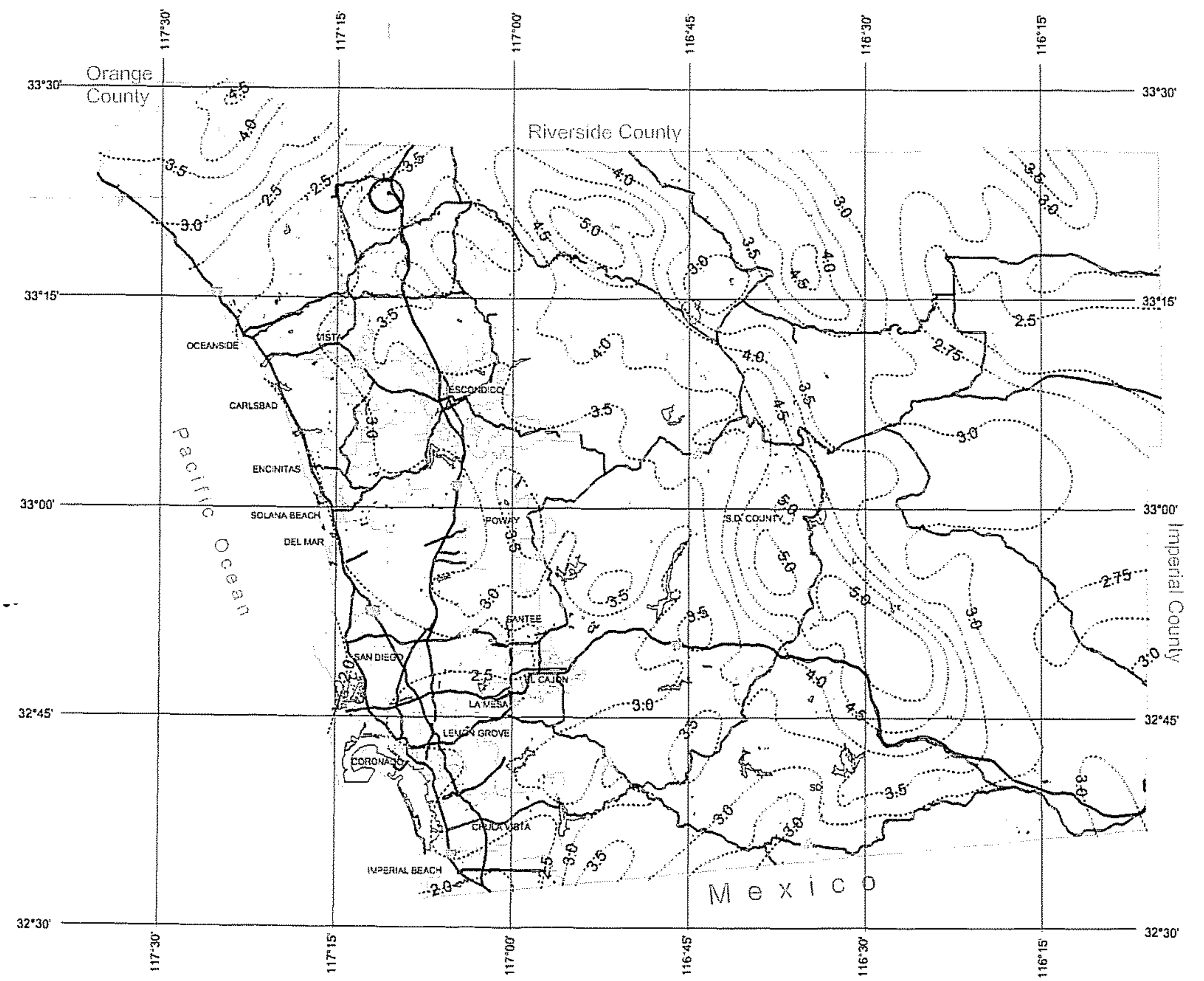
N S E W

3 0 3 Miles




# County of San Diego Hydrology Manual

*Rainfall Isopluvials*

**100 Year Rainfall Event - 6 Hours**

Isopluvial (inches)

**P(6) 100 = 3.5 Inches**

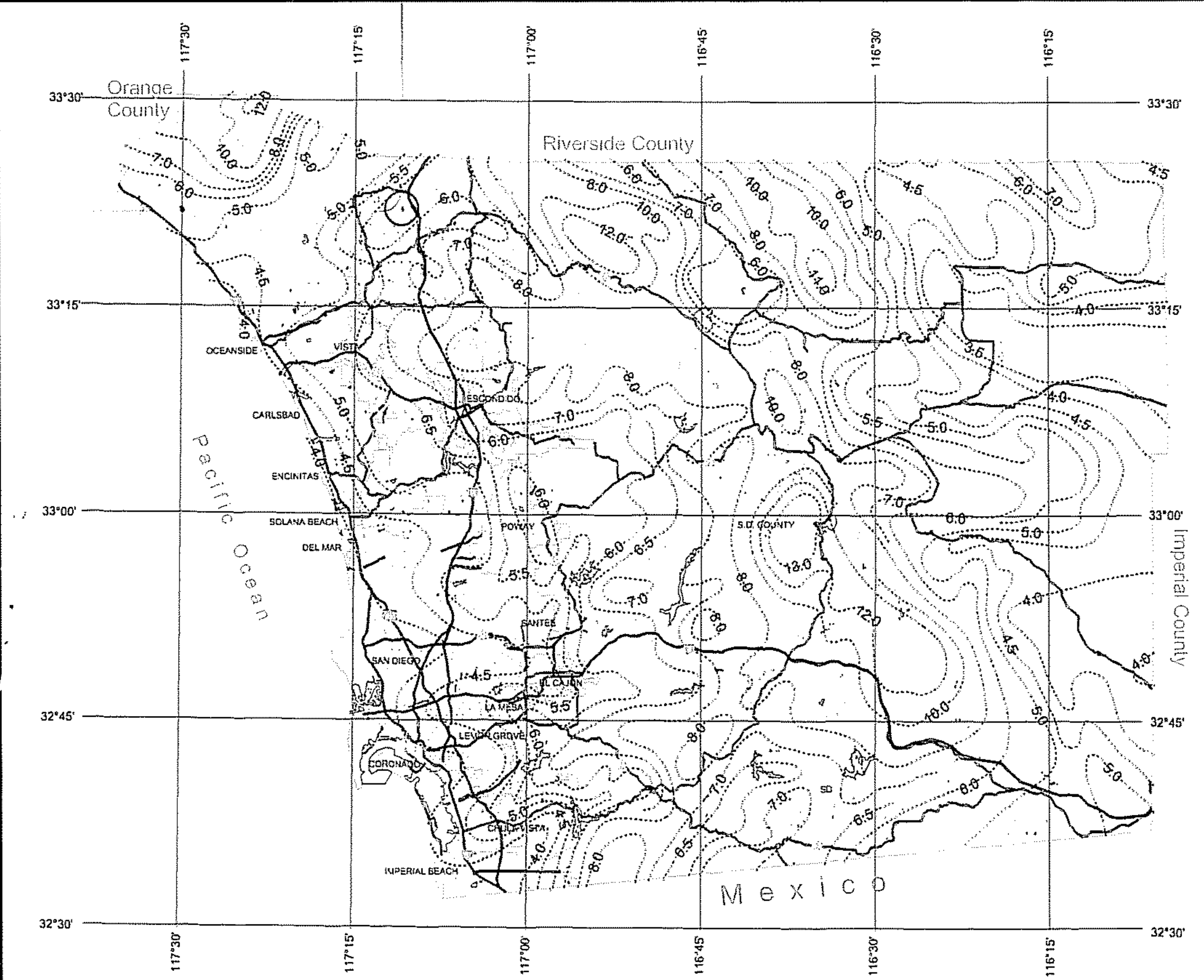
DPW GIS

SanGIS

N S E W

3 0 3 Miles

58




# County of San Diego Hydrology Manual

*Rainfall Isopluvials*

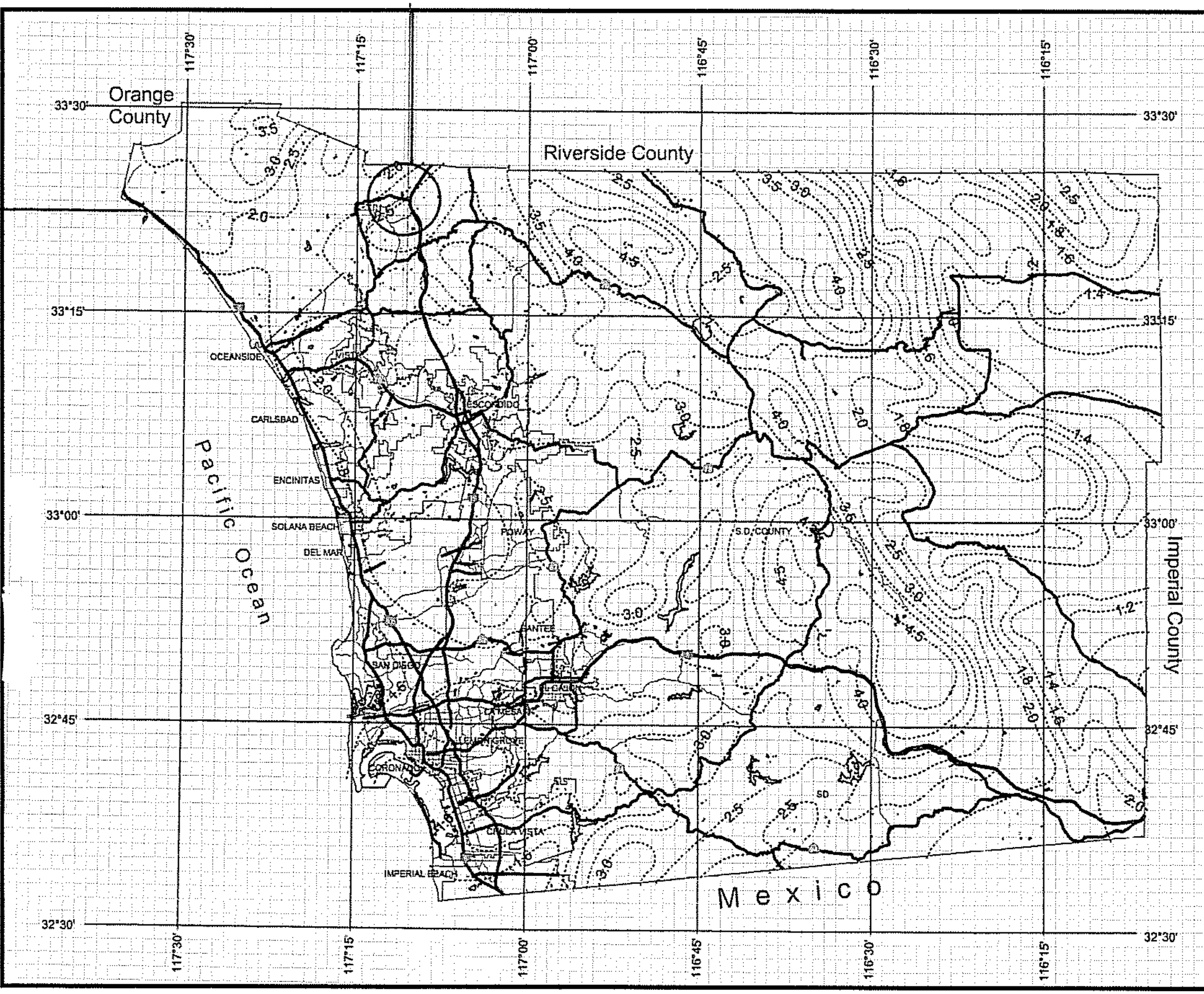
**100 Year Rainfall Event - 24 Hours**

Isopluvial (inches)

**P(24) 100 = 6.0 Inches**

DPW GIS
SanGIS

3 0 3 Miles




# County of San Diego Hydrology Manual

*Rainfall Isopluvials*

**2 Year Rainfall Event - 24 Hours**

Isopluvial (inches)

**SITE LOCATION**

**W 117° 10' 15"**

**N 33° 22' 30"**

DPW GIS

SanGIS We Have San Diego Covered!

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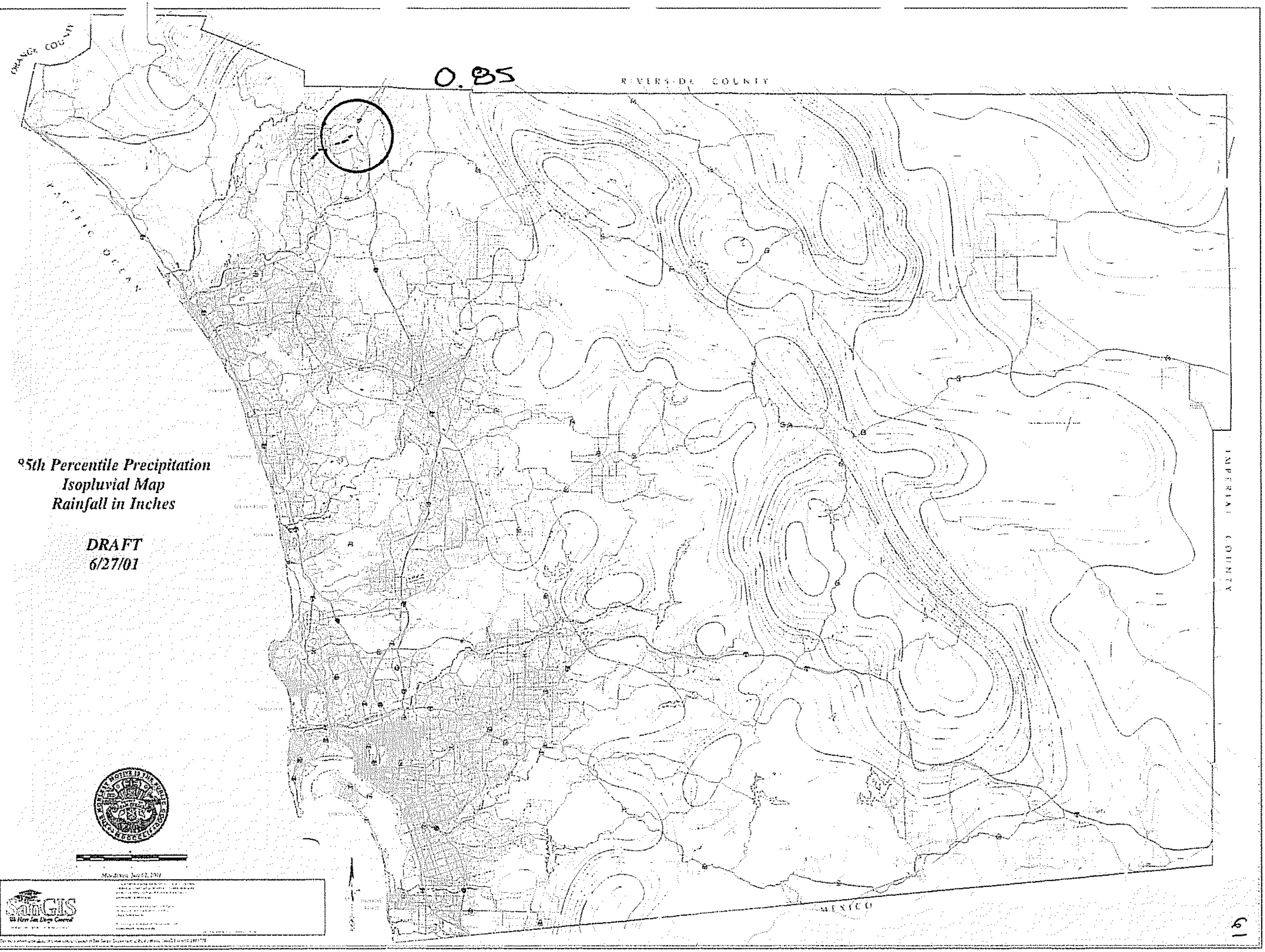
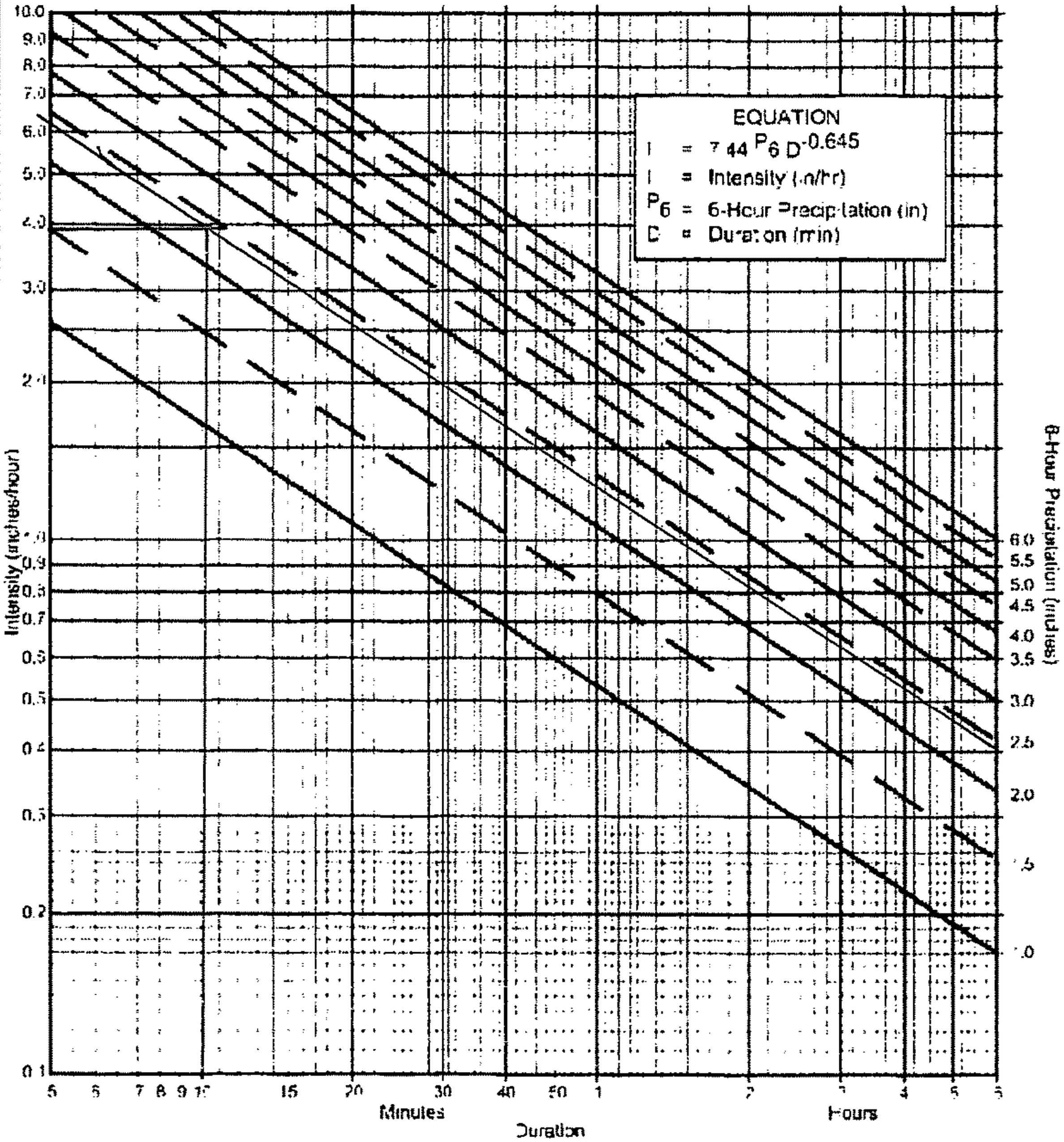
N E S W

3 0 3 Miles



85th Percentile Precipitation
Isopluvial Map
Rainfall in Inches
DRAFT
6/27/01
0.85
RIVERSIDE COUNTY
ORANGE COUNTY
PACIFIC OCEAN
IMPERIAL COUNTY
MEXICO
SanGIS
61




**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 applicable 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 10 year

(b) $P_6$ = 2.4 in., $P_{24}$ = 4.0, $\frac{P_6}{P_{24}}$ = 60 %(2)

(c) Adjusted $P_6$(2) = 2.4 in.

(d) $t_x$ = 10 min

(e) I = 4 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**

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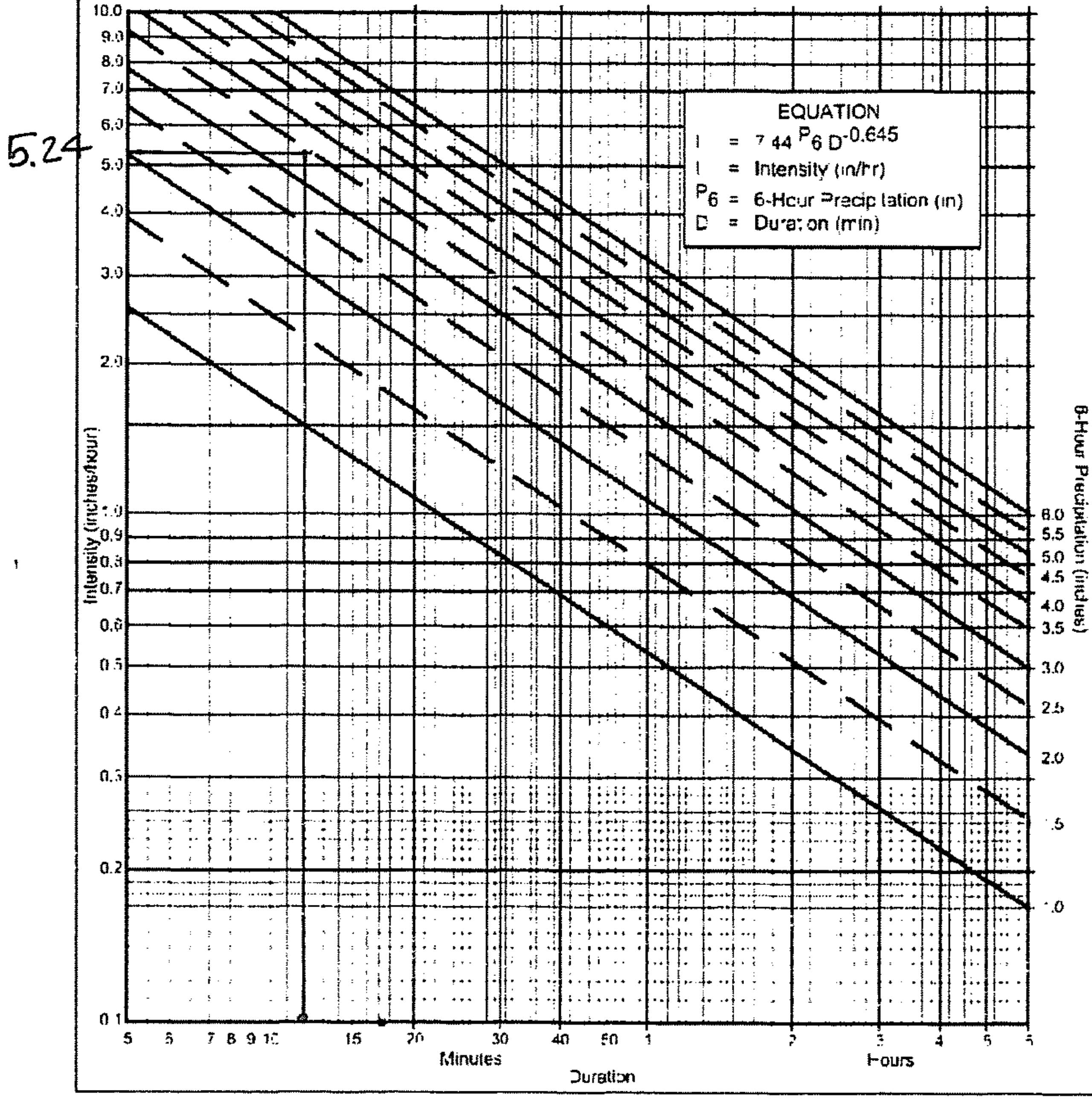



**Directions for Application:**

(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 applicable 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) $P_6$ = 3.5 in., $P_{24}$ = 6.0, $\frac{P_6}{P_{24}}$ = 58 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.5 in

(d) $t_x$ = 12 min

(e) I = 5.24 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 | 6.49 |
| 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**

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.

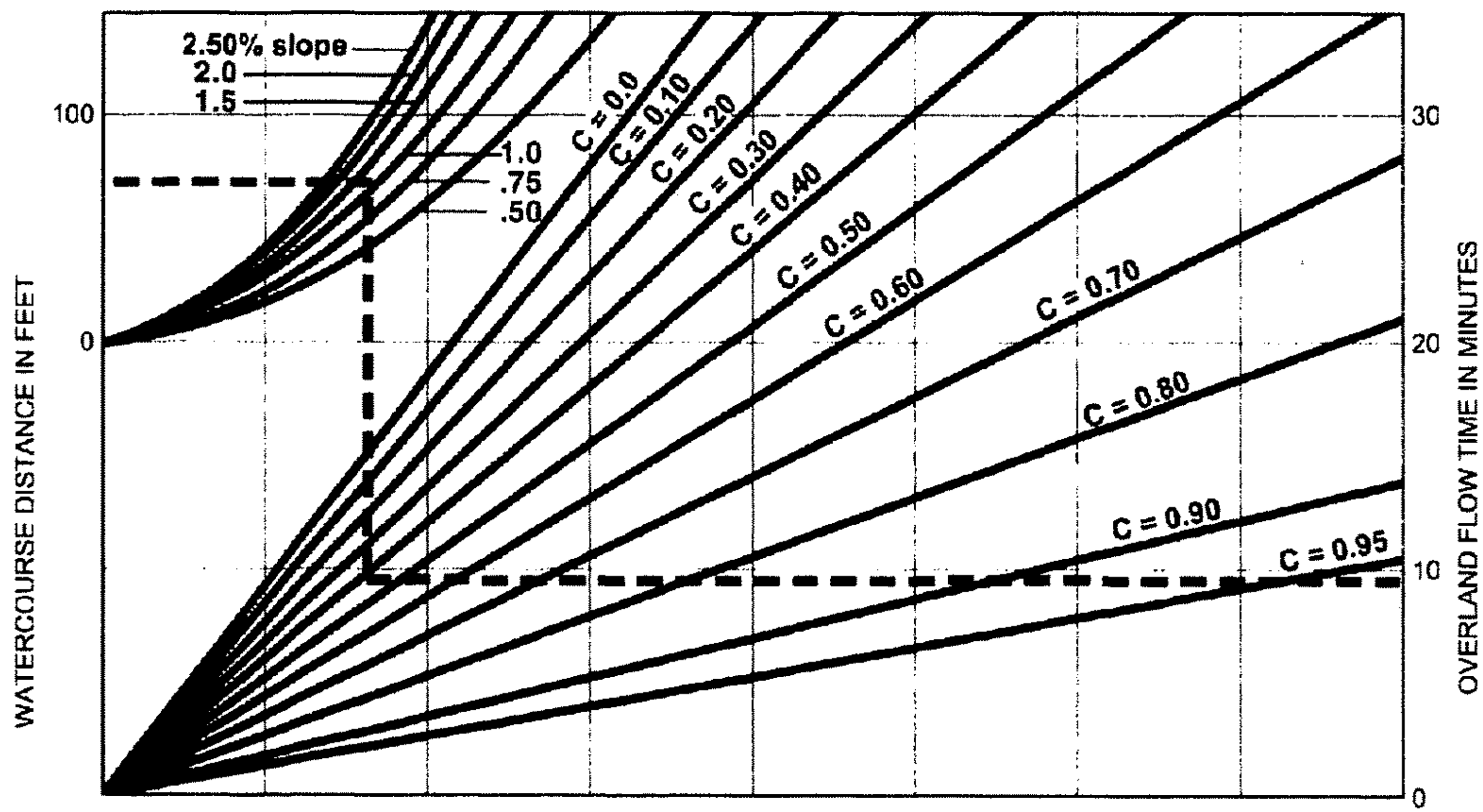
Table 3-2 provides limits of the length (Maximum Length ($L_M$)) of sheet flow to be used in hydrology studies. Initial $T_i$ values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be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




EXAMPLE

Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

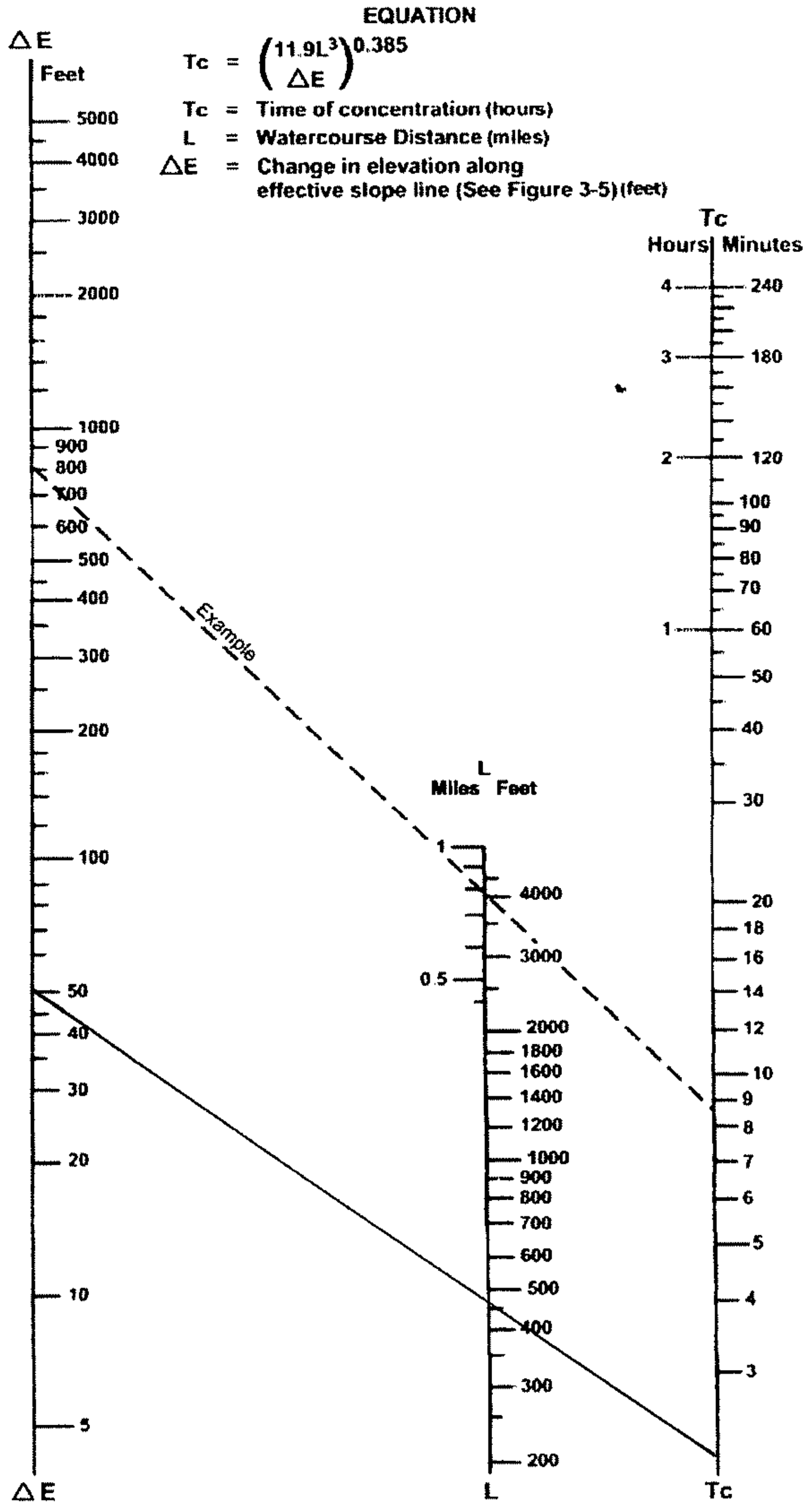
$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

**Rational Formula - Overland Time of Flow Nomograph**

FIGURE

**3-3**

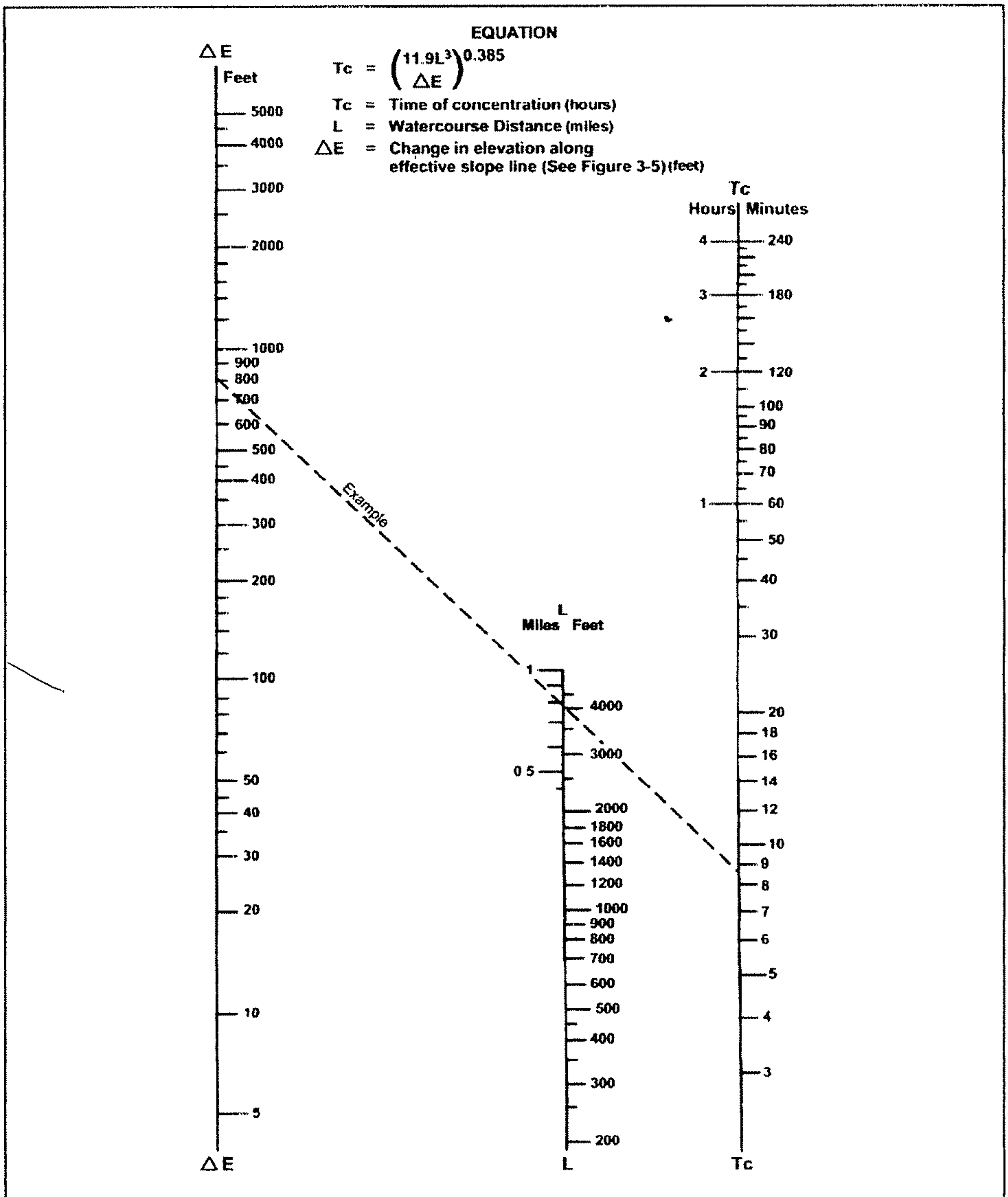



SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE **3-4**

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

EAST W/S

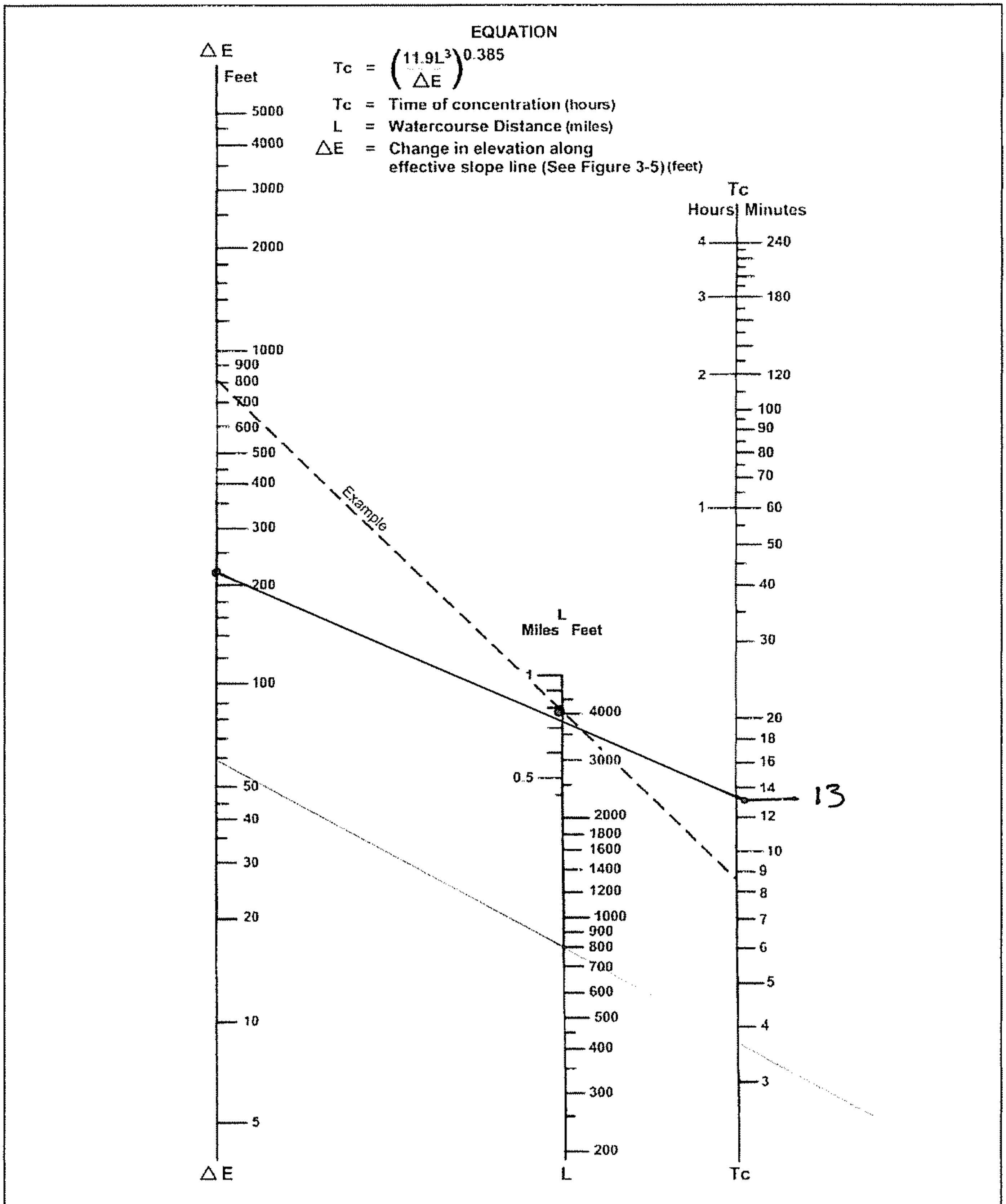



SOURCE: California Division of Highways (1941) and Kirpich (1940)

**FIGURE 3-4**

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

WEST W/S

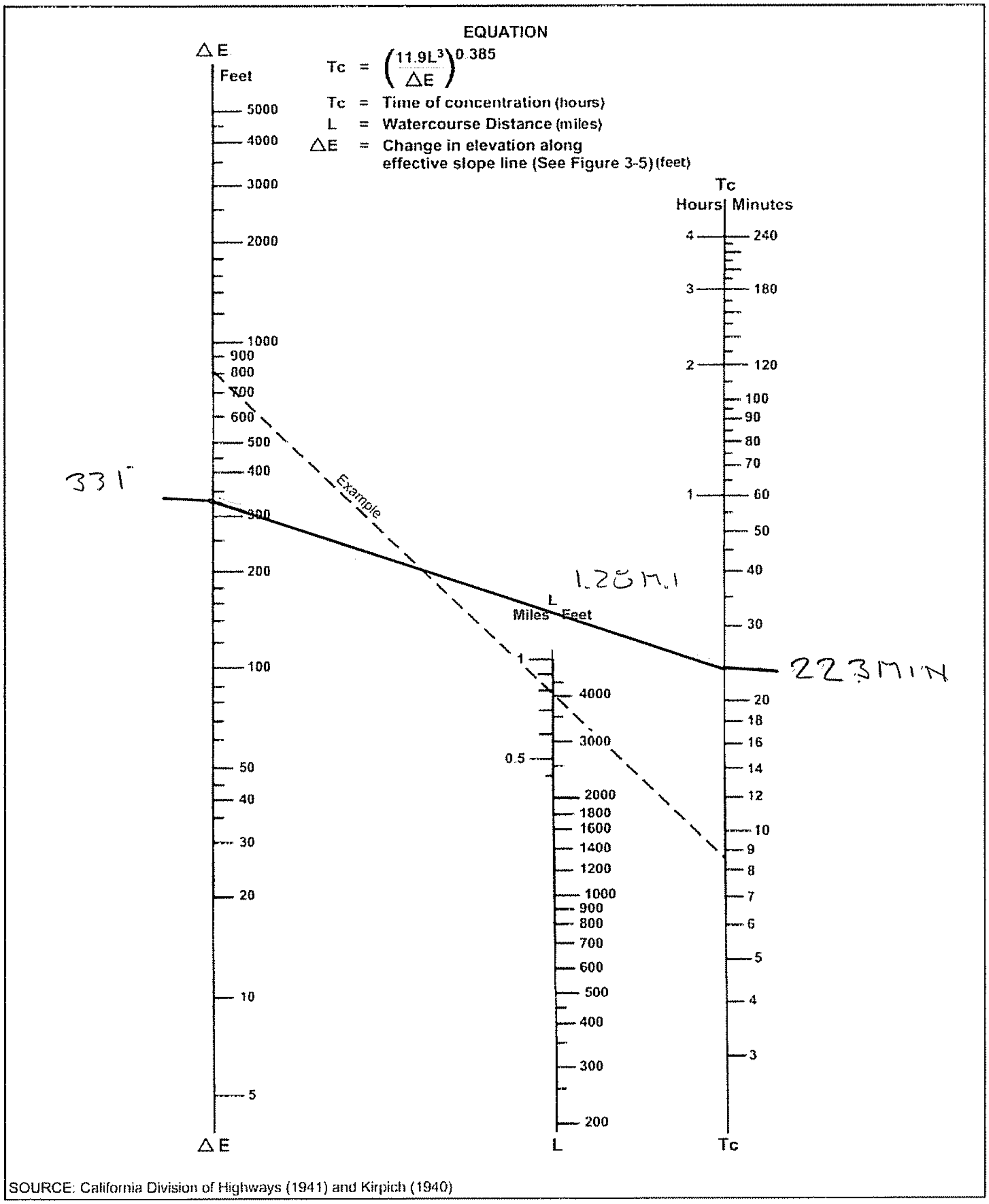



SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-4

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

NORTH W/S



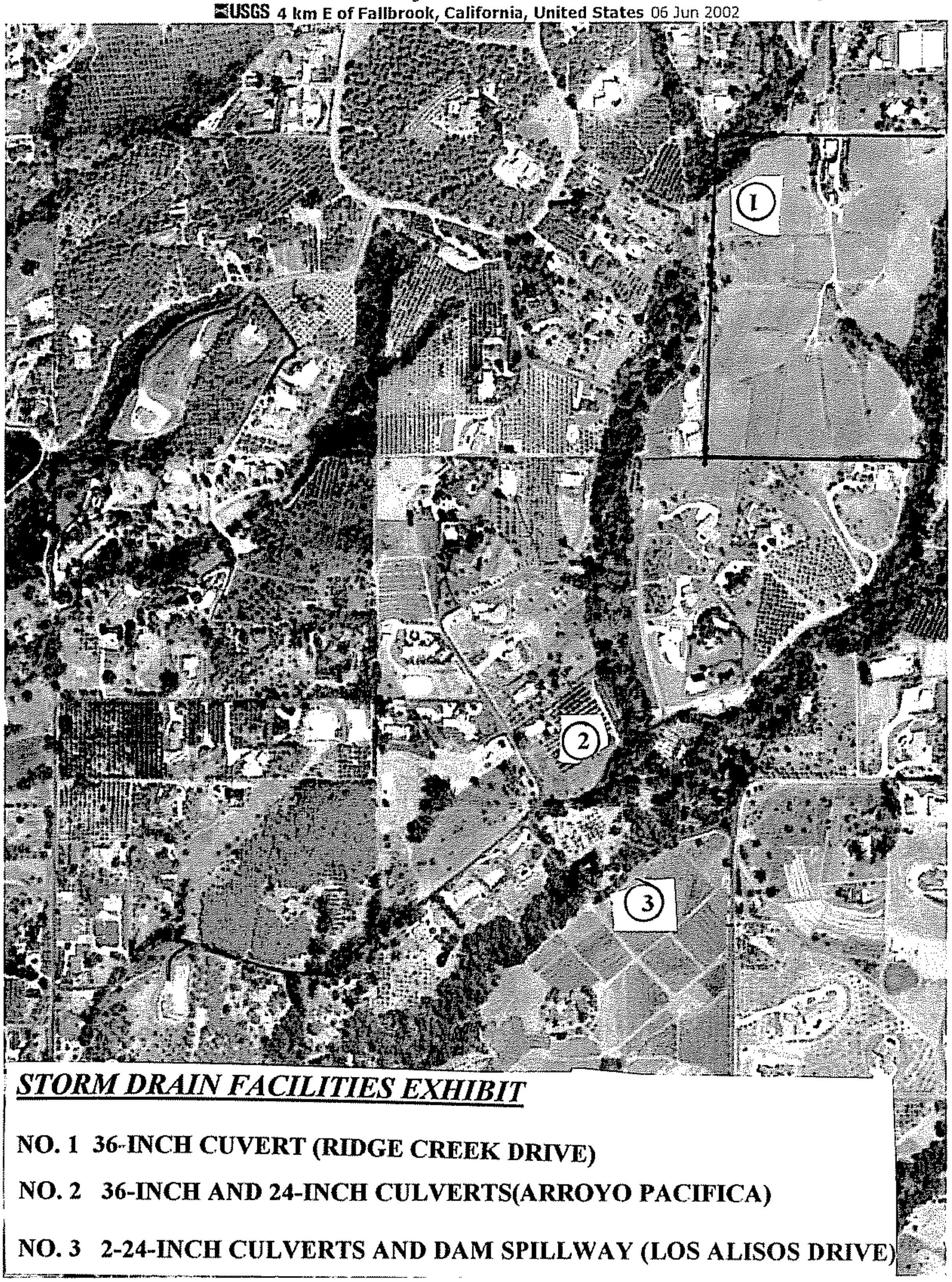

FIGURE

**3-4**

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

Send To Printer Back To TerraServer Change to 11x17 Print Size Show Grid Lines Change to Landscape

USGS 4 km E of Fallbrook, California, United States 06 Jun 2002




0 200M 0 200yd

Image courtesy of the U.S. Geological Survey

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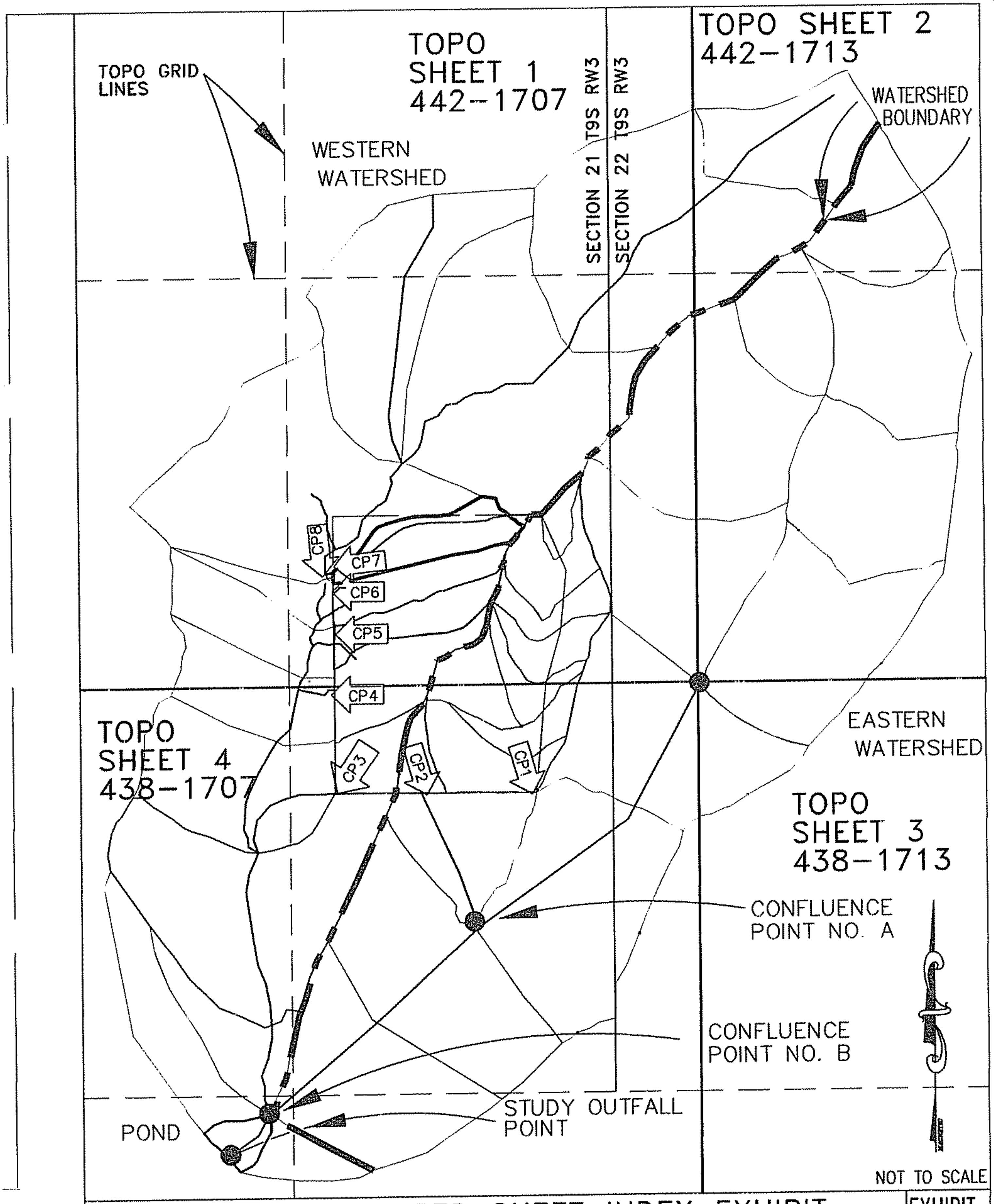
# APPENDIX B

4.21

## PREDEVELOPED DATA SHEETS AND EXHIBITS

Lg

maps




PRE-DEVELOPED SHEET INDEX EXHIBIT
TM 5469
E:\PROJECTS\RIDGE_CREEK\JUL2007\SHEET_INDEX_BASINS.dwg

EXHIBIT NO. 4

| BASIN | Distance (D) | Elev. A | Elev. B | Slope | Tc(min) | Acres | C | I(in/hr) | Q100 | Peak Q | D/S PT | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FE1 | 70 | 1000.7 | 1000 | 1.00 | 11.5 | 7.1 | 0.41 | 5.3888 | 15.69 | 15.7 | | Initial Basin Lm=70' Ti=11.5 Min |
| FE2 | 805 | 1000 | 940 | 7.45 | 13 | 10.9 | 0.41 | 4.9791 | 22.25 | 37.9 | | FAR EAST BASIN |
| FE3 | 765 | 940 | 900 | 5.23 | 15 | 12.58 | 0.41 | 4.5401 | 23.42 | 61.4 | | Qpeak at PT OFCONFLUENCE W/FE4 |
| FE4 | 930 | 900 | 850 | 5.38 | 17 | 15.05 | 0.41 | 4.1879 | 25.84 | 87.2 | | Qpeak at PT OFCONFLUENCE W/FE3 |
| | | | | | | | | | | | | |
| FE9 | 70 | 950.7 | 950 | 1.00 | 11.5 | 5.55 | 0.41 | 5.3888 | 12.26 | 12.3 | | Initial Basin Lm=70' Ti=11.5 Min |
| FE10 | 807 | 950 | 900 | 6.20 | 13 | 16.58 | 0.41 | 4.9791 | 33.85 | 46.1 | | FAR EAST BASIN |
| FE11 | 820 | 900 | 850 | 6.10 | 14 | 12.91 | 0.41 | 4.7467 | 25.12 | 71.2 | | Qpeak at PT OFCONFLUENCE W/FE4 |
| | | | | | | | | | | | | |
| | | | | | 17.0 | | 0.41 | 4.1879 | 150.00 | 150.0 | | CONFLUENCE Qpeak SEE TABLE NO. 1 C1 |
| FE5 | 775 | 850 | 815 | 4.52 | 17 | 15.57 | 0.41 | 4.1879 | 26.73 | 176.7 | | FAR EAST BASIN |
| FE6 | 955 | 815 | 775 | 4.19 | 20 | 17.56 | 0.41 | 3.7712 | 27.15 | 203.9 | | Qpeak at PT OFCONFLUENCE W/ E9 & S2 |
| | | | | | | | | | | | | |
| E1 | 70 | 930.7 | 930 | 1.00 | 11.5 | 0.96 | 0.35 | 5.3888 | 1.81 | 1.8 | | Initial Basin Lm=70' Ti=11.5 Min |
| E2 | 311 | 930 | 873 | 18.33 | 13 | 3.19 | 0.35 | 5.1066 | 5.70 | 7.5 | | |
| E3 | 98 | 873 | 866 | 7.14 | 14.5 | 1.99 | 0.35 | 4.6404 | 3.23 | 10.7 | | |
| E4 | 220 | 866 | 842 | 10.91 | 15 | 2.26 | 0.35 | 4.6404 | 3.67 | 14.4 | | |
| E5 | 238 | 842 | 828 | 5.88 | 16 | 1.74 | 0.35 | 4.3550 | 2.65 | 17.1 | | |
| E6 | 516 | 888 | 828 | 11.63 | 17 | 2.72 | 0.35 | 4.1879 | 3.99 | 21.1 | | ADDITIONAL SUB-AREA |
| E7 | 185 | 828 | 814.6 | 7.24 | 18 | 1.96 | 0.35 | 4.0364 | 2.77 | 23.8 | | |
| E8 | 170 | 814.6 | 807 | 4.47 | 19 | 3.76 | 0.35 | 3.8980 | 5.13 | 29.0 | CP1 | |
| | | | | | | | | | | | | |
| E9 | 710 | 807 | 770 | 5.21 | 21 | 3.38 | 0.35 | 3.6543 | 4.32 | 33.3 | | Qpeak at PT OFCONFLUENCE W/ S2 FE6 |
| | | | | | | | | | | | | |
| S1 | 70 | 896.7 | 896 | 1.00 | 13 | 1.35 | 0.35 | 4.9791 | 2.35 | 2.4 | CP2 | Initial Basin Lm=70' Ti=11.5 Min |
| S2 | 704 | 896 | 770 | 17.90 | 15 | 3.27 | 0.35 | 4.5401 | 5.20 | 7.5 | | Qpeak at PT OFCONFLUENCE W/ E9 FE6 |
| | | | | | | | | | | | | |
| | | | | | 20 | | | 3.7712 | 241.90 | 241.9 | | CONFLUENCE Qpeak SEE TABLENO.1 C2 |
| FE7 | 702 | 775 | 745 | 4.27 | 22 | 16.55 | 0.41 | 3.5463 | 24.06 | 266.0 | | Qpeak |
| FE8 | 703 | 745 | 720 | 3.56 | 23 | 13.57 | 0.41 | 3.4461 | 23.38 | 289.3 | **PT A** | Qpeak at PT OFCONFLUENCE W/ FW12 |
| **TACRES** | | | | | | **170.5** | | | | | | |
| BASIN | Distance (D) | Elev. A | Elev. B | Slope | Tc(min) | Acres | C | I(in/hr) | Q100 | Peak Q | D/S PT | |

| BASIN | Distance (D) | Elev. A | Elev. B | Slope | Tc(min) | Acres | C | I(in/hr) | Q100 | Peak Q | D/S PT | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FW1 | 100 | 1005 | 1000 | 5.00 | 11.5 | 7.4 | 0.41 | 5.3888 | 16.35 | 16.3 | | Initial Basin Lm=70' Ti=11.5 Min |
| FW2 | 1100 | 1000 | 925 | 6.82 | 15.0 | 24.2 | 0.41 | 4.5401 | 45.05 | 61.4 | | QPEAK PT OF CONFL W /OFF 4 |
| FW3 | 1000 | 925 | 870 | 5.50 | 18.5 | 23.4 | 0.41 | 3.9657 | 38.05 | 99.4 | | QPEAK PT OF CONFL W/ OFF 3 |
| FW4 | 1200 | 965 | 870 | 7.92 | 15.0 | 14.6 | 0.41 | 4.5401 | 27.18 | 126.6 | | ADDITIONAL AREA |
| FW5 | 750 | 870 | 842.3 | 3.69 | 23.0 | 21.1 | 0.41 | 3.4461 | 29.81 | 156.4 | | QPEAK PT AT PIPE |
| | | | | | | | | | | | | |
| FW6 | 1095 | 955 | 842.3 | 10.29 | 19.4 | 4.09 | 0.35 | 3.7100 | 5.31 | 5.3 | CP7 | ADDITIONAL AREA |
| | | | | | 23.0 | | | 3.4461 | | 161.3 | CP8 | CONFLUENCE SEE TABLE NO. 2 C3 |
| CP6 | | | | | 18.9 | 3.34 | 0.35 | 3.9100 | 4.57 | | CP6 | ADDITIONAL AREA |
| FW7 | 256 | 839 | 824 | 5.86 | 25.0 | 2.45 | 0.41 | 3.2657 | 3.28 | 164.6 | FW7 | |
| | | | | | 25.0 | | | 3.2657 | | 168.4 | | CONFLUENCE SEE TABLE NO. 2 C4 |
| CP5 | | | | | 19.4 | 3.12 | 0.35 | 3.8300 | 4.18 | | CP5 | ADDITIONAL AREA |
| FW8 | 256 | 824 | 820 | 1.56 | 26.0 | 5.65 | 0.41 | 3.1841 | 7.38 | 175.8 | FW8 | |
| | | | | | 26.0 | | | 3.1841 | | 179.3 | | CONFLUENCE SEE TABLE NO. 2 C5 |
| CP4 | | | | | 20.0 | 4.91 | 0.35 | 3.7700 | 6.48 | | CP4 | ADDITIONAL AREA |
| FW9 | 350 | 820 | 790 | 8.57 | 27.0 | 6.53 | 0.41 | 3.1075 | 8.32 | 187.6 | FW9 | |
| | | | | | 27.0 | | | 3.1075 | | 192.9 | | CONFLUENCE SEE TABLE NO. 2 C6 |
| CP3 | | | | | 14.9 | 2.45 | 0.35 | 4.5600 | 3.91 | | CP3 | ADDITIONAL AREA |
| FW10 | 614 | 790 | 765 | 4.07 | 28.0 | 11.38 | 0.41 | 3.0355 | 14.16 | 207.1 | FW10 | |
| | | | | | 28.0 | | | 3.0355 | | 209.7 | PT A | CONFLUENCE SEE TABLE NO. 2 C7 |
| FW11 | 820 | 765 | 740 | 3.05 | 29.0 | 20 | 0.41 | 2.9675 | 24.33 | 234.0 | | |
| FW12 | 451 | 740 | 720 | 4.43 | 30.0 | 4.65 | 0.41 | 2.9033 | 5.54 | 239.6 | | QPEAK PT OF CONFL W/ FE 8 |
| | | | | | 30.0 | | | 2.9033 | | 483.3 | | CONFLUENCE SEE TABLE NO. 2 C8 |
| **FW13** | 303 | 720 | 719 | 0.33 | 31.0 | 10.13 | 0.41 | 2.8426 | 11.81 | 495.1 | PT B | POND |
| | | | | | | 169.4 | | | | | | |
| **TACRES** | | | | | | 339.9 | | | | | | |
| BASIN | Distance (D) | Elev. A | Elev. B | Slope | Tc(min) | Acres | C | I(in/hr) | Q100 | Peak Q | D/S PT | Notes |

| PRE | DEVELOPED | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BASIN | | | | Q100 | | | | Q100 | | | | Q100 | | | |
| **COL** | **CONFLUENCING** | **BASIN** | **T1** | **I1** | **Q1** | **BASIN** | **T2** | **I2** | **Q2** | **BASIN** | **T3** | **I3** | **Q3** | **QT1** | **QT2** | **QT3** |
| **C1** | **FE4 & FE11** | FE11 | 14.00 | 4.7467 | 71.20 | FE4 | 17.00 | 4.1879 | 87.20 | N/A | 0.00 | 0.00 | 0.00 | 143.0 | **150.0** | 0.0 |
| | | | | | | | | | | | | | | | | |
| **C2** | **FE6 & S2 & E9** | S2 | 15.00 | 4.5401 | 7.50 | FE6 | 20.00 | 3.77 | 203.90 | E9 | 21.00 | 3.6543 | 33.40 | 184.3 | **241.9** | 237.0 |
| | | | | | | | | | | | | | | | | |
| **C3** | **FW5 & FW6** | FW6 | 19.40 | 3.7100 | 5.31 | FW5 | 23.00 | 3.4461 | 156.40 | N/A | 0.00 | 0.00 | 0.00 | 137.2 | **161.3** | 0.0 |
| **C4** | **CP6 & FW7** | CP6 | 18.90 | 3.9100 | 4.57 | FW7 | 25.00 | 3.2657 | 164.60 | N/A | 0.00 | 0.00 | 0.00 | 129.0 | **168.4** | 0.0 |
| **C5** | **CP5 & FW8** | CP5 | 19.40 | 3.8300 | 4.18 | FW8 | 26.00 | 3.1841 | 175.80 | N/A | 0.00 | 0.00 | 0.00 | 135.4 | **179.3** | 0.0 |
| **C6** | **CP4 & FW9** | CP4 | 20.00 | 3.7700 | 6.48 | FW9 | 27.00 | 3.1075 | 187.60 | N/A | 0.00 | 0.00 | 0.00 | 145.4 | **192.9** | 0.0 |
| **C7** | **CP3 & FW10** | CP3 | 14.90 | 4.5600 | 3.91 | FW10 | 28.00 | 3.0355 | 207.10 | N/A | 0.00 | 0.00 | 0.00 | 114.1 | **209.7** | 0.0 |
| **C8** | **FW12 & FE8** | FE8 | 23.00 | 3.4461 | 289.30 | FW12 | 30.00 | 2.9033 | 239.60 | N/A | 0.00 | 0.00 | 0.00 | 473.0 | **483.3** | 0.0 |
| | T1<T2<T3 | | | | | | | | | | | | | | | |
| | QT1 is equal to | | | | | | | | | | | | | | | |
| | Q1+(T1/T2) *Q2 | | | | | | | | | | | | | | | |
| | +(T1/T3)*Q3 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | QT2 is equal to | | | | | | | | | | | | | | | |
| | Q2+(I2/I1) * Q1 | | | | | | | | | | | | | | | |
| | +(T2/T3)*Q3 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | QT3 is equal to | | | | | | | | | | | | | | | |
| | Q3+(I3/I1) * Q1 | | | | | | | | | | | | | | | |
| | +(I3/I2)*Q2 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |

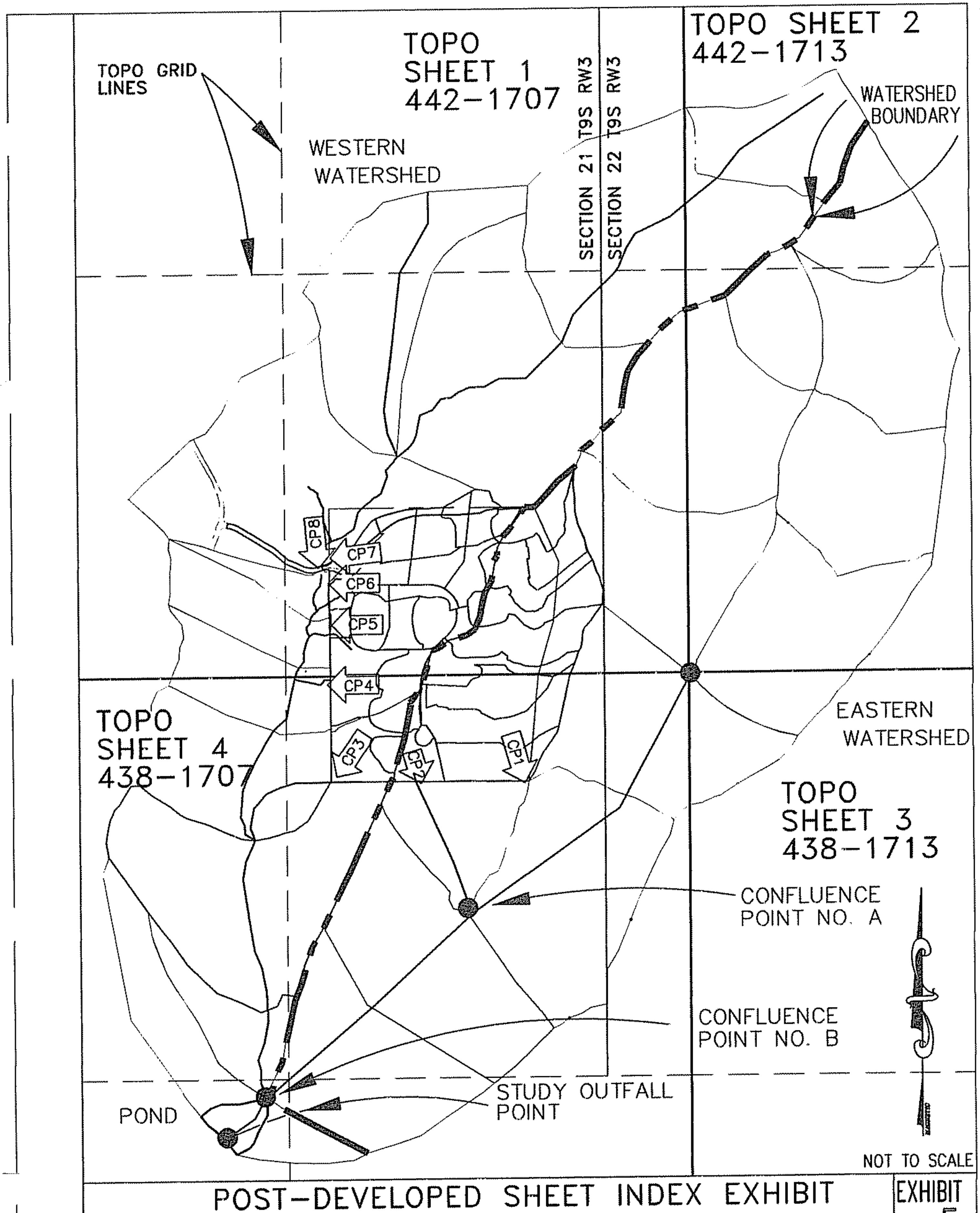
Lg

maps

# APPENDIX C



## POST DEVELOPED DATA SHEETS AND EXHIBITS




POST-DEVELOPED SHEET INDEX EXHIBIT
TM 5469
E:\PROJECTS\RIDGE_CREEK\JUL2007\SHEET_INDEX_POST_DEVELOPED_BASINS.dwg

EXHIBIT NO. 5

Q100_POST_ONSITE_rev17.xls
rev'ed "C"=0.39 and
rev'ed "Ti"=11.9 min

| BASIN | Distance (D) | Elev. A | Elev. B | Slope | Tt(min) | Ti+Tc(min) | Area | Acres | C | CA | Tc(min) | I(in/hr) | Q100 | Peak Q | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CP5W_1A | 85 | 885.85 | 885 | 1.00 | 11.90 | 11.9 | 44707 | 1.03 | 0.390 | 0.400 | 11.900 | 5.2712 | 2.11 | 2.1 | |
| CP5W_1B | 300 | 885 | 868 | 5.67 | 3.06 | 15.0 | 34972 | 0.80 | 0.390 | 0.313 | | 4.5479 | 1.42 | 3.5 | |
| CP5W_1C | 265 | 868 | 861 | 2.64 | 3.06 | 18.0 | 47439 | 1.09 | 0.390 | 0.425 | | 4.0335 | 1.71 | 5.2 | |
| CP5W_1D | 90 | 854 | 846 | 8.89 | 3.06 | 21.1 | 14450 | 0.33 | 0.390 | 0.129 | | 3.6454 | 0.47 | 5.7 | OUT FALL POINT CP5 |
| | 655 | | | | 9.18 | 21.1 | | 3.25 | | 0.867 | 9.186 | | | | |
| | | | | | | | | | | | 21.086 | | | | Tc CHECK |
| CP4W_1A | 85 | 880 | 879.15 | 1.00 | 11.90 | 11.9 | 77735 | 1.82 | 0.390 | 0.710 | 11.900 | 5.2712 | 3.74 | 3.7 | |
| CP4W_1B | 650 | 879.15 | 837.2 | 6.45 | 3.16 | 15.1 | 95008 | 2.23 | 0.390 | 0.870 | | 4.5284 | 3.94 | 7.7 | OUT FALL POINT CP4 |
| | 735 | | | | 15.06 | | | 4.05 | | 1.580 | 15.561 | | | | |
| | | | | | | | | | | | | | | | Tc CHECK |
| CP3W_1A | 85 | 880 | 879.15 | 1.00 | 11.90 | 11.9 | 21906 | 0.52 | 0.390 | 0.203 | 11.900 | 5.2712 | 1.07 | 1.1 | |
| CP3W_1B | 563 | 879.15 | 837.2 | 7.45 | 3.12 | 15.0 | 75888 | 1.74 | 0.390 | 0.679 | | 4.5362 | 3.08 | 4.2 | OUT FALL POINT CP3 |
| | 648 | | | | 15.02 | | | 2.26 | | 0.882 | 15.021 | | | | |
| CP2S_1A | 170 | 898 | 855 | 25.29 | 5.00 | 5.0 | 9560 | 0.21 | 0.390 | 0.082 | 5.000 | 9.2216 | 0.76 | 0.8 | |
| CP2S_1B | 100 | 855 | 853 | 2.00 | 4.63 | 9.6 | 6590 | 0.14 | 0.900 | 0.126 | | 6.0423 | 0.76 | 1.5 | |
| CP2S_1C | 180 | 853 | 844 | 5.00 | 4.63 | 14.3 | 43530 | 1.00 | 0.390 | 0.390 | | 4.6907 | 1.83 | 3.3 | OUT FALL POINT CP2 |
| | 280 | | | | | | 59680 | 1.35 | | 0.598 | 14.276 | | 2.59 | | |
| | | | | | | 14.276 | | | 0.390 | | 14.276 | | | | Tc CHECK |
| CP1_E1 | 85 | 951.85 | 951 | 1.00 | 11.9 | 11.9 | 62287 | 1.43 | 0.390 | 0.558 | 11.9000 | 5.2712 | 2.94 | 2.9 | |
| CP1_E2 | 198 | 930 | 894 | 18.18 | 2.83 | 14.7 | 63445 | 1.46 | 0.390 | 0.568 | | 4.5936 | 2.61 | 5.5 | |
| CP1_E3 | 106 | 894 | 878 | 15.09 | 2.83 | 17.6 | 80768 | 1.85 | 0.390 | 0.723 | | 4.1013 | 2.97 | 8.5 | |
| CP1_E4 | 92 | 878 | 866 | 13.04 | 2.83 | 20.4 | 94065 | 2.16 | 0.390 | 0.842 | | 3.7245 | 3.14 | 11.7 | |
| CP1_E5 | 110 | 866 | 853 | 11.82 | 2.83 | 23.2 | 134181 | 3.08 | 0.390 | 1.201 | | 3.4250 | 4.11 | 15.8 | |
| CP1_E6 | 98 | 853 | 844 | 9.18 | 2.83 | 26.1 | 70657 | 1.62 | 0.442 | 0.717 | | 3.1801 | 2.28 | 18.0 | |
| CP1_E7 | 221 | 844 | 828 | 7.24 | 2.83 | 28.9 | 99899 | 2.29 | 0.390 | 0.894 | | 2.9755 | 2.66 | 20.7 | |
| CP1_E8 | 195 | 828 | 816 | 6.15 | 2.83 | 31.7 | 115003 | 2.90 | 0.390 | 1.131 | | 2.8014 | 3.17 | 23.9 | |
| CP1_E9 | 180 | 816 | 808 | 4.44 | 2.83 | 34.5 | 106248 | 2.18 | 0.390 | 0.850 | | 2.6511 | 2.25 | 26.1 | |
| | 1285 | | | | 34.54 | | 826553 | 18.98 | | 6.927 | 22.646 | | 23.19 | | OUT FALL POINT CP1 |
| | | | | | | | | | | | 34.546 | | | | Tc CHECK |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Road portion of CP1_E7_portion | 221 | 844 | 828 | 7.24 | 2.75 | 2.8 | 5972 | 0.14 | 0.900 | 0.123 | 2.7500 | 2.9755 | 0.37 | 0.4 | To Grass swale on Lot 8 |

| Q100 | POST DEVELOPED | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CONFLUENCE TABLE | | | | Q100 | | | | Q100 | | | | Q100 | | | |
| COL | CONFLUENCING | BASIN | T1 | I1 | Q1 | BASIN | T2 | I2 | Q2 | BASIN | T3 | I3 | Q3 | **QT1** | **QT2** | **QT3** |
| C1 | FE4 & FE11 | FE11 | 15.00 | 4.74 | 70.10 | **FE4** | **17.00** | **4.19** | 87.20 | N/A | 0.00 | 0.00 | 0.00 | 147.0 | **149.1** | 0.0 |
| | | | | | | | | | | | | | | | | |
| C2 | FE6 & S2 & E10 | S2 | 16.40 | 4.28 | 10.10 | **FE6** | **20.00** | **3.77** | 202.00 | E10 | 35.90 | 2.58 | 29.30 | 189.1 | **227.2** | 173.6 |
| | | | | | | | | | | | | | | | | |
| C3 | FW5 & CP7 | **FW5** | **23.00** | **3.45** | 156.40 | CP7 | 34.25 | 2.67 | 5.90 | N/A | 0.00 | 0.00 | 0.00 | **160.4** | **126.9** | 0.0 |
| | | | | | | | | | | | | | | | | |
| C4 | CP6W2B & CP6W1C | CP6W2B | 17.35 | 4.13 | 1.50 | CP6W1C | 35.51 | 2.61 | 3.50 | N/A | 0.00 | 0.00 | 0.00 | 3.2 | **4.4** | 0.0 |
| | | | | | | | | | | | | | | | | |
| C5 | FW6 & CP6 | **FW6** | **24.00** | **3.35** | 163.10 | CP6 | 29.47 | 3.27 | 6.40 | N/A | 0.00 | 0.00 | 0.00 | **168.3** | 165.4 | 0.0 |
| | | | | | | | | | | | | | | | | |
| C6 | FW7 & CP5 | CP5 | 25.10 | 3.25 | 5.50 | **FW7** | **26.00** | **3.18** | 176.50 | N/A | 0.00 | 0.00 | 0.00 | 175.9 | **181.9** | 0.0 |
| | | | | | | | | | | | | | | | | |
| C7 | FW8 & CP4 | **FW8** | **28.00** | **3.04** | 190.00 | CP4 | 29.90 | 2.91 | 6.60 | N/A | 0.00 | 0.00 | 0.00 | **196.2** | 188.7 | 0.0 |
| | | | | | | | | | | | | | | | | |
| C8 | FW9 & CP3 | **FW9** | **30.00** | **2.90** | 209.70 | CP3 | 31.60 | 2.81 | 3.60 | N/A | 0.00 | 0.00 | 0.00 | **213.1** | 206.4 | 0.0 |
| | | | | | | | | | | | | | | | | |
| C9 | FW11 & FE8 | FE8 | 24.00 | 3.35 | 274.10 | **FW11** | **33.50** | **2.70** | 241.10 | N/A | 0.00 | 0.00 | 0.00 | 446.8 | **462.2** | 0.0 |
| | | | | | | | | | | | | | | | | |
| | T1<T2<T3 | | | | | | | | | | | | | | | |
| | QT1 is equal to | | | | | | | | | | | | | | | |
| | Q1+(T1/T2) *Q2 | | | | | | | | | | | | | | | |
| | +(T1/T3)*Q3 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | QT2 is equal to | | | | | | | | | | | | | | | |
| | Q2+(I2/I1) * Q1 | | | | | | | | | | | | | | | |
| | +(T2/T3)*Q3 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | QT3 is equal to | | | | | | | | | | | | | | | |
| | Q3+(I3/I1) * Q1 | | | | | | | | | | | | | | | |
| | +(I3/I2)*Q2 | | | | | | | | | | | | | | | |

| BASIN | Distance (D) | Elev. A | Elev. B | Slope | Tt(min) | Ti+Tc(min) | Area | Acres | C | CA | Tc(min) | I(in/hr) | Q100 | Peak Q | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CP7W_1A | 85 | 950.85 | 950 | 1.00 | 11.90 | 11.9 | 12804 | 0.29 | 0.390 | 0.115 | 11.900 | 5.2712 | 0.60 | 0.6 | INITIAL Lm=85FT Ti=10.5MIN |
| | | | | | | | | | | | | | | | |
| CP7W_1B | 144 | 950 | 928 | 15.28 | 4.87 | 16.8 | 33509 | 0.77 | 0.390 | 0.300 | | 4.2249 | 1.27 | 1.9 | |
| CP7W_2A | 143 | 928 | 904 | 16.78 | 4.87 | 21.6 | 20488 | 0.47 | 0.390 | 0.183 | | 3.5843 | 0.66 | 2.5 | |
| CP7W_2B | 120 | 904 | 889 | 12.50 | 4.87 | 26.5 | 45786 | 1.05 | 0.390 | 0.410 | | 3.1444 | 1.29 | 3.8 | |
| CP7W_3A | 325 | 889 | 873 | 4.92 | 4.87 | 31.4 | 49450 | 1.14 | 0.390 | 0.443 | | 2.8203 | 1.25 | 5.1 | |
| CP7W_3B | 315 | 873 | 850 | 7.30 | 4.87 | 36.3 | 29188 | 0.67 | 0.390 | 0.261 | | 2.5697 | 0.67 | 5.7 | OUT FALL POINT CP7 |
| | 1132 | | | | 36.25 | | | 4.39 | | 1.597 | 24.374 | | 5.13 | | |
| | | | | | | | | | | | 36.274 | | | | Tc CHECK |
| | | | | | | | | | | | | | | | |
| CP6W_1A | 85 | 905.61 | 900.78 | 5.68 | 11.90 | 11.9 | 38083 | 0.87 | 0.390 | 0.341 | 11.900 | 5.2712 | 1.80 | 1.8 | |
| | | | | | | | | | | | | | | | |
| CP6W_1B | 41 | 900.78 | 896.57 | 10.27 | 11.76 | 23.7 | 35837 | 0.82 | 0.390 | 0.321 | | 3.3841 | 1.09 | 2.9 | |
| CP6W_1C | 268 | 896.57 | 862.5 | 12.71 | 11.76 | 35.4 | 26659 | 0.61 | 0.390 | 0.239 | | 2.6087 | 0.62 | 3.5 | SEE CONFL TABLE R17 C4 |
| | | | | | 35.41 | | | | | 0.560 | 23.513 | | 1.71 | | |
| PIPE | 50 | 861.5 | 860.5 | 2.00 | 0.10 | | | | | | 35.413 | | | | Tc CHECK |
| | | | | | 35.51 | | | | | | 35.413 | | | | |
| | | | | | | | | | | | | | | | |
| CP6W_2A | 409 | 905.61 | 871.08 | 8.44 | 11.90 | 11.9 | 20974 | 0.48 | 0.390 | 0.188 | 11.900 | 5.2712 | 0.99 | 1.0 | |
| | | | | | | | | | | | | | | | |
| CP6W_2B | 191 | 871.08 | 860.3 | 5.64 | 5.45 | 17.3 | 12805 | 0.29 | 0.390 | 0.115 | | 4.1334 | 0.47 | 1.5 | SEE CONFL TABLE R15 C1 |
| | | | | | 17.35 | | | | | 0.115 | 5.448 | | | | |
| | | | | | | | | | | | 17.348 | | | | Tc CHECK |
| CONPT C1 | | | | | | | | | | | 35.510 | 2.6087 | 2.61 | 4.4 | SEE CONFL TABLE R17 C4 |
| CP6W_2C | 160 | 860.3 | 850 | 6.44 | 6.45 | 6.5 | 19770 | 0.45 | 0.390 | 0.177 | 6.450 | 7.8248 | 1.39 | 5.8 | OUT FALL POINT CP6 |
| | | | | | | 23.80 | | 3.54 | | | 41.960 | | | | Tc |
| | | | | | | | | | | 0.180 | 6.508 | | | | Tc CHECK |
| | | | | | | | | | | | | | | | Tc EQ NO 1 |
| | | | | | | | | | | | | | | | 1.8(1.1-C)*[(L)^1/2)/(S^1/3)] |
| | | | | | | | | | | | | | | | Tc EQ NO 2 |
| | | | | | | | | | | | | | | | [(SUM(C*A))*(7.44)*(P6)/q]^1.55 |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |

rev'ed "C"=0.39 and
rev'ed "Ti"=11.9 min

| BASIN | Distance (D) | Elev. A | Elev. B | Slope | Tt(min) | Ti+Tc(min) | Area | Acres | C | CA | Tc(min) | I(in/hr) | Q100 | Peak Q | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OS RDFW R1 | 450 | 942 | 903 | 8.67 | 5.00 | 5.0 | 13590 | 0.31 | 0.900 | 0.281 | 5.000 | 9.2216 | 2.59 | 2.6 | INITIAL Lm=85FT Ti=10.5MIN |
| OS RDFW R2 | 550 | 903 | 846 | 10.36 | 5.00 | 10.0 | 12910 | 0.30 | 0.900 | 0.267 | 10.000 | 5.8971 | 1.57 | 1.6 | AT CATCH BASIN NEAR CP8 |

# APPENDIX D

4.22

## REFERENCE CALCULATIONS AND EXHIBITS

TPM RPL
DRAINAGE BASIN
PERVIOUS/IMPERVIOUS
ANALYSIS

| DRAINAGE | DRAINAGE | DRAINAGE | Impervious | Impervious | Impervious | Impervious | Percent | Pervious | Pervious | Total | Percent | ** Formula from Section 3.1.2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BASIN | BASIN | BASIN | Pavement | Driveways | Roof/Patios | Area | Impervious | Pad | Balance | Pervious | Pervious | San Diego Co. Hydrology Manual |
| ID | AREA | AREA | Areas | Areas | Areas | Total | Area | Areas | of Area | AREA | AREA | C=(0.90)%IMP+Cp*(1-%IMP) |
| NO. | Sq Ft | Acres | Sq Ft | Sq Ft | Sq Ft | Sq Ft | percent | Sq Ft | Sq Ft | Sq Ft | percent | [0.90 x H5] + [0.35(1-H5)] |
| E1 | 18295.2 | 0.42 | 0.00 | 0 | 1720 | 1720 | 0.094 | 12222 | 4353 | 16575 | 0.906 | 0.402 |
| E2 | 40075.2 | 0.92 | 0.00 | 0 | 0 | 0 | 0.000 | 0 | 40075 | 40075 | 1.000 | 0.350 |
| E3 | 63597.6 | 1.46 | 0.00 | 0 | 1720 | 1720 | 0.027 | 9492 | 52386 | 61878 | 0.973 | 0.365 |
| E4 | 20473.2 | 0.47 | 0.00 | 0 | 0 | 0 | 0.000 | 0 | 20473 | 20473 | 1.000 | 0.350 |
| E5 | 40946.4 | 0.94 | 0.00 | 0 | 0 | 0 | 0.000 | 0 | 40946 | 40946 | 1.000 | 0.350 |
| E6 | 17859.6 | 0.41 | 0.00 | 0 | 1720 | 1720 | 0.096 | 11083 | 5057 | 16140 | 0.904 | 0.403 |
| E7 | 58370.4 | 1.34 | 0.00 | 0 | 0 | 0 | 0.000 | 0 | 58370 | 58370 | 1.000 | 0.350 |
| E8 | 55321.2 | 1.27 | 0.00 | 0 | 0 | 0 | 0.000 | 0 | 55321 | 55321 | 1.000 | 0.350 |
| E9 | 23522.4 | 0.54 | 0.00 | 0 | 1720 | 1720 | 0.073 | 13638 | 8164 | 21802 | 0.927 | 0.390 |
| E10 | 55321.2 | 1.27 | 0.00 | 0 | 0 | 0 | 0.000 | 0 | 55321 | 55321 | 1.000 | 0.350 |
| E11 | 27442.8 | 0.63 | 0.00 | 0 | 0 | 0 | 0.000 | 0 | 27443 | 27443 | 1.000 | 0.350 |
| E12 | 10838 | 0.25 | 10084.00 | 0 | 0 | 10084 | 0.930 | 0 | 754 | 754 | 0.070 | 0.862 |
| E13 | 22147 | 0.51 | 0.00 | 480 | 1720 | 2200 | 0.099 | 8555 | 11392 | 19947 | 0.901 | 0.405 |
| E14 | 38332.8 | 0.88 | 0.00 | 0 | 0 | 0 | 0.000 | 0 | 38333 | 38333 | 1.000 | 0.350 |
| E15 | 98579 | 2.26 | 0.00 | 480 | 3440 | 3920 | 0.040 | 26408 | 68251 | 94659 | 0.960 | 0.372 |
| E16 | 53647 | 1.23 | 0.00 | 0 | 1720 | 1720 | 0.032 | 10608 | 41319 | 51927 | 0.968 | 0.368 |
| E17 | 153331.2 | 3.52 | 7460.00 | 960 | 5160 | 13580 | 0.089 | 25181 | 114570 | 139751 | 0.911 | 0.399 |
| S1 | 6534 | 0.15 | 0.00 | 0 | 0 | 0 | 0.000 | 0 | 6534 | 6534 | 1.000 | 0.350 |

TPM RPL
DRAINAGE BASIN
PERVIOUS/IMPERVIOUS
ANALYSIS

| DRAINAGE | DRAINAGE | DRAINAGE | Impervious | Impervious | Impervious | Impervious | Percent | Pervious | Pervious | Total | Percent | ** Formula from Section 3.1.2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BASIN | BASIN | BASIN | Pavement | Driveways | Roof/Patios | Area | Impervious | Pad | Balance | Pervious | Pervious | San Diego Co. Hydrology Manual |
| ID | AREA | AREA | Areas | Areas | Areas | Total | Area | Areas | of Area | AREA | AREA | C=(0.90)%IMP+Cp*(1-%IMP) |
| NO. | Sq Ft | Acres | Sq Ft | Sq Ft | Sq Ft | Sq Ft | percent | Sq Ft | Sq Ft | Sq Ft | percent | [0.90 x H5] + [0.35(1-H5)] |
| W1 | 17424 | 0.40 | 0.00 | 480 | 1720 | 2200 | 0.126 | 11556 | 3668 | 15224 | 0.874 | 0.419 |
| W2 | 31363.2 | 0.72 | 0.00 | 6550 | 1720 | 8270 | 0.264 | 0 | 23093 | 23093 | 0.736 | 0.495 |
| W3 | 52272 | 1.20 | 2634.00 | 960 | 3440 | 7034 | 0.135 | 22826 | 22412 | 45238 | 0.865 | 0.424 |
| W4 | 69696 | 1.60 | 1404.00 | 480 | 3440 | 5324 | 0.076 | 27399 | 36973 | 64372 | 0.924 | 0.392 |
| W5 | 50094 | 1.15 | 2288.00 | 480 | 3440 | 6208 | 0.124 | 25070 | 18816 | 43886 | 0.876 | 0.418 |
| W6 | 39204 | 0.90 | 3009.00 | 480 | 0.000 | 3489 | 0.089 | 10778 | 24937 | 35715 | 0.911 | 0.399 |
| W7 | 19602 | 0.45 | 8636.00 | 0 | 0.000 | 8636 | 0.441 | 0 | 10966 | 10966 | 0.559 | 0.592 |
| W8 | 29620.8 | 0.68 | 0.00 | 0 | 0.000 | 0 | 0.000 | 0 | 29621 | 29621 | 1.000 | 0.350 |
| W9 | 56628 | 1.30 | 0.00 | 0 | 1720 | 1720 | 0.030 | 22824 | 32084 | 54908 | 0.970 | 0.367 |
| W10 | 19602 | 0.45 | 0.00 | 0 | 0.000 | 0 | 0.000 | 0 | 19602 | 19602 | 1.000 | 0.350 |
| W11 | 45738 | 1.05 | 0.00 | 480 | 1720 | 2200 | 0.048 | 12398 | 31140 | 43538 | 0.952 | 0.376 |
| W12 | 23086.8 | 0.53 | 0.00 | 0 | 0.000 | 0 | 0.000 | 0 | 23087 | 23087 | 1.000 | 0.350 |
| W13 | 44426 | 1.02 | 0.00 | 0 | 1720 | 1720 | 0.039 | 21714 | 20992 | 42706 | 0.961 | 0.371 |
| W14 | 46609.2 | 1.07 | 0.00 | 0 | 0.000 | 0 | 0.000 | 0 | 46609 | 46609 | 1.000 | 0.350 |
| W15 | 47984 | 1.10 | 0.00 | 480 | 1720 | 2200 | 0.046 | 9454 | 36330 | 45784 | 0.954 | 0.375 |
| W16 | 27442.8 | 0.63 | 0.00 | 0 | 0.000 | 0 | 0.000 | 0 | 27443 | 27443 | 1.000 | 0.350 |
| W17 | 141713 | 3.25 | 0.00 | 0 | 1720 | 1720 | 0.012 | 10222 | 129771 | 139993 | 0.988 | 0.357 |
| W18 | 27442.8 | 0.63 | 0.00 | 0 | 0.000 | 0 | 0.000 | 0 | 27443 | 27443 | 1.000 | 0.350 |
| W19 | 19602 | 0.45 | 0.00 | 0 | 1720 | 1720 | 0.088 | 16602 | 1280 | 17882 | 0.912 | 0.398 |
| W22 | 17520 | 0.40 | 0.00 | 0 | 0.000 | 0 | 0.000 | 0 | 17520 | 17520 | 1.000 | 0.350 |
| W20 | 33105.6 | 0.76 | 0.00 | 0 | 0.000 | 0 | 0.000 | 0 | 33106 | 33106 | 1.000 | 0.350 |
| W21 | 16946 | 0.39 | 0.00 | 0 | 1720.000 | 1720 | 0.101 | 12599 | 2627 | 15226 | 0.899 | 0.406 |
| W23 | 107953 | 2.48 | 2571.00 | 960 | 3440 | 6971 | 0.065 | 43793 | 57189 | 100982 | 0.935 | 0.386 |
| Totals | 1789709 | 41.09 | 38086.00 | 13270 | 48160 | 99516 | | 364422 | 1325771 | 1690193 | | |
| Total | 1789709 | 41.09 | 38086 | 13270 | 48160 | 99516 | | 364422 | 1325771 | 1690193 | | 0.392 |
| | Column | Column | Column | Column | Column | Column | | Column | Column | Column | | Column Average |
| | Total | Total * | Total | Total | Total | Total | | Total | Total | Total | | |
| | | 8.14 | | | | | | | | | | |

* Total includes 233,642 SF(8.14ac) of offsite area along eastern property including portions of Basins E-2 , and portions of Basin 3, 5, 7,8, 10, 11, 14, 15, 16, and 17

# V100 Calc's For CP1 w/q100 PRE DEVEL
## Worksheet for Triangular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V Calc's For pr q100 Discharge Point CP1 |
| Flow Element | Triangular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.040 | |
| Channel Slope | 0.044700 | ft/ft |
| Left Side Slope | 0.750000 | H : V |
| Right Side Slope | 0.750000 | H : V |
| Discharge | 29.00 | cfs |

| Results | | |
|---|---|---|
| Depth | 2.46 | ft |
| Flow Area | 4.53 | $ft^2$ |
| Wetted Perimeter | 6.14 | ft |
| Top Width | 3.68 | ft |
| Critical Depth | 2.48 | ft |
| Critical Slope | 0.042910 | ft/ft |
| Velocity | 6.41 | ft/s |
| Velocity Head | 0.64 | ft |
| Specific Energy | 3.09 | ft |
| Froude Number | 1.02 | |
| Flow is supercritical. | | |

# V100 Calc's For CP2 w/Q100 PREDEV
## Worksheet for Triangular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V Calc's For OUTFALL CP2 Q100 PREDEV |
| Flow Element | Triangular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.035 | |
| Channel Slope | 0 179000 | ft/ft |
| Left Side Slope | 40.000000 | H : V |
| Right Side Slope | 40.000000 | H : V |
| Discharge | 2.40 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.14 | ft |
| Flow Area | 0.79 | $ft^2$ |
| Wetted Perimeter | 11.22 | ft |
| Top Width | 11.22 | ft |
| Critical Depth | 0.19 | ft |
| Critical Slope | 0.039403 | ft/ft |
| Velocity | 3.05 | ft/s |
| Velocity Head | 0.14 | ft |
| Specific Energy | 0.29 | ft |
| Froude Number | 2.03 | |
| Flow is supercritical. | | |

# V100 Estimate Worksheet Basin CP3 PREDEV
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | VELOCITY ESTIMATE for EX CP3 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

**Input Data**

Channel Slope 0.050000 ft/ft

Elevation range: 844.00 ft to 850.00 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 847.00 | 0.00 | 300.00 | 0.025 |
| 100.00 | 845.00 | | | |
| 150.00 | 844.00 | | | |
| 240.00 | 845.00 | | | |
| 300.00 | 850.00 | | | |

Discharge 3.91 cfs

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.025 | |
| Water Surface Elevation | 844.15 | ft |
| Flow Area | 1.63 | ft² |
| Wetted Perimeter | 21.39 | ft |
| Top Width | 21.39 | ft |
| Height | 0.15 | ft |
| Critical Depth | 844.18 | ft |
| Critical Slope | 0.020290 | ft/ft |
| Velocity | 2.39 | ft/s |
| Velocity Head | 0.09 | ft |
| Specific Energy | 844.24 | ft |
| Froude Number | 1.53 | |
| Flow is supercritical. | | |

# V100 Estimate Worksheet Basin CP4 PREDEV
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | VELOCITY ESTIMATE for EX CP4 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

Input Data

Channel Slope 0.075000 ft/ft

Elevation range: 864.20 ft to 864.45 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 864.40 | 0.00 | 100.00 | 0.025 |
| 40.00 | 864.25 | | | |
| 50.00 | 864.20 | | | |
| 60.00 | 864.30 | | | |
| 100.00 | 864.45 | | | |

Discharge 6.47 cfs

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.025 | |
| Water Surface Elevation | 864.33 | ft |
| Flow Area | 2.71 | ft² |
| Wetted Perimeter | 48.04 | ft |
| Top Width | 48.04 | ft |
| Height | 0.13 | ft |
| Critical Depth | 864.36 | ft |
| Critical Slope | 0.022272 | ft/ft |
| Velocity | 2.39 | ft/s |
| Velocity Head | 0.09 | ft |
| Specific Energy | 864.42 | ft |
| Froude Number | 1.78 | |
| Flow is supercritical. | | |

# V100 Estimate Worksheet Basin CP5 PREDEV
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | VELOCITY ESTIMATE for EX CP5 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

**Input Data**

Channel Slope 0.075000 ft/ft

Elevation range: 964.22 ft to 964.27 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 964.25 | 0.00 | 100.00 | 0.025 |
| 40.00 | 964.24 | | | |
| 50.00 | 964.22 | | | |
| 60.00 | 964.23 | | | |
| 100.00 | 964.27 | | | |

Discharge 4.20 cfs

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.025 | |
| Water Surface Elevation | 964.27 | ft |
| Flow Area | 2.80 | ft² |
| Wetted Perimeter | 100.02 | ft |
| Top Width | 100.00 | ft |
| Height | 0.05 | ft |
| Critical Depth | 964.28 | ft |
| Critical Slope | 0.027088 | ft/ft |
| Velocity | 1.50 | ft/s |
| Velocity Head | 0.03 | ft |
| Specific Energy | 964.31 | ft |
| Froude Number | 1.58 | |

Flow is supercritical.

Water elevation exceeds lowest end station by 0.02 ft.

# V100 Estimate Worksheet Basin CP6 PREDEV
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | VELOCITY ESTIMATE for EX CP6 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

Input Data

Channel Slope 0.100000 ft/ft

Elevation range: 964.22 ft to 964.30 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 964.30 | 0.00 | 100.00 | 0.025 |
| 40.00 | 964.25 | | | |
| 50.00 | 964.22 | | | |
| 60.00 | 964.25 | | | |
| 100.00 | 964.30 | | | |

Discharge 4.57 cfs

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.025 | |
| Water Surface Elevation | 964.29 | ft |
| Flow Area | 2.56 | ft² |
| Wetted Perimeter | 87.33 | ft |
| Top Width | 87.33 | ft |
| Height | 0.07 | ft |
| Critical Depth | 964.31 | ft |
| Critical Slope | 0.026583 | ft/ft |
| Velocity | 1.79 | ft/s |
| Velocity Head | 0.05 | ft |
| Specific Energy | 964.34 | ft |
| Froude Number | 1.84 | |

Flow is supercritical.

# V100 CALC Worksheet FOR CP7 PREDEV
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V100 CALCS FOR CP7 PREDEV |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

Input Data

Channel Slope 0.072800 ft/ft

Elevation range: 856.00 ft to 858.41 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 856.00 | 0.00 | 17.00 | 0.017 |
| 0.50 | 856.50 | 17.00 | 21.86 | 0.025 |
| 0.93 | 856.51 | | | |
| 1.18 | 856.00 | | | |
| 17.00 | 856.10 | | | |
| 19.18 | 856.90 | | | |
| 19.86 | 857.41 | | | |
| 21.86 | 858.41 | | | |

Discharge 5.48 cfs

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.017 | |
| Water Surface Elevation | 856.13 | ft |
| Flow Area | 1.28 | ft² |
| Wetted Perimeter | 16.36 | ft |
| Top Width | 16.09 | ft |
| Height | 0.13 | ft |
| Critical Depth | 856.20 | ft |
| Critical Slope | 0.008335 | ft/ft |
| Velocity | 4.29 | ft/s |
| Velocity Head | 0.29 | ft |
| Specific Energy | 856.42 | ft |
| Froude Number | 2.69 | |

Flow is supercritical.

Flow is divided.

Water elevation exceeds lowest end station by 0.13 ft.

# V100 Estimate Worksheet for CPI E9
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V calc's for cp1Q100 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

**Input Data**

Channel Slope 0.021100 ft/ft

Elevation range: 807.00 ft to 812.00 ft

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 812.00 | 0.00 | 18.00 | 0.025 |
| 9.00 | 810.00 | 18.00 | 25.00 | 0.040 |
| 18.00 | 808.00 | 25.00 | 35.00 | 0.025 |
| 20.00 | 807.00 | | | |
| 25.00 | 808.00 | | | |
| 30.00 | 810.00 | | | |
| 35.00 | 812.00 | | | |

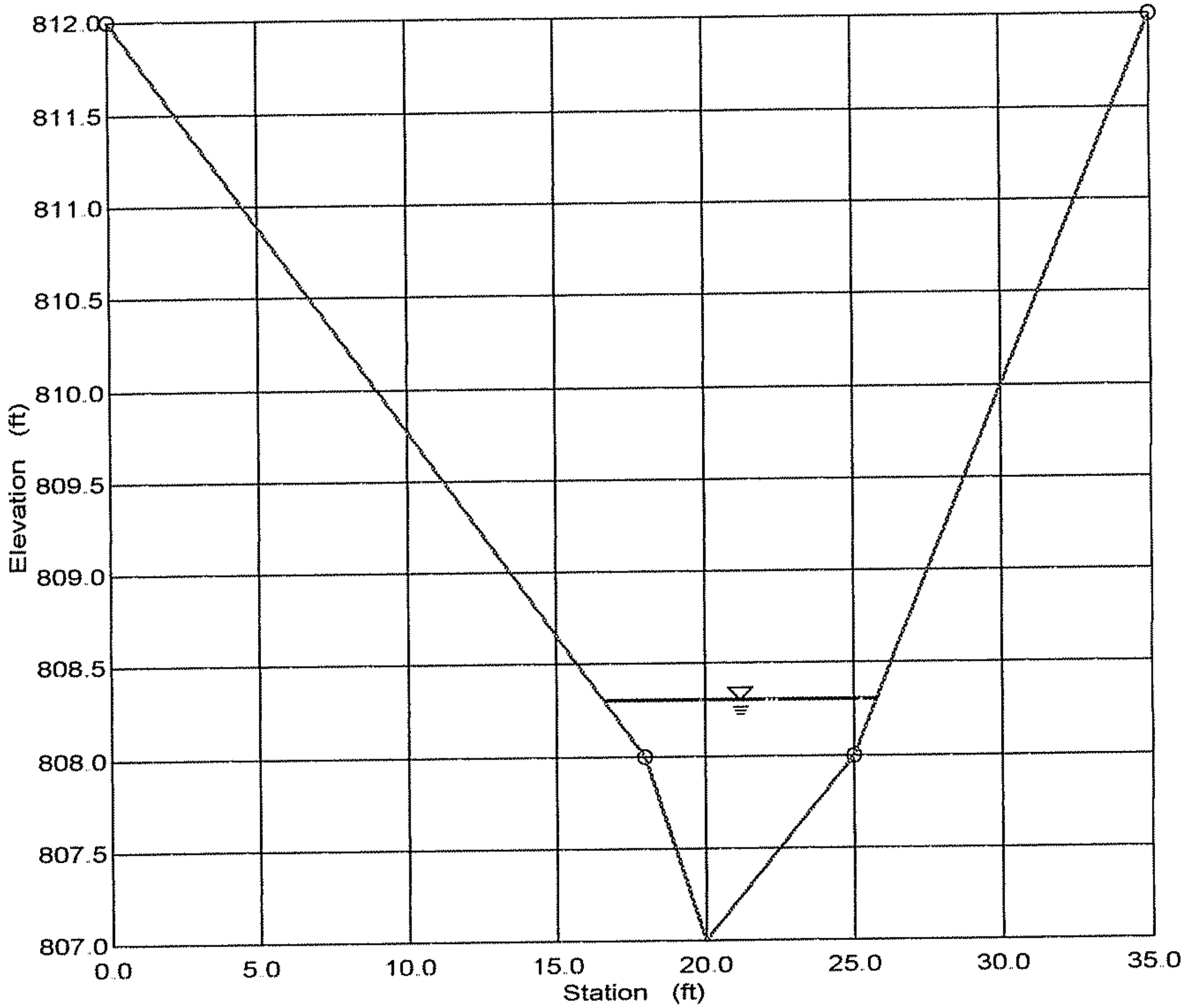
Discharge 26.10 cfs

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.036 | |
| Water Surface Elevation | 808.30 | ft |
| Flow Area | 5.93 | ft² |
| Wetted Perimeter | 9.54 | ft |
| Top Width | 9.11 | ft |
| Height | 1.30 | ft |
| Critical Depth | 808.28 | ft |
| Critical Slope | 0.023166 | ft/ft |
| Velocity | 4.40 | ft/s |
| Velocity Head | 0.30 | ft |
| Specific Energy | 808.60 | ft |
| Froude Number | 0.96 | |
| Flow is subcritical. | | |

# Cross Section
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V calc's for OUTFALL CP1 POSTDEV |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.036 | |
| Channel Slope | 0.021100 ft/ft | |
| Water Surface Elevation | 808.30 | ft |
| Discharge | 26.10 | cfs |



# V100 Calc's For CP2 w/Q100 POSTDEV
## Worksheet for Triangular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V100 Estimate for CP2 POSTDEV |
| Flow Element | Triangular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

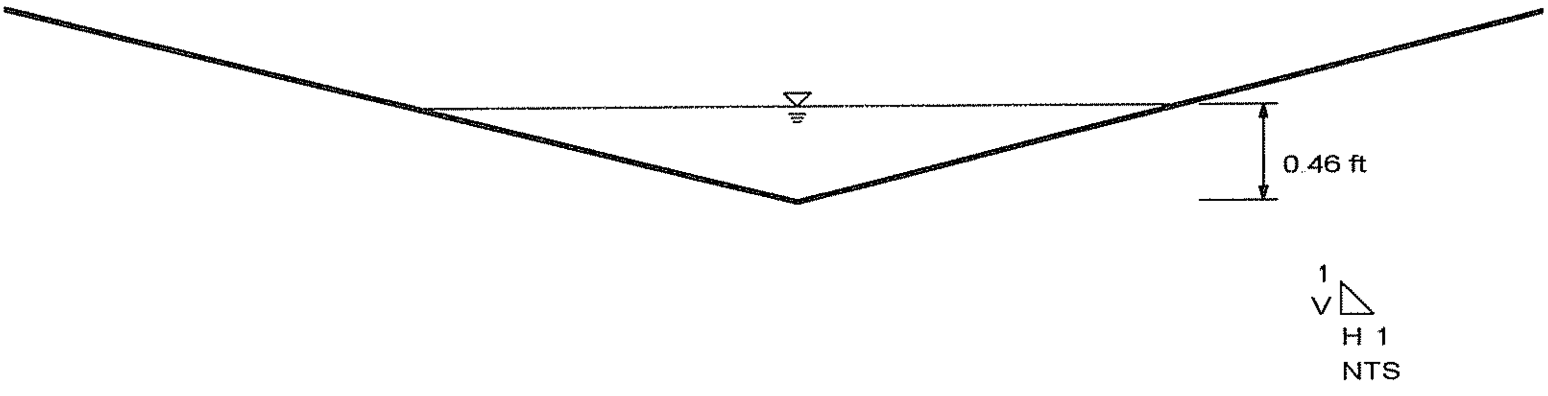
| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.045 | |
| Channel Slope | 0.100000 | ft/ft |
| Left Side Slope | 4.000000 | H : V |
| Right Side Slope | 4.000000 | H : V |
| Discharge | 3.30 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.46 | ft |
| Flow Area | 0.86 | $ft^2$ |
| Wetted Perimeter | 3.81 | ft |
| Top Width | 3.70 | ft |
| Critical Depth | 0.53 | ft |
| Critical Slope | 0.047800 | ft/ft |
| Velocity | 3.86 | ft/s |
| Velocity Head | 0.23 | ft |
| Specific Energy | 0.69 | ft |
| Froude Number | 1.41 | |
| Flow is supercritical. | | |

# Cross Section
## Cross Section for Triangular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V100 Estimate for CP2 POSTDEV |
| Flow Element | Triangular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Section Data | | |
|---|---|---|
| Mannings Coefficient | 0.045 | |
| Channel Slope | 0.100000 | ft/ft |
| Depth | 0.46 | ft |
| Left Side Slope | 4.000000 | H : V |
| Right Side Slope | 4.000000 | H : V |
| Discharge | 3.30 | cfs |



# V100 Estimate Worksheet for CP3 POSTDEV
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V100 ESTIMATE for CP3 POSTDEV |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

Input Data

Channel Slope 0.063000 ft/ft

Elevation range: 844.00 ft to 850.00 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 847.00 | 0.00 | 300.00 | 0.025 |
| 100.00 | 845.00 | | | |
| 150.00 | 844.00 | | | |
| 240.00 | 845.00 | | | |
| 300.00 | 850.00 | | | |

Discharge 4.20 cfs

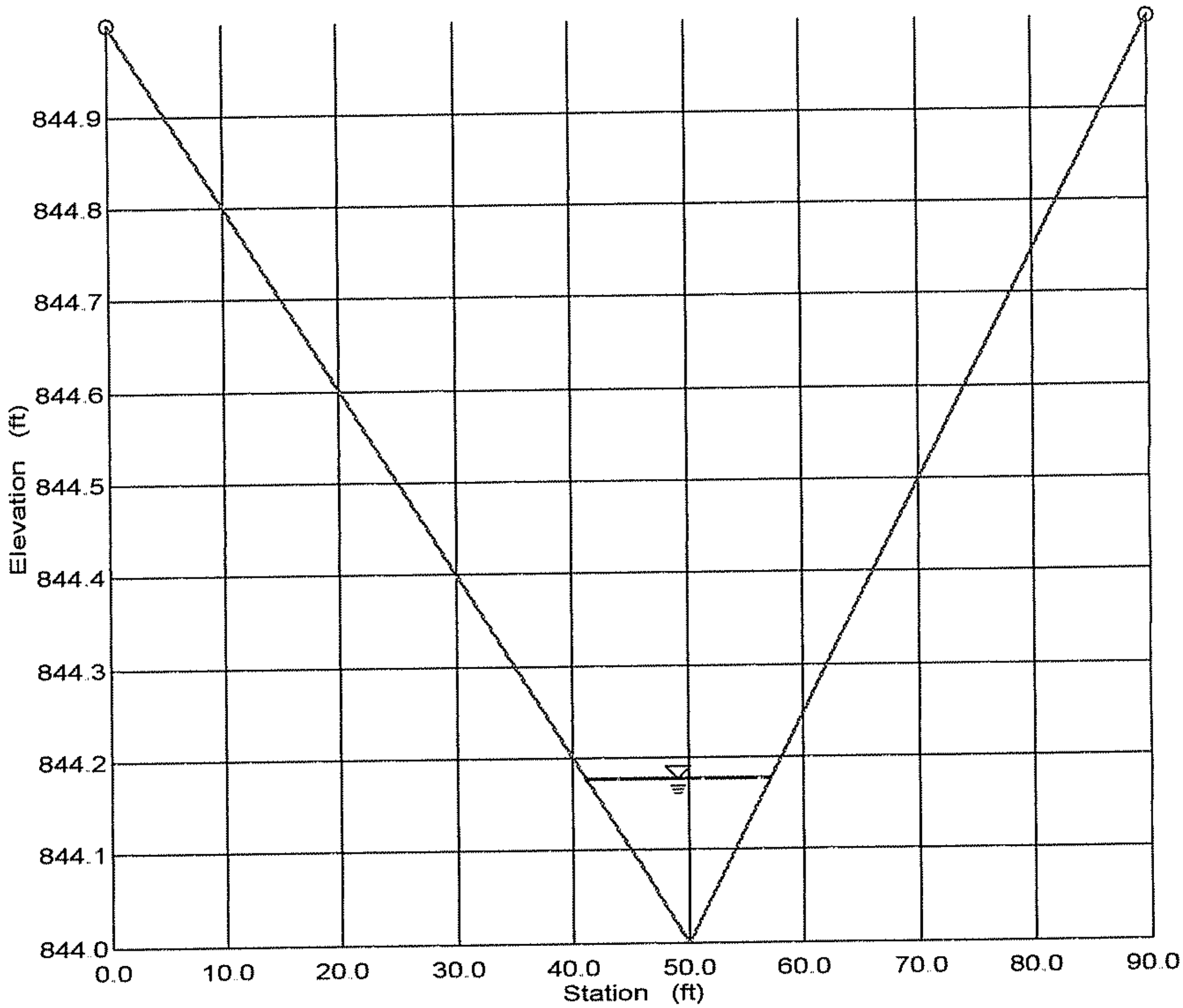
| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.025 | |
| Water Surface Elevation | 844.15 | ft |
| Flow Area | 1.58 | ft² |
| Wetted Perimeter | 21.04 | ft |
| Top Width | 21.04 | ft |
| Height | 0.15 | ft |
| Critical Depth | 844.19 | ft |
| Critical Slope | 0.020097 | ft/ft |
| Velocity | 2.66 | ft/s |
| Velocity Head | 0.11 | ft |
| Specific Energy | 844.26 | ft |
| Froude Number | 1.71 | |

Flow is supercritical.

# Cross Section for Velocity Estimate
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V100 ESTIMATE for CP3 POSTDEV |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.025 | |
| Channel Slope | 0.063000 ft/ft | |
| Water Surface Elevation | 844.18 | ft |
| Discharge | 4.20 | cfs |



# V100 Estimate Worksheet for CP4 POSTDEV
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V100 ESTIMATE for CP4 POSTDEV |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

**Input Data**

Channel Slope 0.051000 ft/ft

Elevation range: 864.20 ft to 864.45 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 864.40 | 0.00 | 100.00 | 0.025 |
| 40.00 | 864.25 | | | |
| 50.00 | 864.20 | | | |
| 60.00 | 864.30 | | | |
| 100.00 | 864.45 | | | |

Discharge 7.70 cfs

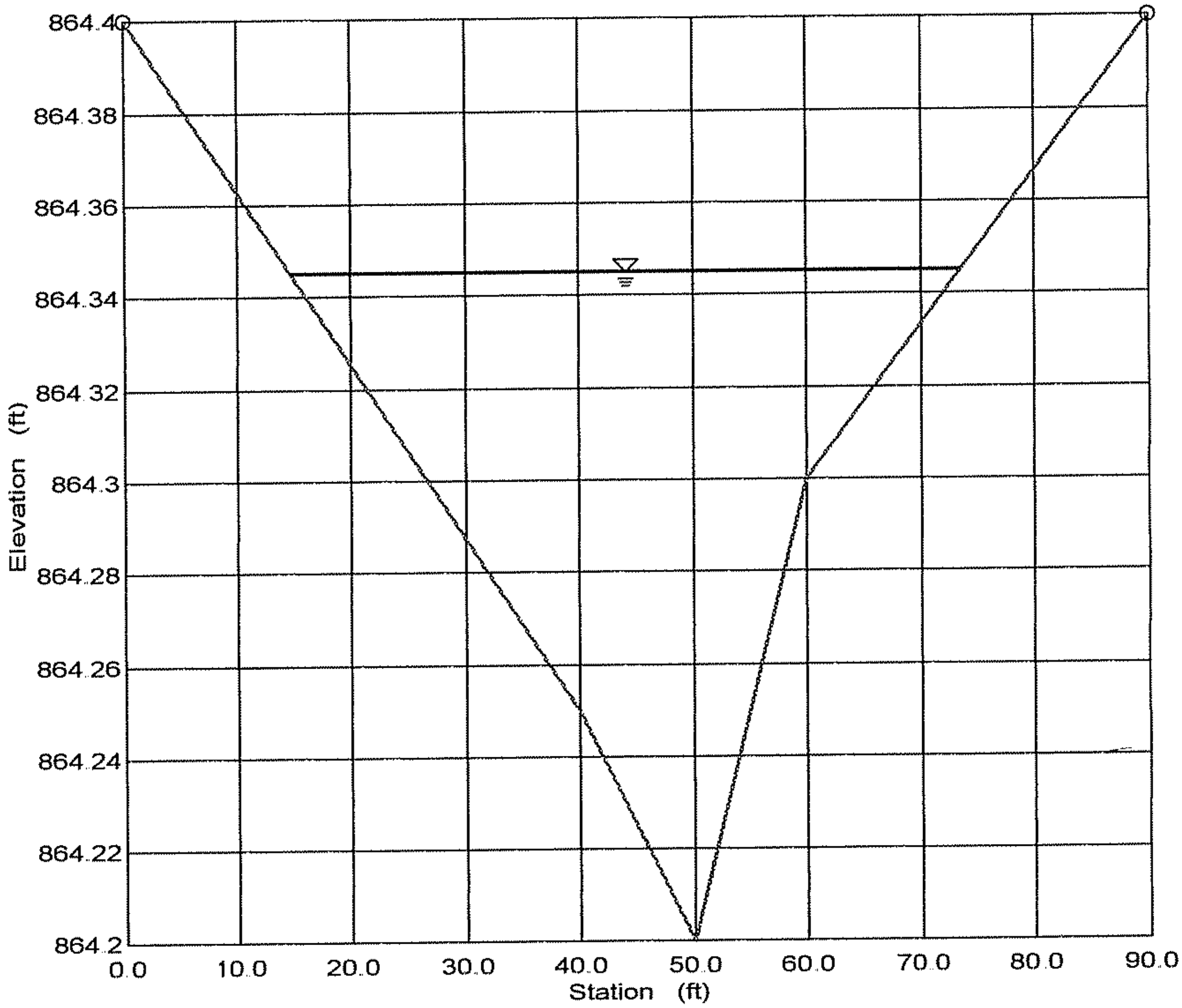
| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.025 | |
| Water Surface Elevation | 864.34 | ft |
| Flow Area | 3.62 | ft² |
| Wetted Perimeter | 57.28 | ft |
| Top Width | 57.28 | ft |
| Height | 0.14 | ft |
| Critical Depth | 864.37 | ft |
| Critical Slope | 0.021821 | ft/ft |
| Velocity | 2.13 | ft/s |
| Velocity Head | 0.07 | ft |
| Specific Energy | 864.42 | ft |
| Froude Number | 1.49 | |

Flow is supercritical.

# Cross Section for Velocity Estimate
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V100 ESTIMATE for CP4 POSTDEV |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.025 | |
| Channel Slope | 0.051000 ft/ft | |
| Water Surface Elevation | 864.34 | ft |
| Discharge | 7.70 | cfs |



# V100 Estimate Worksheet Basin CP5 , Post Dev
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V100 ESTIMATE for CP5 POSTDEV |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

**Input Data**

Channel Slope 0.078000 ft/ft

Elevation range: 964.22 ft to 964.27 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 964.25 | 0.00 | 100.00 | 0.025 |
| 40.00 | 964.24 | | | |
| 50.00 | 964.22 | | | |
| 60.00 | 964.23 | | | |
| 100.00 | 964.27 | | | |

Discharge 5.70 cfs

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.025 | |
| Water Surface Elevation | 964.28 | ft |
| Flow Area | 3.32 | ft² |
| Wetted Perimeter | 100.03 | ft |
| Top Width | 100.00 | ft |
| Height | 0.06 | ft |
| Critical Depth | 964.29 | ft |
| Critical Slope | 0.025335 | ft/ft |
| Velocity | 1.72 | ft/s |
| Velocity Head | 0.05 | ft |
| Specific Energy | 964.32 | ft |
| Froude Number | 1.66 | |

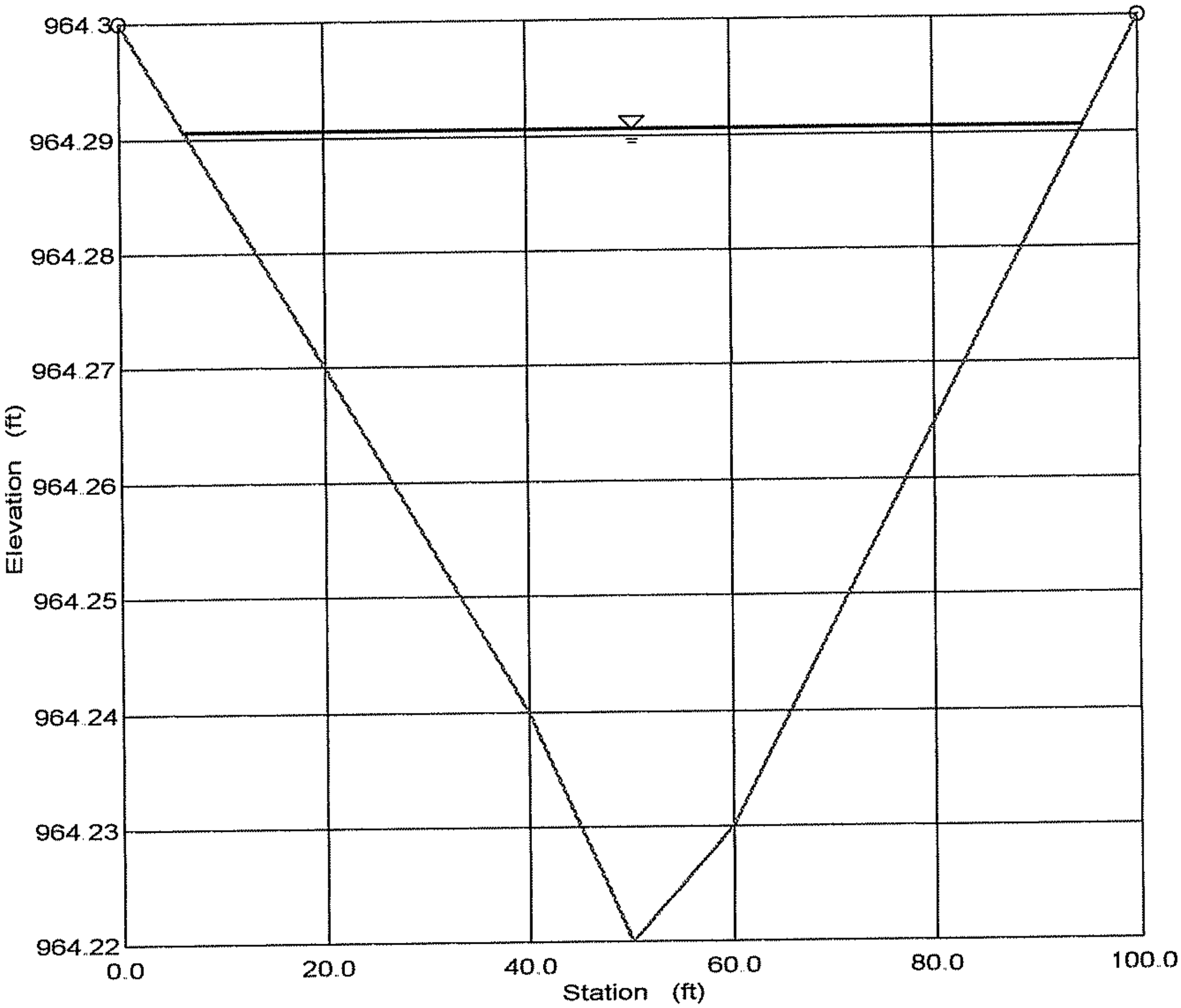
Flow is supercritical.

Water elevation exceeds lowest end station by 0.03 ft.

# Cross Section for Velocity Estimate
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V100 ESTIMATE for CP5 POSTDEV |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.025 | |
| Channel Slope | 0.078000 ft/ft | |
| Water Surface Elevation | 964.29 | ft |
| Discharge | 5.70 | cfs |



# V100 Estimate Worksheet For CP6 POSTDEV
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V100 ESTIMATE for CP6 POSTDEV |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | |
|---|---|
| Channel Slope | 0.036000 ft/ft |

Elevation range: 964.22 ft to 964.30 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 964.30 | 0.00 | 100.00 | 0.025 |
| 40.00 | 964.25 | | | |
| 50.00 | 964.22 | | | |
| 60.00 | 964.25 | | | |
| 100.00 | 964.30 | | | |

| | | |
|---|---|---|
| Discharge | 6.40 | cfs |

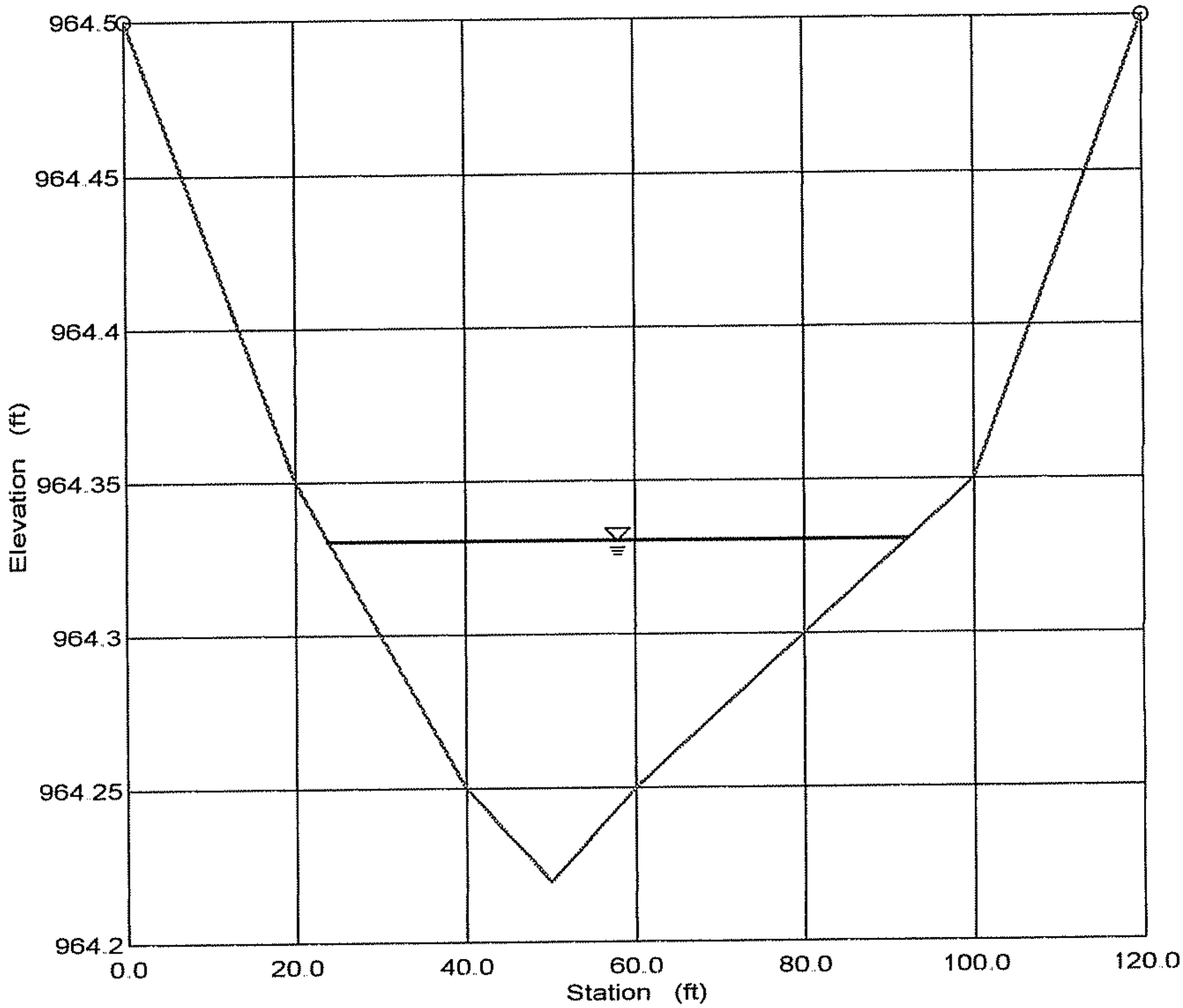
| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.025 | |
| Water Surface Elevation | 964.31 | ft |
| Flow Area | 4.49 | ft² |
| Wetted Perimeter | 100.02 | ft |
| Top Width | 100.00 | ft |
| Height | 0.09 | ft |
| Critical Depth | 964.32 | ft |
| Critical Slope | 0.024686 | ft/ft |
| Velocity | 1.42 | ft/s |
| Velocity Head | 0.03 | ft |
| Specific Energy | 964.34 | ft |
| Froude Number | 1.19 | |

Flow is supercritical.
Water elevation exceeds lowest end station by 0.01 ft.

# Cross Section for Velocity Estimate
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V100 ESTIMATE for CP6 POSTDEV |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.025 | |
| Channel Slope | 0.036000 ft/ft | |
| Water Surface Elevation | 964.33 | ft |
| Discharge | 6.40 | cfs |



# V100 Estimate Worksheet FOR CP7 POSTDEV
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V100 CALCS FOR CP7 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

Input Data

Channel Slope 0.072800 ft/ft

Elevation range: 856.00 ft to 858.41 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 856.50 | 0.00 | 19.86 | 0.017 |
| 0.50 | 856.50 | 19.86 | 21.86 | 0.025 |
| 0.93 | 856.51 | | | |
| 1.18 | 856.00 | | | |
| 19.18 | 856.90 | | | |
| 19.43 | 857.40 | | | |
| 19.86 | 857.41 | | | |
| 21.86 | 858.41 | | | |

Discharge 5.70 cfs

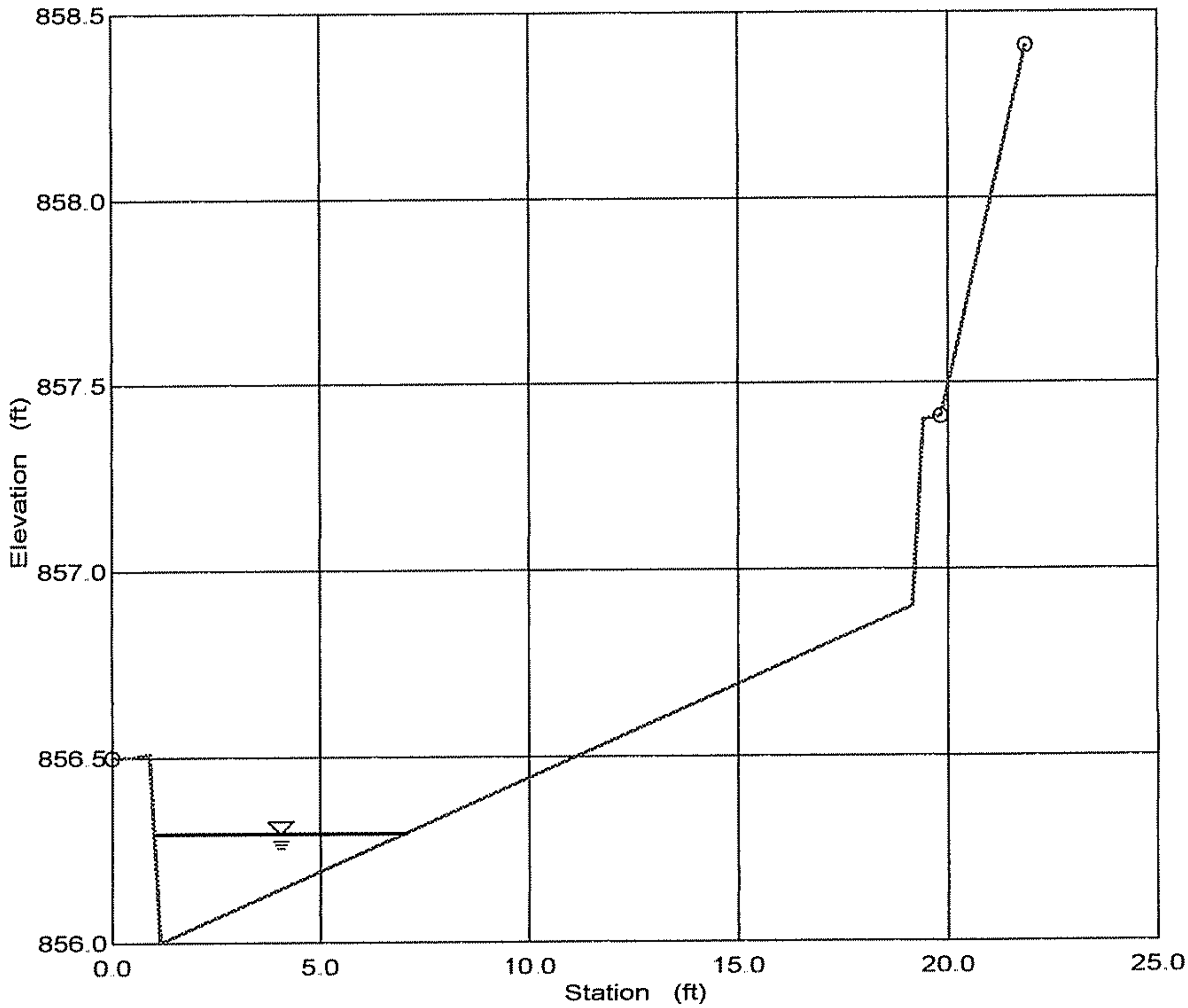
| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.017 | |
| Water Surface Elevation | 856.29 | ft |
| Flow Area | 0.89 | $ft^2$ |
| Wetted Perimeter | 6.22 | ft |
| Top Width | 6.03 | ft |
| Height | 0.29 | ft |
| Critical Depth | 856.45 | ft |
| Critical Slope | 0.007198 | ft/ft |
| Velocity | 6.43 | ft/s |
| Velocity Head | 0.64 | ft |
| Specific Energy | 856.94 | ft |
| Froude Number | 2.96 | |

Flow is supercritical.

# Cross Section
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V100 CALCS FOR CP7 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.017 | |
| Channel Slope | 0.072800 | ft/ft |
| Water Surface Elevation | 856.29 | ft |
| Discharge | 5.70 | cfs |



# Flood Limits Section 1
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Flood Limits Section 1 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

**Input Data**

Channel Slope 0.050900 ft/ft

Elevation range: 834.00 ft to 859.00 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 859.00 | 0.00 | 90.00 | 0.035 |
| 70.00 | 852.00 | 90.00 | 110.00 | 0.049 |
| 90.00 | 846.00 | 110.00 | 195.00 | 0.035 |
| 110.00 | 834.00 | | | |
| 115.00 | 834.00 | | | |
| 138.00 | 839.00 | | | |
| 195.00 | 848.00 | | | |

Discharge 162.00 cfs

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.038 | |
| Water Surface Elevation | 835.70 | ft |
| Flow Area | 17.51 | ft² |
| Wetted Perimeter | 16.29 | ft |
| Top Width | 15.64 | ft |
| Height | 1.70 | ft |
| Critical Depth | 836.12 | ft |
| Critical Slope | 0.020435 | ft/ft |
| Velocity | 9.25 | ft/s |
| Velocity Head | 1.33 | ft |
| Specific Energy | 837.03 | ft |
| Froude Number | 1.54 | |
| Flow is supercritical. | | |

# Flood Limits Section 2
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Flood Limits Section 2 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

**Input Data**

Channel Slope 0.050900 ft/ft

Elevation range: 836.00 ft to 862.00 ft.

| Station (ft) | Elevation (ft) |
|---|---|
| 0.00 | 862.00 |
| 75.00 | 854.00 |
| 87.00 | 848.00 |
| 103.00 | 846.00 |
| 110.00 | 840.00 |
| 130.00 | 836.00 |
| 138.00 | 836.50 |
| 160.00 | 841.30 |
| 170.00 | 844.00 |
| 175.00 | 846.00 |
| 185.00 | 846.10 |
| 195.00 | 848.00 |

| Start Station | End Station | Roughness |
|---|---|---|
| 0.00 | 87.00 | 0.035 |
| 87.00 | 103.00 | 0.049 |
| 103.00 | 195.00 | 0.035 |

Discharge 162.00 cfs

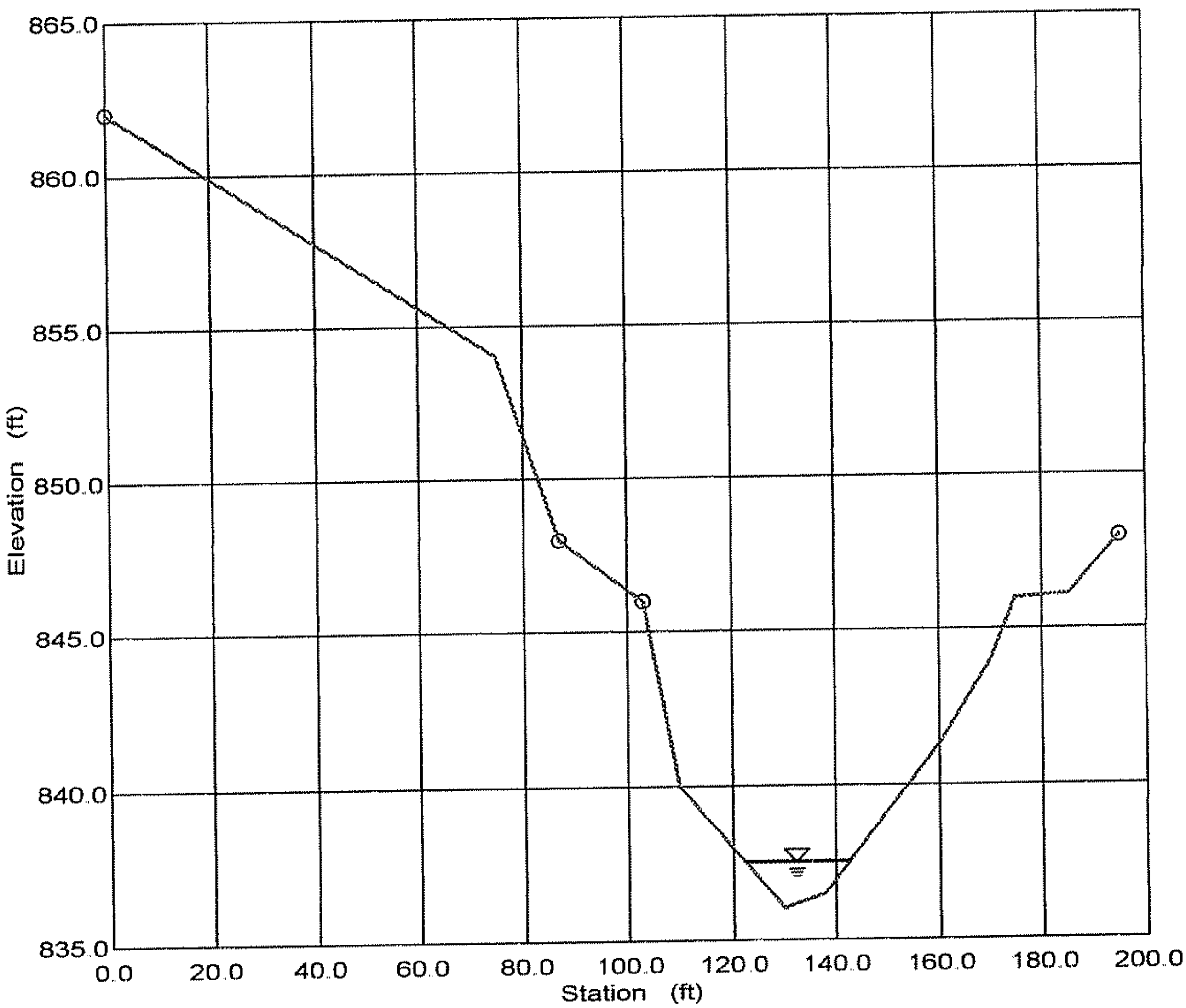
| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.035 | |
| Water Surface Elevation | 837.52 | ft |
| Flow Area | 18.28 | ft² |
| Wetted Perimeter | 20.53 | ft |
| Top Width | 20.25 | ft |
| Height | 1.52 | ft |
| Critical Depth | 837.91 | ft |
| Critical Slope | 0.017517 | ft/ft |
| Velocity | 8.86 | ft/s |
| Velocity Head | 1.22 | ft |
| Specific Energy | 838.74 | ft |
| Froude Number | 1.65 | |

Flow is supercritical.

# Flood Limits Section 2 Cross Section
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Flood Limits Section 2 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

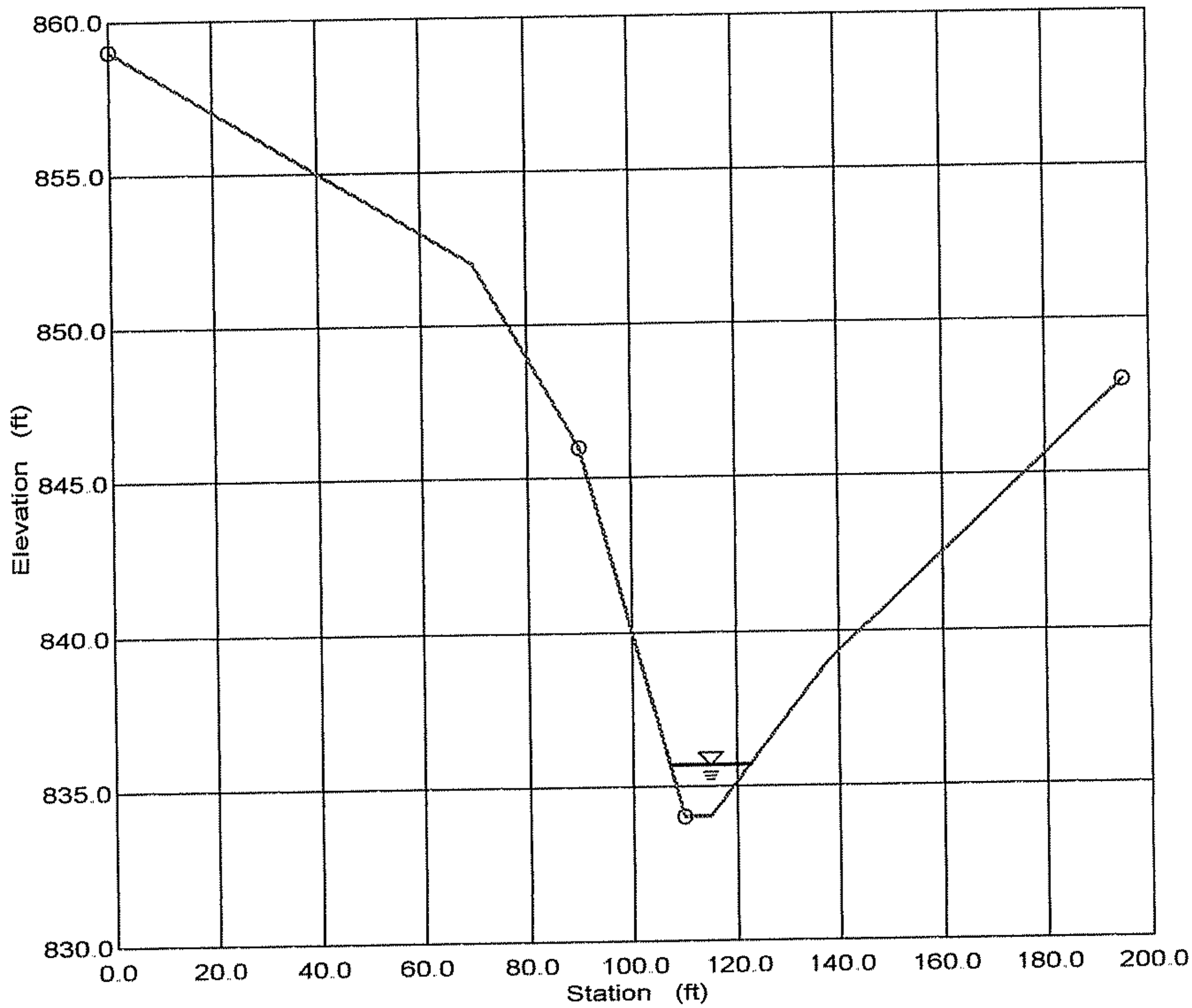
| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.035 | |
| Channel Slope | 0.050900 ft/ft | |
| Water Surface Elevation | 837.52 | ft |
| Discharge | 162.00 | cfs |

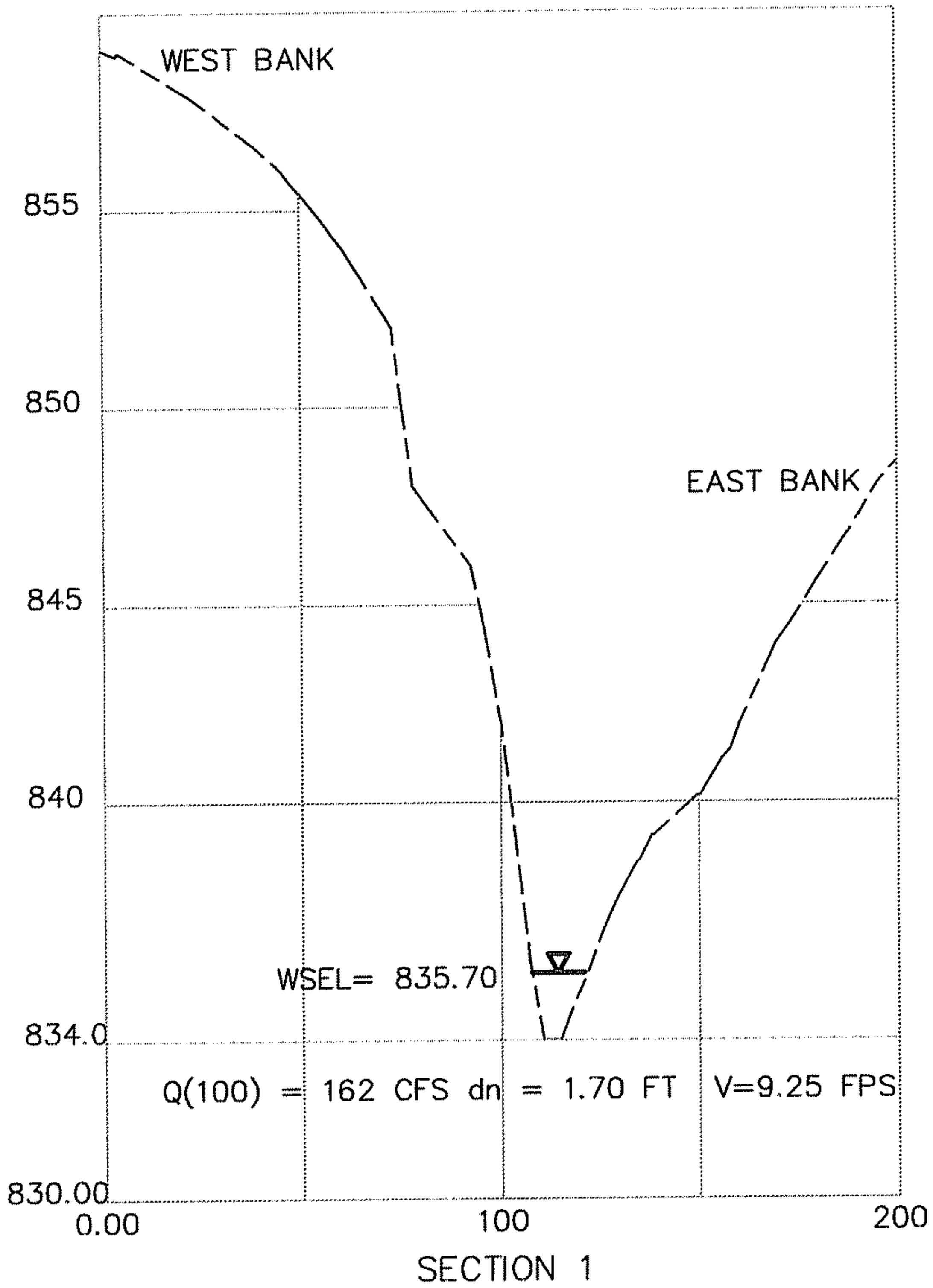


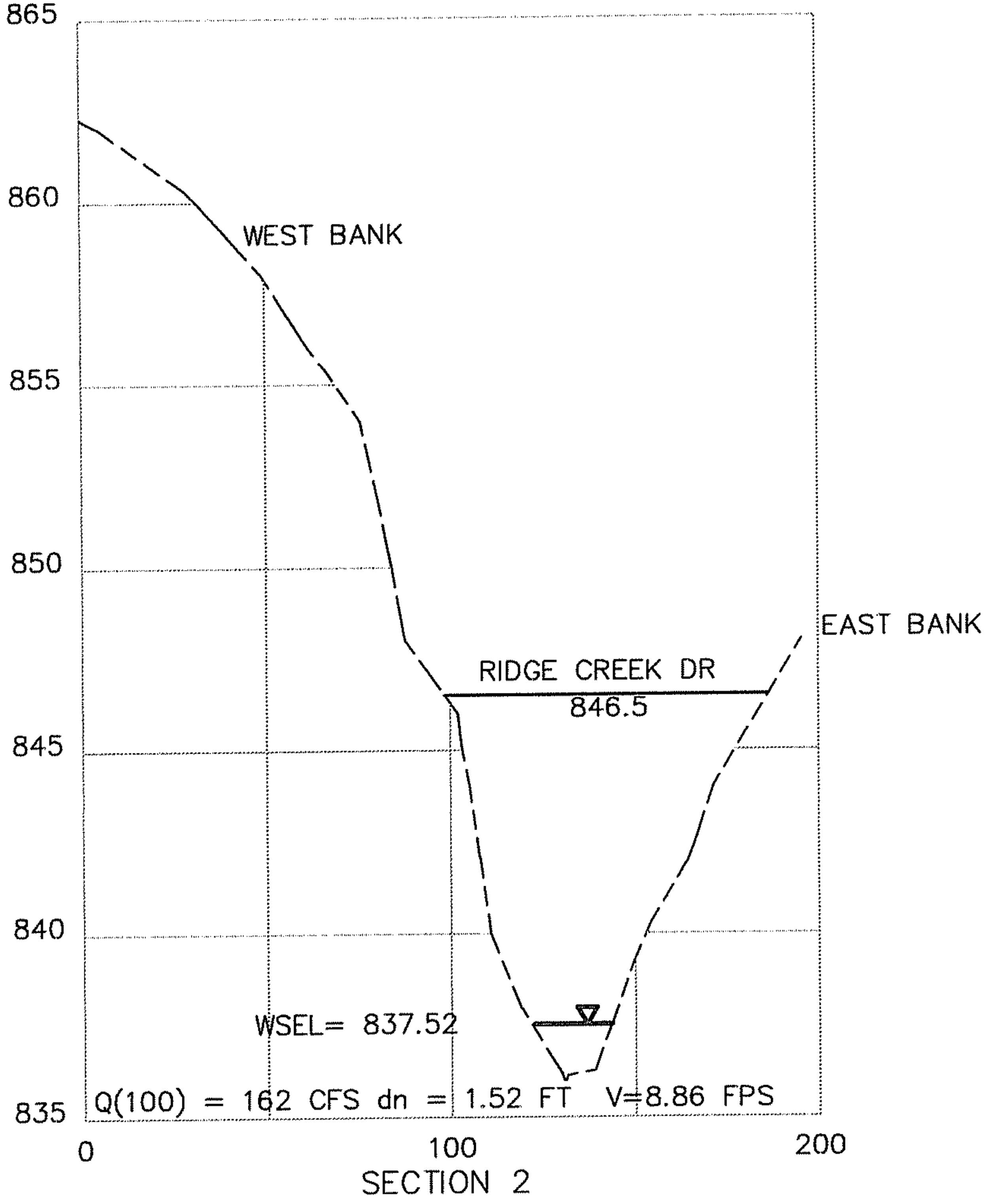
# Flood Limits Section 1 Cross Section
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Flood Limits Section 1 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.038 | |
| Channel Slope | 0.050900 | ft/ft |
| Water Surface Elevation | 835.70 | ft |
| Discharge | 162.00 | cfs |




WEST BANK
EAST BANK
855
850
845
840
834.0
830.00
0.00
100
200
WSEL= 835.70
Q(100) = 162 CFS dn = 1.70 FT V=9.25 FPS
SECTION 1


865
860
855
850
845
840
835
WEST BANK
EAST BANK
RIDGE CREEK DR
846.5
WSEL= 837.52
Q(100) = 162 CFS dn = 1.52 FT V=8.86 FPS
0
100
200
SECTION 2

# Flood Limits Section 3
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Flood Limits Section 3 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

**Input Data**

Channel Slope 0.050900 ft/ft

Elevation range: 851.00 ft to 872.00 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 872.00 | 0.00 | 75.00 | 0.035 |
| 50.00 | 866.00 | 75.00 | 135.00 | 0.049 |
| 75.00 | 860.00 | 135.00 | 235.00 | 0.035 |
| 135.00 | 851.00 | | | |
| 210.00 | 852.50 | | | |
| 235.00 | 860.00 | | | |

Discharge 162.00 cfs

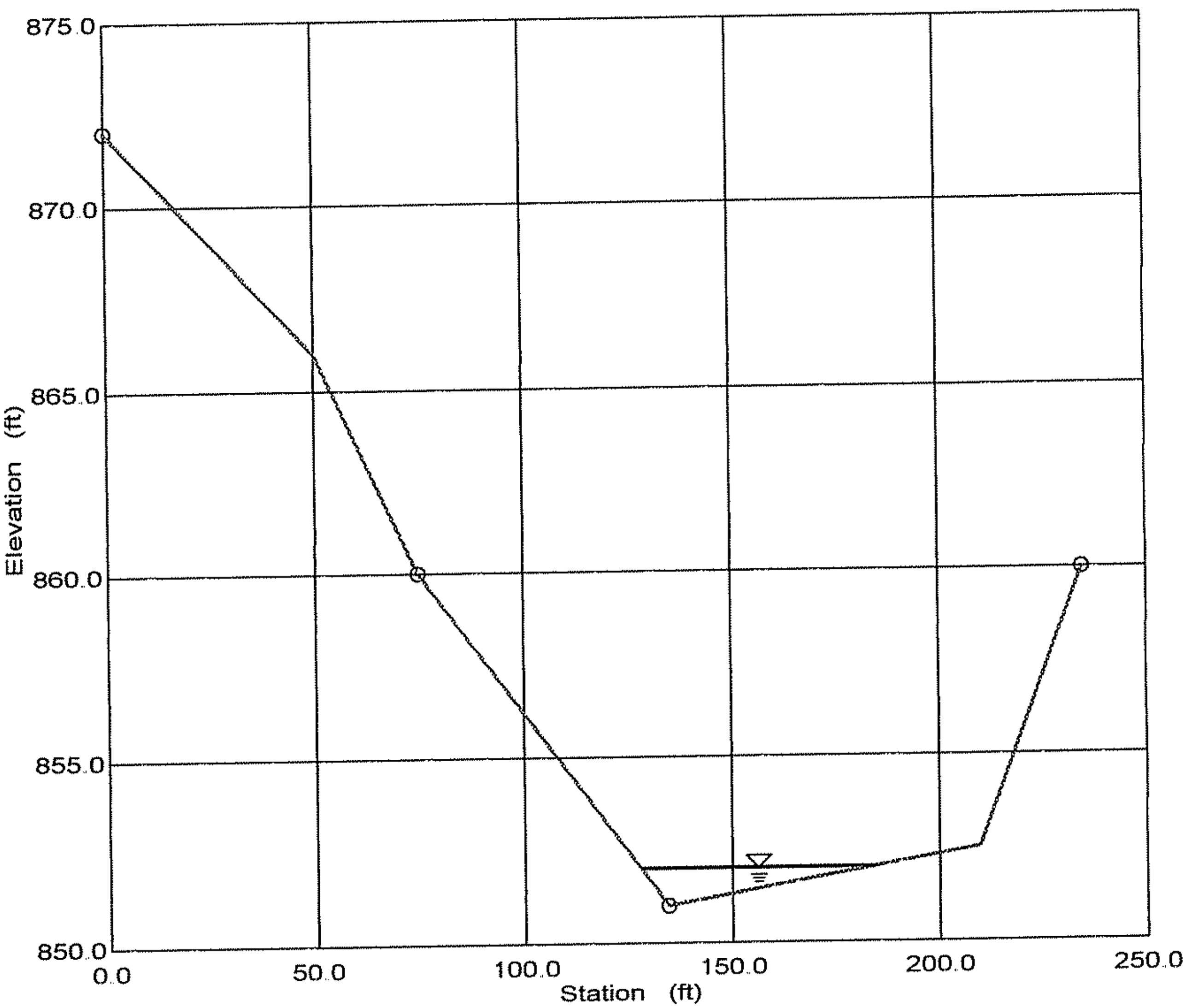
| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.036 | |
| Water Surface Elevation | 851.99 | ft |
| Flow Area | 27.93 | ft² |
| Wetted Perimeter | 56.35 | ft |
| Top Width | 56.27 | ft |
| Height | 0.99 | ft |
| Critical Depth | 852.15 | ft |
| Critical Slope | 0.023005 | ft/ft |
| Velocity | 5.80 | ft/s |
| Velocity Head | 0.52 | ft |
| Specific Energy | 852.52 | ft |
| Froude Number | 1.45 | |

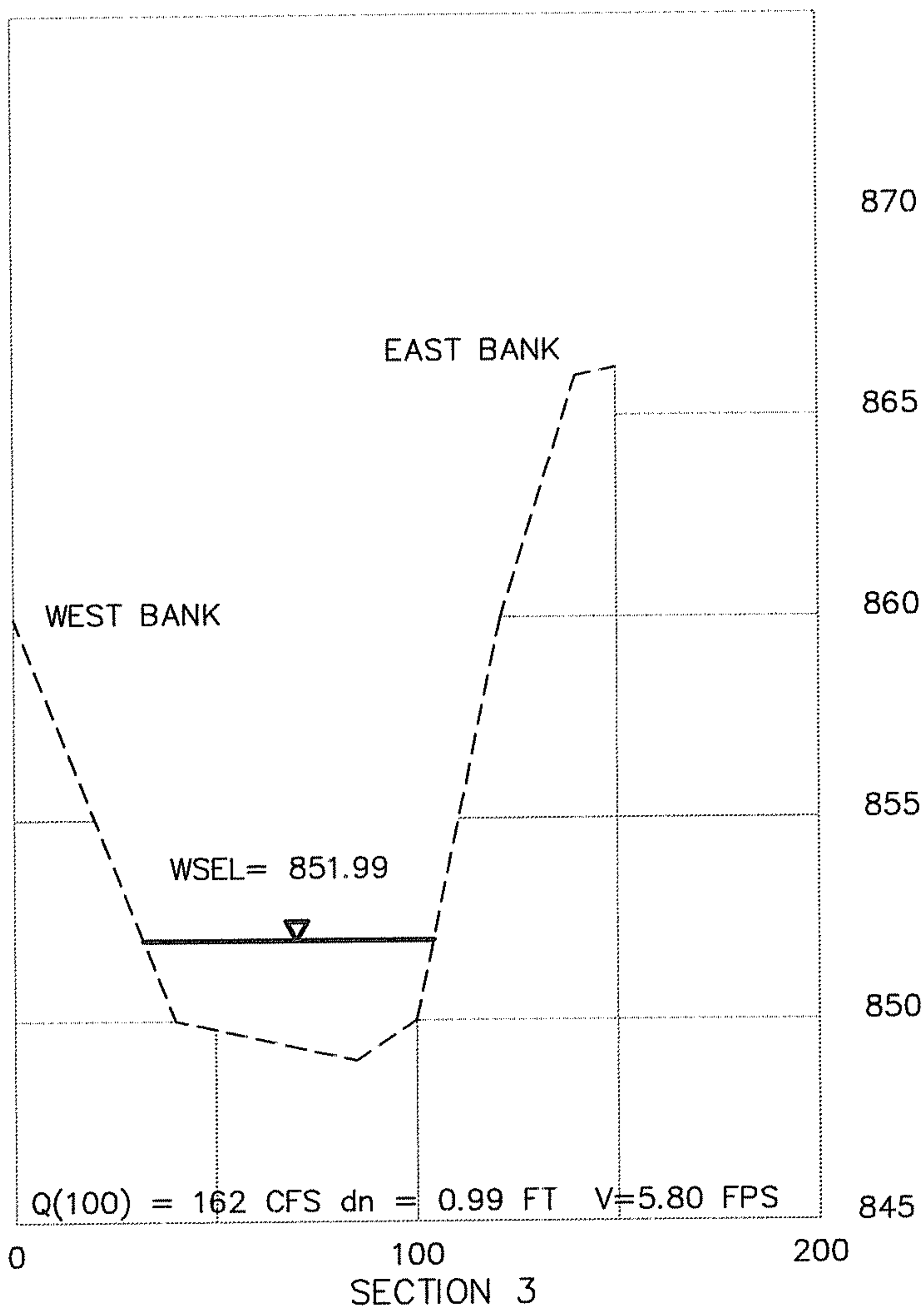
Flow is supercritical.

# Flood Limits Section 3 Cross Section
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Flood Limits Section 3 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.036 | |
| Channel Slope | 0.050900 ft/ft | |
| Water Surface Elevation | 851.99 | ft |
| Discharge | 162.00 | cfs |




870
865
860
855
850
845
EAST BANK
WEST BANK
WSEL= 851.99
Q(100) = 162 CFS dn = 0.99 FT V=5.80 FPS
0
100
200
SECTION 3

# Flood Limits Section 3.75
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Flood Limits Section 3.75 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

**Input Data**

Channel Slope 0.050900 ft/ft

Elevation range: 849.00 ft to 866.20 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 860.00 | 0.00 | 85.00 | 0.035 |
| 40.00 | 850.00 | 85.00 | 140.00 | 0.049 |
| 85.00 | 849.00 | 140.00 | 150.00 | 0.035 |
| 100.00 | 850.00 | | | |
| 121.00 | 860.00 | | | |
| 140.00 | 866.00 | | | |
| 150.00 | 866.20 | | | |

Discharge 162.00 cfs

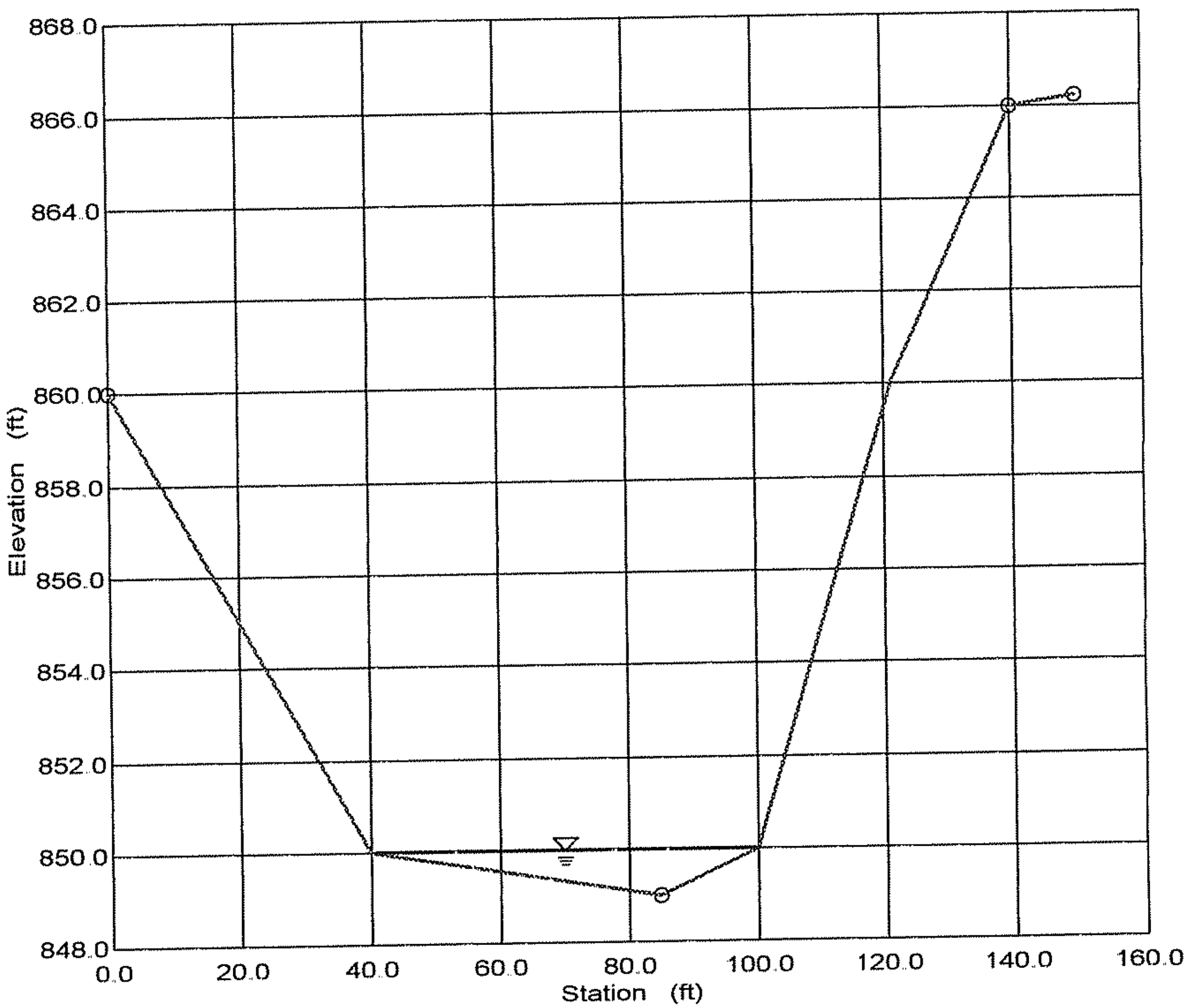
| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.038 | |
| Water Surface Elevation | 849.99 | ft |
| Flow Area | 29.19 | ft² |
| Wetted Perimeter | 59.23 | ft |
| Top Width | 59.18 | ft |
| Height | 0.99 | ft |
| Critical Depth | 850.11 | ft |
| Critical Slope | 0.024507 | ft/ft |
| Velocity | 5.55 | ft/s |
| Velocity Head | 0.48 | ft |
| Specific Energy | 850.47 | ft |
| Froude Number | 1.39 | |

Flow is supercritical.

# Flood Limits Section 3.75 Cross Section
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Flood Limits Section 3.75 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.038 | |
| Channel Slope | 0.050900 | ft/ft |
| Water Surface Elevation | 849.99 | ft |
| Discharge | 162.00 | cfs |



# Flood Limits Section 4
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Flood Limits Section 4 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

**Input Data**

Channel Slope 0.050900 ft/ft

Elevation range: 852.00 ft to 870.00 ft.

| Station (ft) | Elevation (ft) |
|---|---|
| 0.00 | 860.00 |
| 12.00 | 856.00 |
| 38.00 | 854.00 |
| 52.00 | 852.00 |
| 74.00 | 852.00 |
| 94.00 | 854.00 |
| 98.00 | 856.00 |
| 104.00 | 858.00 |
| 108.00 | 860.00 |
| 134.00 | 868.00 |
| 144.00 | 868.00 |
| 150.00 | 870.00 |

| Start Station | End Station | Roughness |
|---|---|---|
| 0.00 | 98.00 | 0.035 |
| 98.00 | 144.00 | 0.049 |
| 144.00 | 150.00 | 0.035 |

Discharge 162.00 cfs

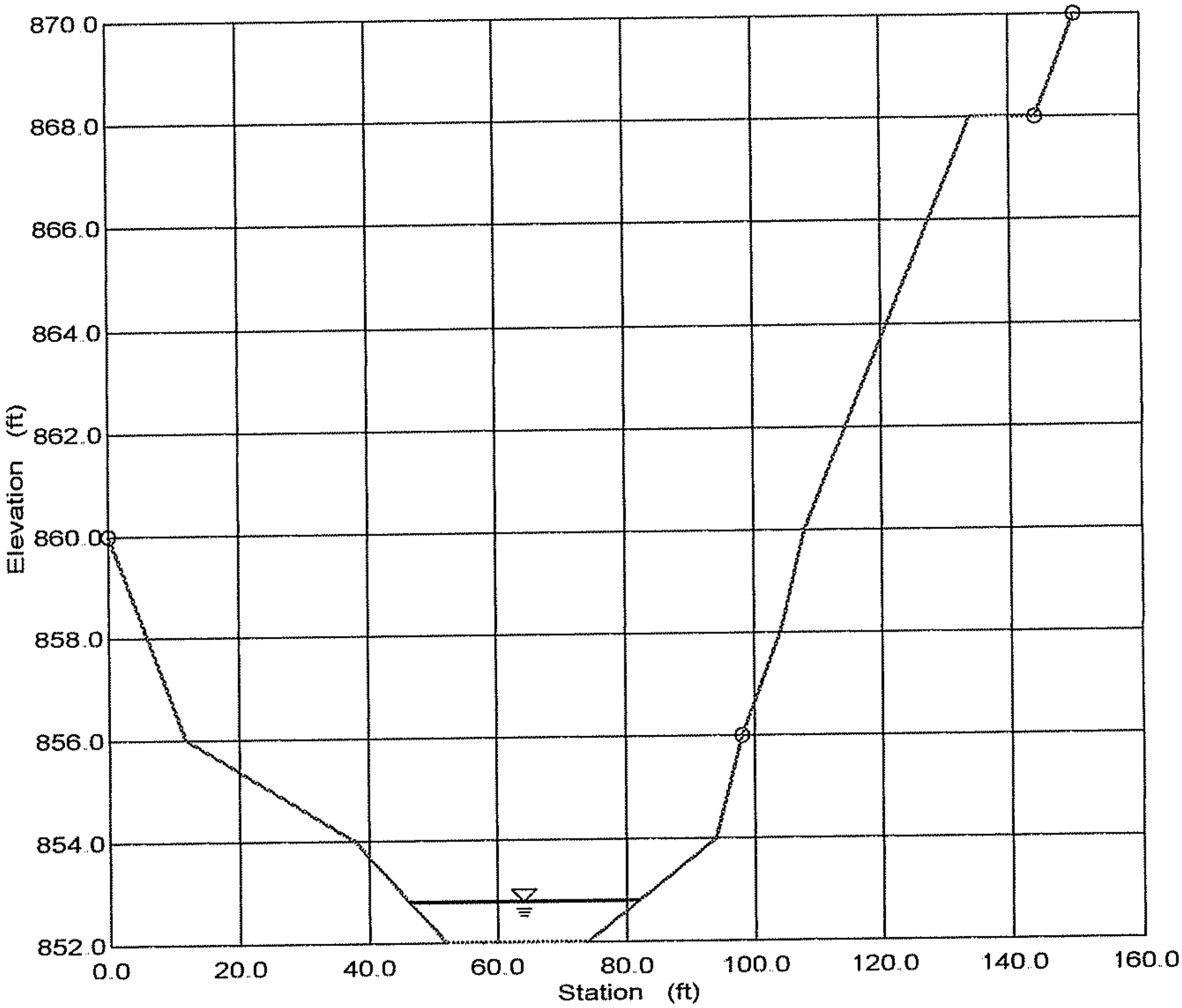
| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.035 | |
| Water Surface Elevation | 852.79 | ft |
| Flow Area | 22.77 | ft² |
| Wetted Perimeter | 35.57 | ft |
| Top Width | 35.47 | ft |
| Height | 0.79 | ft |
| Critical Depth | 853.03 | ft |
| Critical Slope | 0.019274 | ft/ft |
| Velocity | 7.11 | ft/s |
| Velocity Head | 0.79 | ft |
| Specific Energy | 853.58 | ft |
| Froude Number | 1.57 | |

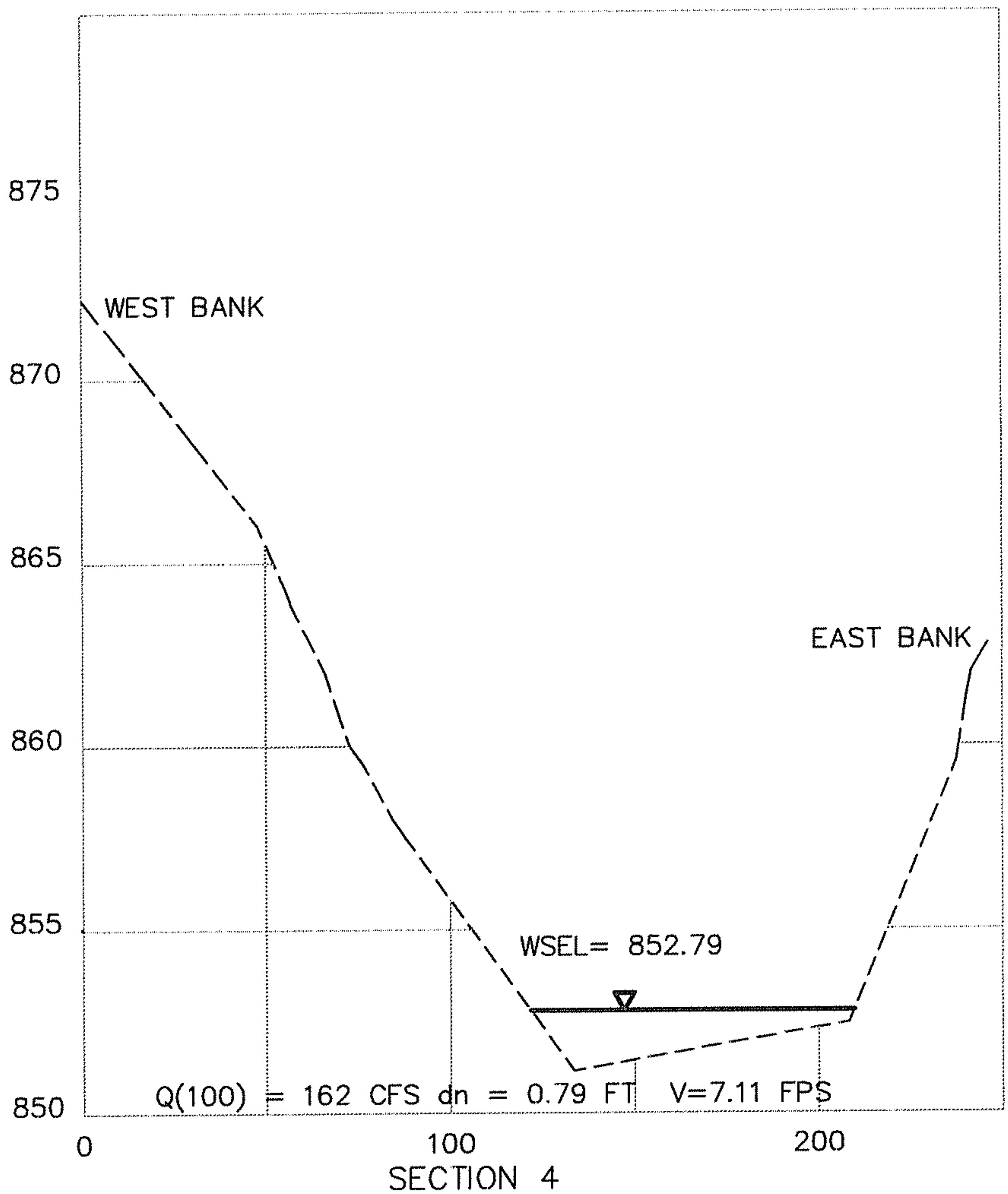
Flow is supercritical.

# Flood Limits Section 4 Cross Section
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Flood Limits Section 4 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.035 | |
| Channel Slope | 0.050900 | ft/ft |
| Water Surface Elevation | 852.79 | ft |
| Discharge | 162.00 | cfs |




875
870
865
860
855
850
WEST BANK
EAST BANK
WSEL= 852.79
Q(100) = 162 CFS dn = 0.79 FT V=7.11 FPS
0
100
200
SECTION 4

# Capacity Calc's for 39" Culvert at CP8
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Capacity Calc's for Culvert at CP8 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Channel Slope | 0.040000 | ft/ft |
| Diameter | 39.00 | in |
| Discharge | 162.00 | cfs |

| Results | | |
|---|---|---|
| Depth | 31.3 | in |
| Flow Area | 7.14 | ft² |
| Wetted Perimeter | 7.22 | ft |
| Top Width | 2.59 | ft |
| Critical Depth | 3.21 | ft |
| Percent Full | 80.30 | |
| Critical Slope | 0.035263 | ft/ft |
| Velocity | 22.69 | ft/s |
| Velocity Head | 8.00 | ft |
| Specific Energy | 10.61 | ft |
| Froude Number | 2.41 | |
| Maximum Discharge | 177.63 | cfs |
| Full Flow Capacity | 165.13 | cfs |
| Full Flow Slope | 0.038499 | ft/ft |
| Flow is supercritical. | | |

# Capacity Calc's for 39" Culvert at CP8
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Capacity Calc's for Culvert at CP8 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Full Flow Capacity |

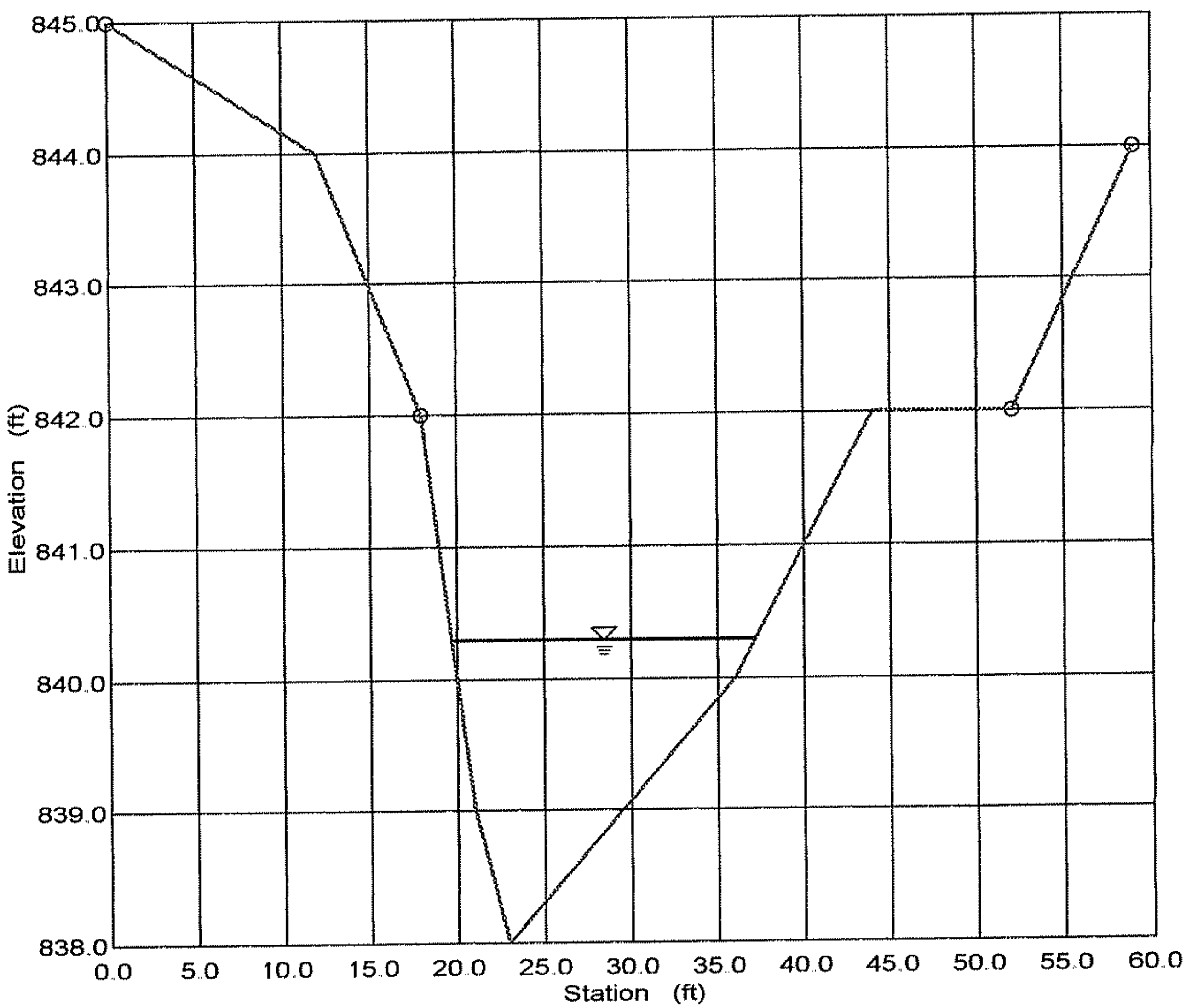
| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Channel Slope | 0.050000 | ft/ft |
| Diameter | 39.00 | in |

| Results | | |
|---|---|---|
| Depth | 39.0 | in |
| Discharge | 184.62 | cfs |
| Flow Area | 8.30 | $ft^2$ |
| Wetted Perimeter | 10.21 | ft |
| Top Width | 0.00 | ft |
| Critical Depth | 3.23 | ft |
| Percent Full | 100.00 | |
| Critical Slope | 0.046657 | ft/ft |
| Velocity | 22.25 | ft/s |
| Velocity Head | 7.70 | ft |
| Specific Energy | FULL | ft |
| Froude Number | FULL | |
| Maximum Discharge | 198.60 | cfs |
| Full Flow Capacity | 184.62 | cfs |
| Full Flow Slope | 0.050000 | ft/ft |

# Rip Rap At CP8 at Outlet Cross Section
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Rip-Rap Calc's At CP8 at outlet |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.049 | |
| Channel Slope | 0.052000 ft/ft | |
| Water Surface Elevation | 840.28 | ft |
| Discharge | 162.00 | cfs |



# V100 Calc's CP8 at Culvert Outlet
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Rip-Rap Calc's At CP8 at outlet |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

**Input Data**

Channel Slope 0.052000 ft/ft

Elevation range: 838.00 ft to 845.00 ft.

| Station (ft) | Elevation (ft) |
|---|---|
| 0.00 | 845.00 |
| 12.00 | 844.00 |
| 18.00 | 842.00 |
| 20.00 | 840.00 |
| 21.00 | 839.00 |
| 23.00 | 838.00 |
| 36.00 | 840.00 |
| 44.00 | 842.00 |
| 52.00 | 842.00 |
| 59.00 | 844.00 |

| Start Station | End Station | Roughness |
|---|---|---|
| 0.00 | 18.00 | 0.035 |
| 18.00 | 52.00 | 0.049 |
| 52.00 | 59.00 | 0.035 |

Discharge 162.00 cfs

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.049 | |
| Water Surface Elevation | 840.28 | ft |
| Flow Area | 21.26 | ft² |
| Wetted Perimeter | 18.38 | ft |
| Top Width | 17.42 | ft |
| Height | 2.28 | ft |
| Critical Depth | 840.47 | ft |
| Critical Slope | 0.034179 | ft/ft |
| Velocity | 7.62 | ft/s |
| Velocity Head | 0.90 | ft |
| Specific Energy | 841.19 | ft |
| Froude Number | 1.22 | |
| Flow is supercritical. | | |

# Required Size Calc's for Culvert at CP8
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Capacity Calc's at CP8 Culvert |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Full Flow Capacity |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Channel Slope | 0.040000 | ft/ft |
| Diameter | 36.00 | in |

| Results | | |
|---|---|---|
| Depth | 36.0 | in |
| Discharge | 133.39 | cfs |
| Flow Area | 7.07 | $ft^2$ |
| Wetted Perimeter | 9.42 | ft |
| Top Width | 0.00 | ft |
| Critical Depth | 2.97 | ft |
| Percent Full | 100.00 | |
| Critical Slope | 0.036671 | ft/ft |
| Velocity | 18.87 | ft/s |
| Velocity Head | 5.53 | ft |
| Specific Energy | FULL | ft |
| Froude Number | FULL | |
| Maximum Discharge | 143.49 | cfs |
| Full Flow Capacity | 133.39 | cfs |
| Full Flow Slope | 0.040000 | ft/ft |

# Capacity Calc's for 36" Culvert AT CP8
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Capacity Calc's at CP8 Culvert |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Full Flow Capacity |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Channel Slope | 0.050000 | ft/ft |
| Diameter | 36.00 | in |

| Results | | |
|---|---|---|
| Depth | 36.0 | in |
| Discharge | 149.13 | cfs |
| Flow Area | 7.07 | ft² |
| Wetted Perimeter | 9.42 | ft |
| Top Width | 0.00 | ft |
| Critical Depth | 2.98 | ft |
| Percent Full | 100.00 | |
| Critical Slope | 0.046576 | ft/ft |
| Velocity | 21.10 | ft/s |
| Velocity Head | 6.92 | ft |
| Specific Energy | FULL | ft |
| Froude Number | FULL | |
| Maximum Discharge | 160.42 | cfs |
| Full Flow Capacity | 149.13 | cfs |
| Full Flow Slope | 0.050000 | ft/ft |

# Required Size Calc's for Culvert at CP8
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Capacity Calc's for Culvert at CP8 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Diameter |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Channel Slope | 0.040000 | ft/ft |
| Depth | 36.0 | in |
| Discharge | 162.00 | cfs |

| Results | | |
|---|---|---|
| Diameter | 37.71 | in |
| Flow Area | 7.63 | $ft^2$ |
| Wetted Perimeter | 8.52 | ft |
| Top Width | 1.31 | ft |
| Critical Depth | 3.12 | ft |
| Percent Full | 95.47 | |
| Critical Slope | 0.042731 | ft/ft |
| Velocity | 21.23 | ft/s |
| Velocity Head | 7.01 | ft |
| Specific Energy | 10.01 | ft |
| Froude Number | 1.55 | |
| Maximum Discharge | 162.36 | cfs |
| Full Flow Capacity | 150.94 | cfs |
| Full Flow Slope | 0.046079 | ft/ft |
| Flow is supercritical. | | |

# Required Size Calc's for Culvert at CP8
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Capacity Calc's at CP8 Culvert |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Diameter |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Channel Slope | 0.050000 | ft/ft |
| Depth | 36.0 | in |
| Discharge | 162.00 | cfs |

| Results | | |
|---|---|---|
| Diameter | 36.49 | in |
| Flow Area | 7.24 | $ft^2$ |
| Wetted Perimeter | 8.85 | ft |
| Top Width | 0.70 | ft |
| Critical Depth | 3.02 | ft |
| Percent Full | 98.66 | |
| Critical Slope | 0.051464 | ft/ft |
| Velocity | 22.37 | ft/s |
| Velocity Head | 7.77 | ft |
| Specific Energy | 10.77 | ft |
| Froude Number | 1.23 | |
| Maximum Discharge | 166.30 | cfs |
| Full Flow Capacity | 154.60 | cfs |
| Full Flow Slope | 0.054904 | ft/ft |
| Flow is supercritical. | | |

# V100 Calc's 40' D/S FROM CP8 Rip-Rap
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Rip-Rap Calc's At CP8 + 40' d/s |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

**Input Data**

Channel Slope 0.052000 ft/ft

Elevation range: 835.00 ft to 842.00 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 842.00 | 0.00 | 12.00 | 0.035 |
| 5.00 | 840.00 | 12.00 | 48.00 | 0.049 |
| 12.00 | 838.00 | 48.00 | 60.00 | 0.035 |
| 20.00 | 836.00 | | | |
| 24.00 | 835.00 | | | |
| 30.00 | 836.00 | | | |
| 48.00 | 838.00 | | | |
| 57.00 | 840.00 | | | |
| 60.00 | 842.00 | | | |

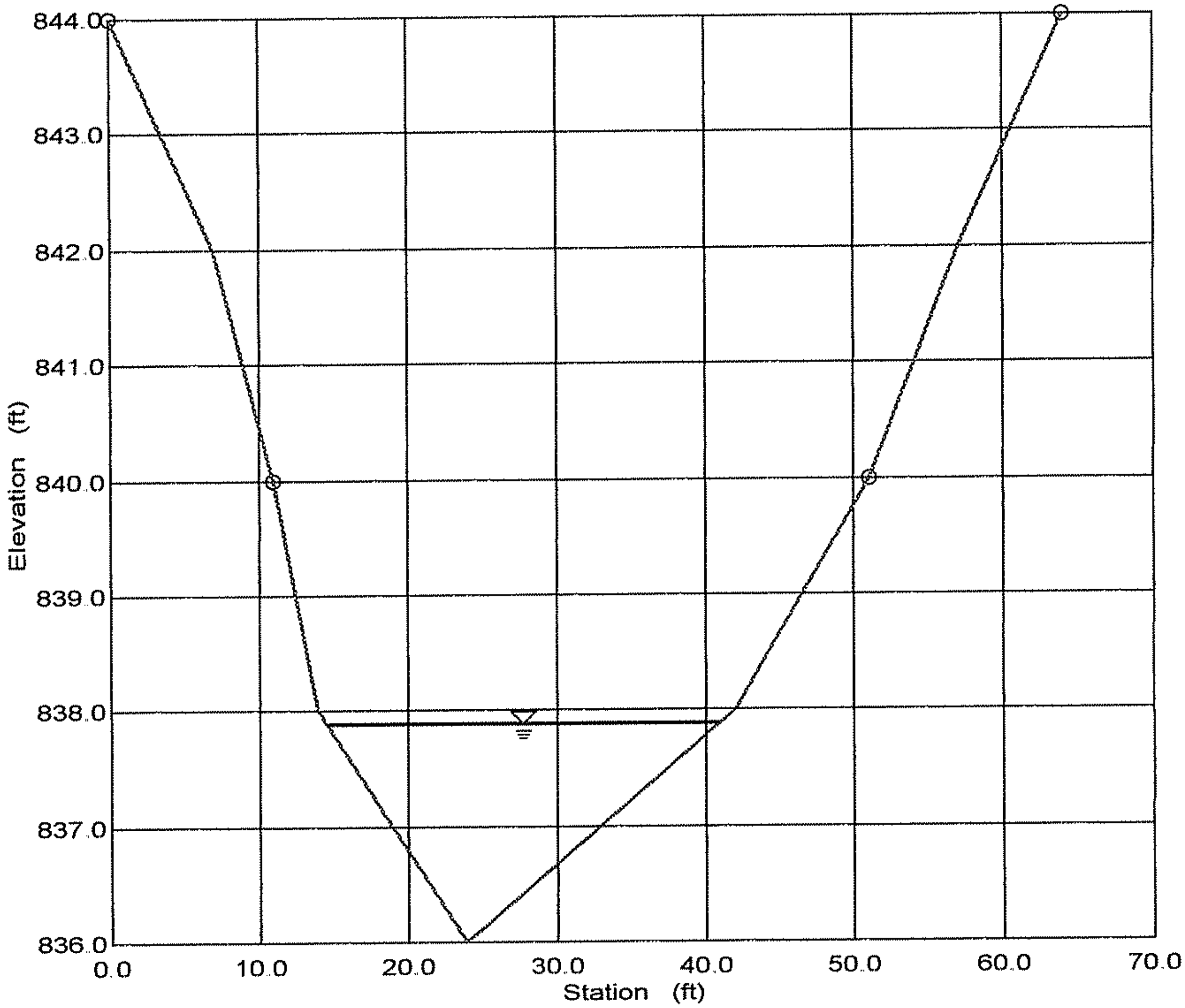
Discharge 162.00 cfs

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.049 | |
| Water Surface Elevation | 837.10 | ft |
| Flow Area | 23.95 | ft² |
| Wetted Perimeter | 24.75 | ft |
| Top Width | 24.34 | ft |
| Height | 2.10 | ft |
| Critical Depth | 837.26 | ft |
| Critical Slope | 0.035107 | ft/ft |
| Velocity | 6.77 | ft/s |
| Velocity Head | 0.71 | ft |
| Specific Energy | 837.81 | ft |
| Froude Number | 1.20 | |
| Flow is supercritical. | | |

# Rip Rap D/S FROM CP8 Cross Section
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Rip-Rap Calc's At CP8 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.049 | |
| Channel Slope | 0.052000 ft/ft | |
| Water Surface Elevation | 837.88 | ft |
| Discharge | 162.00 | cfs |



# V100 Calc's D/S FROM CP8 Rip-Rap
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Rip-Rap Calc's At CP8 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

Input Data

Channel Slope 0.052000 ft/ft

Elevation range: 836.00 ft to 844.00 ft.

| Station (ft) | Elevation (ft) |
|---|---|
| 0.00 | 844.00 |
| 7.00 | 842.00 |
| 11.00 | 840.00 |
| 14.00 | 838.00 |
| 24.00 | 836.00 |
| 42.00 | 838.00 |
| 51.00 | 840.00 |
| 57.00 | 842.00 |
| 64.00 | 844.00 |

| Start Station | End Station | Roughness |
|---|---|---|
| 0.00 | 11.00 | 0.035 |
| 11.00 | 51.00 | 0.049 |
| 51.00 | 64.00 | 0.035 |

Discharge 162.00 cfs

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.049 | |
| Water Surface Elevation | 837.88 | ft |
| Flow Area | 24.63 | ft² |
| Wetted Perimeter | 26.55 | ft |
| Top Width | 26.26 | ft |
| Height | 1.88 | ft |
| Critical Depth | 838.01 | ft |
| Critical Slope | 0.035379 | ft/ft |
| Velocity | 6.58 | ft/s |
| Velocity Head | 0.67 | ft |
| Specific Energy | 838.55 | ft |
| Froude Number | 1.20 | |

Flow is supercritical.

# V100 Calc's Down Stream Rip Rap
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | RIP RAP FOR RIDGE CREEK SD |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.049 | |
| Channel Slope | 0.051700 | ft/ft |
| Left Side Slope | 3.000000 | H : V |
| Right Side Slope | 3.000000 | H : V |
| Bottom Width | 12.00 | ft |
| Discharge | 162.00 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.38 | ft |
| Flow Area | 22.36 | ft² |
| Wetted Perimeter | 20.75 | ft |
| Top Width | 20.30 | ft |
| Critical Depth | 1.55 | ft |
| Critical Slope | 0.033828 | ft/ft |
| Velocity | 7.25 | ft/s |
| Velocity Head | 0.82 | ft |
| Specific Energy | 2.20 | ft |
| Froude Number | 1.22 | |
| Flow is supercritical. | | |

# RipRap Worksheet for RIDGE CREEK SD
## Worksheet for Rectangular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Rip Rap Worksheet for CULVERT |
| Flow Element | Rectangular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

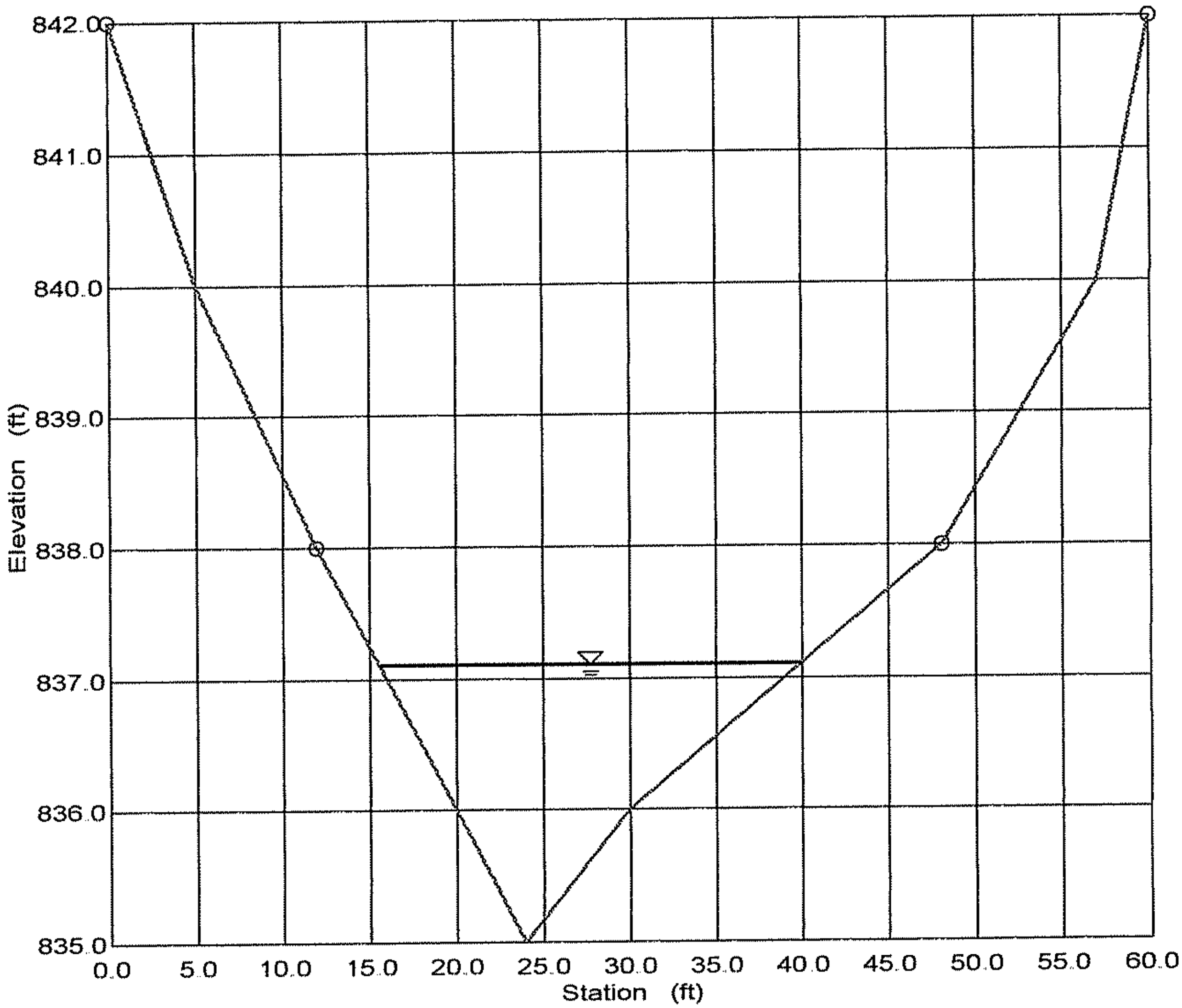
| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.049 | |
| Channel Slope | 0.051700 | ft/ft |
| Bottom Width | 12.00 | ft |
| Discharge | 173.10 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.72 | ft |
| Flow Area | 20.67 | $ft^2$ |
| Wetted Perimeter | 15.45 | ft |
| Top Width | 12.00 | ft |
| Critical Depth | 1.86 | ft |
| Critical Slope | 0.040778 | ft/ft |
| Velocity | 8.37 | ft/s |
| Velocity Head | 1.09 | ft |
| Specific Energy | 2.81 | ft |
| Froude Number | 1.12 | |
| Flow is supercritical. | | |

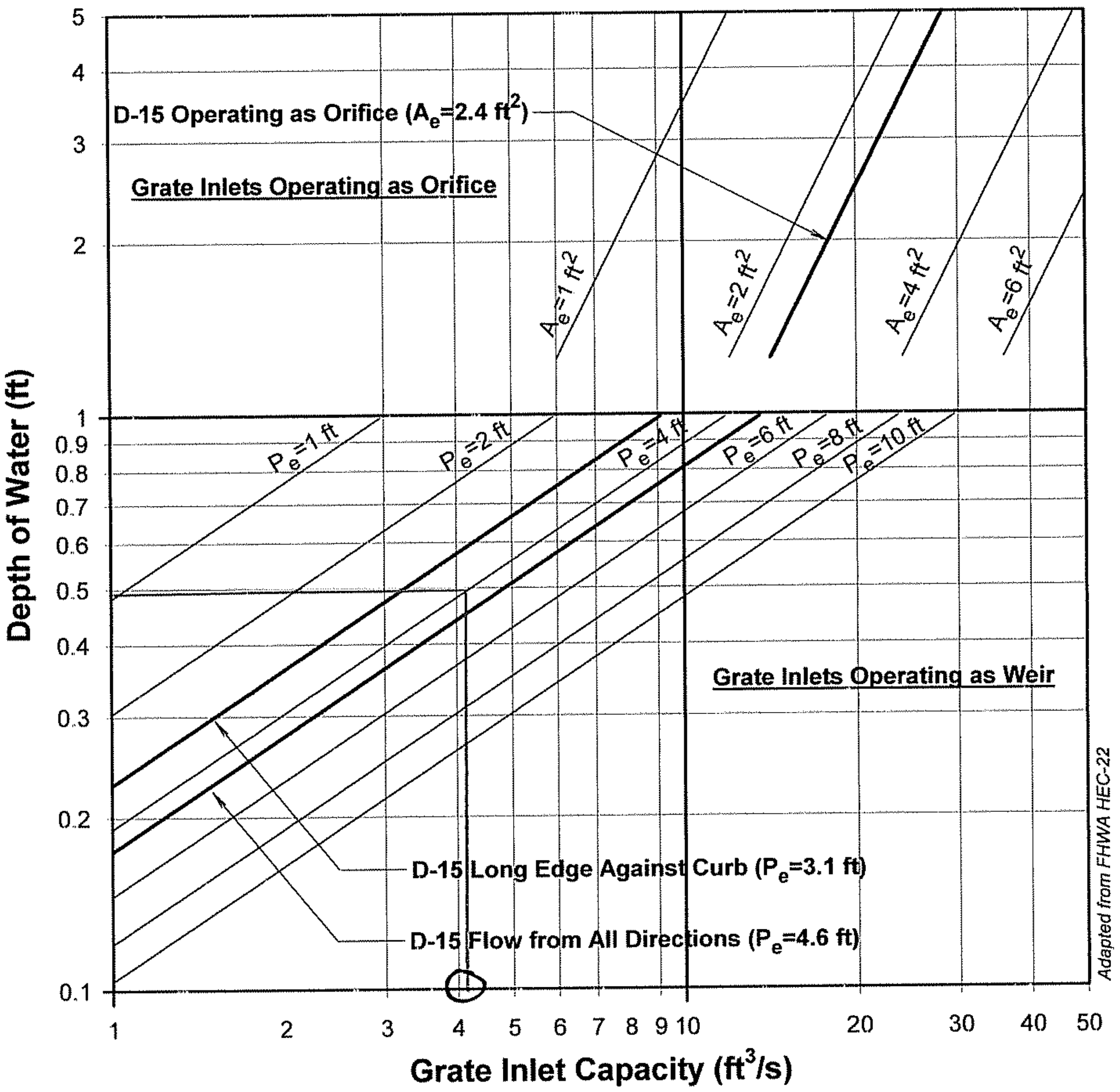
# Rip Rap 40' D/S FROM CP8 Cross Section
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Rip-Rap Calc's At CP8 + 40' d/s |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.049 | |
| Channel Slope | 0.052000 ft/ft | |
| Water Surface Elevation | 837.10 | ft |
| Discharge | 162.00 | cfs |



# Figure 2-5



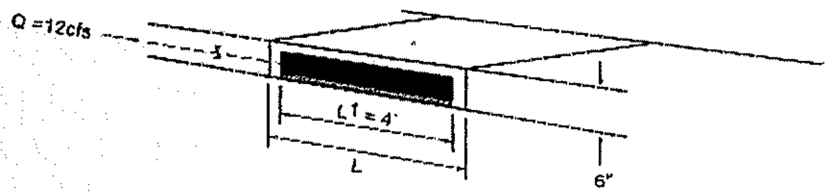

MAX DEPTH 0.5' 6" AC DIKE
$Q_{100}$= 4.2 CFS OK.

**Figure 2-5** Capacity of Grate Inlets in Sump Locations

## WB-1.2 CURB INLET IN SAG

The goal of this example is to show how to determine the length of inlet required to meet the Drainage Design Manual standards for a given situation.

*A 4-foot curb inlet is located in a sag. The peak 100-year flow approaching the inlet in the gutter is 12 cfs. The road cross slope is 2 percent and the curb height is 6 inches. Does the curb inlet meet the design criteria set forth in the Drainage Design Manual? If not, what size inlet is required? The following sketch helps illustrate this example.*




**Flow Capture of Curb Inlet**

Equation 2-8 determines the flow captured by a curb inlet in a sag condition:

$$Q = C_W L_W d^{3/2}$$

Because a curb inlet in a sag needs to capture 100 percent of the flow, and we do not want flows overtopping the curb during the 100-year event, we assume a depth of 9.9 inches (just below the San Diego Regional Standard B-Type inlet opening dimension) and solve Equation 2-8 for the curb length required. From Table 2-1, the weir coefficient for curb inlets $C_W$=3.0. Substituting into Equation 2-8, this yields:

$$Q = 12.0 = C_W L_W d^{3/2} = 3.00 * L_W * \left(\frac{9.9}{12}\right)^{3/2} = 12.0 cfs$$

For L = 12 ft

$$Q = 3.0 \times 12 \left(\frac{3.6}{12}\right)^{3/2} = 6.0$$

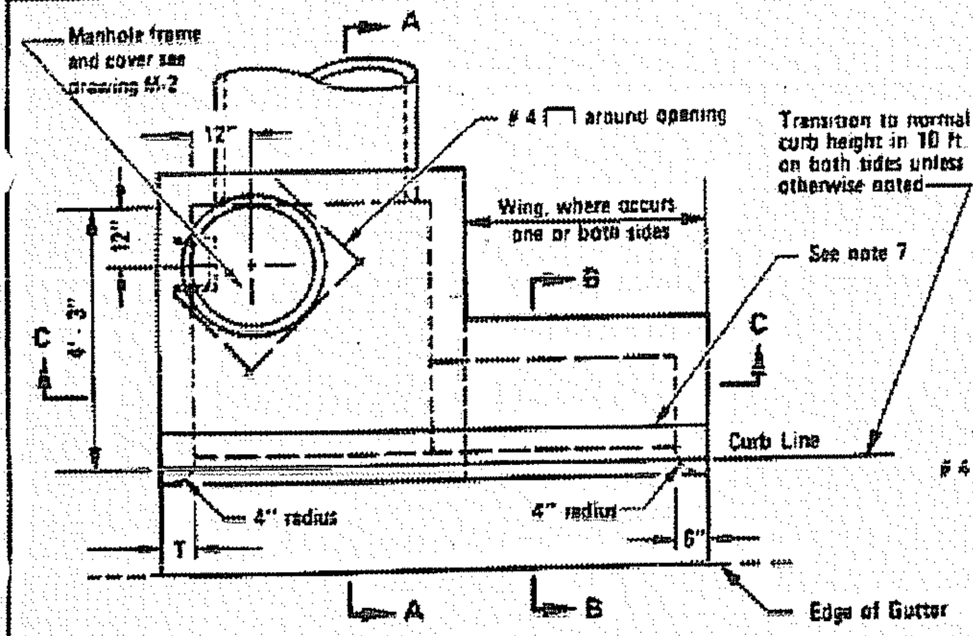
For Depressed Curb

$$Q = 3.0 (1.8 \cdot 12) d^{3/2} \quad d = 0.30 < 0.83$$

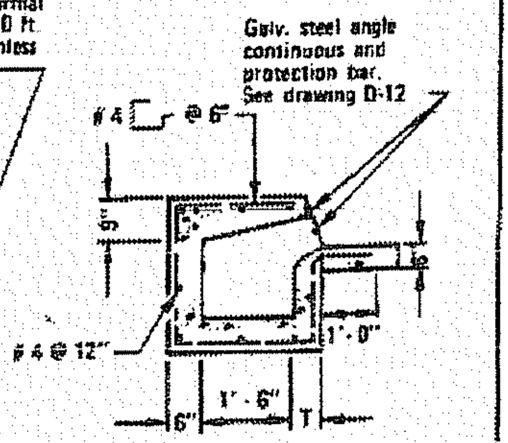
$$= 10.64 < 12' \quad \text{So.}$$

USE RSD No D-2 Type, B-2

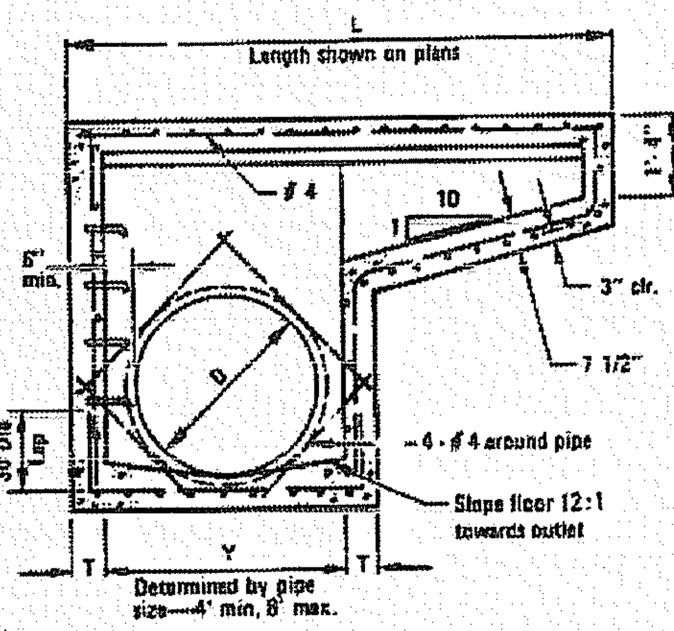
L = 4 w/ 2-9' wings)



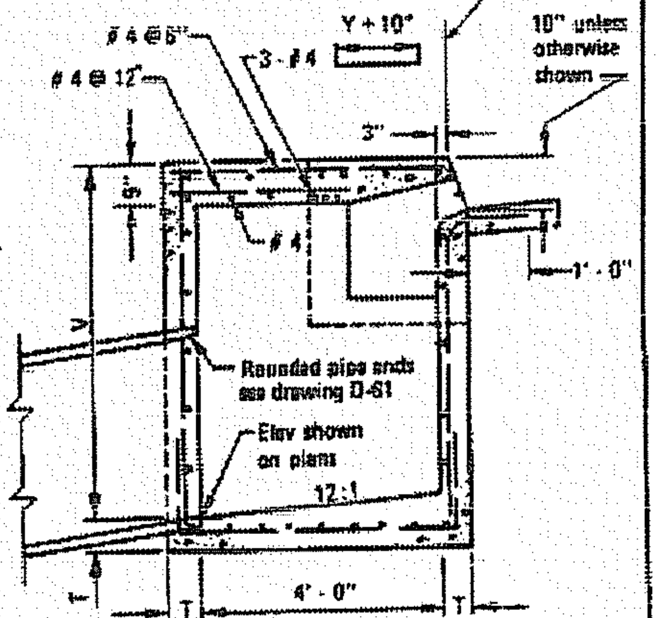

PLAN




SECTION B—B




SECTION C—C



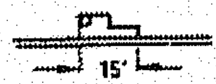

SECTION A—A

**NOTES:**

1. See Standard Drawings D-11 & D-12 for additional notes and details.
2. Types are designated as follows: (no wing) B, (one wing) B-1, (two wings) B-2.
3. Exposed edges of concrete shall be rounded with a radius of 1/2".
4. When V exceeds 4' steps shall be installed. See Standard Drawing D-11 for details.
5. Concrete gutter to match adjacent gutters.
6. An expansion joint shall be placed at the ends of the inlet where the curb is to adjoin.
7. Provide 1/4" tooled groove in top slab in line with back of adjacent curb.
8. Surface of top slab shall be sidewalk finished to drain toward street at a slope of 1/4" per foot.
9. Maintain 1 1/2" clear spacing between reinforcing and surface unless otherwise noted.

LEGEND ON PLANS

15' Type B-1 inlet




RECOMMENDED BY THE SAN DIEGO REGIONAL STANDARDS COMMITTEE

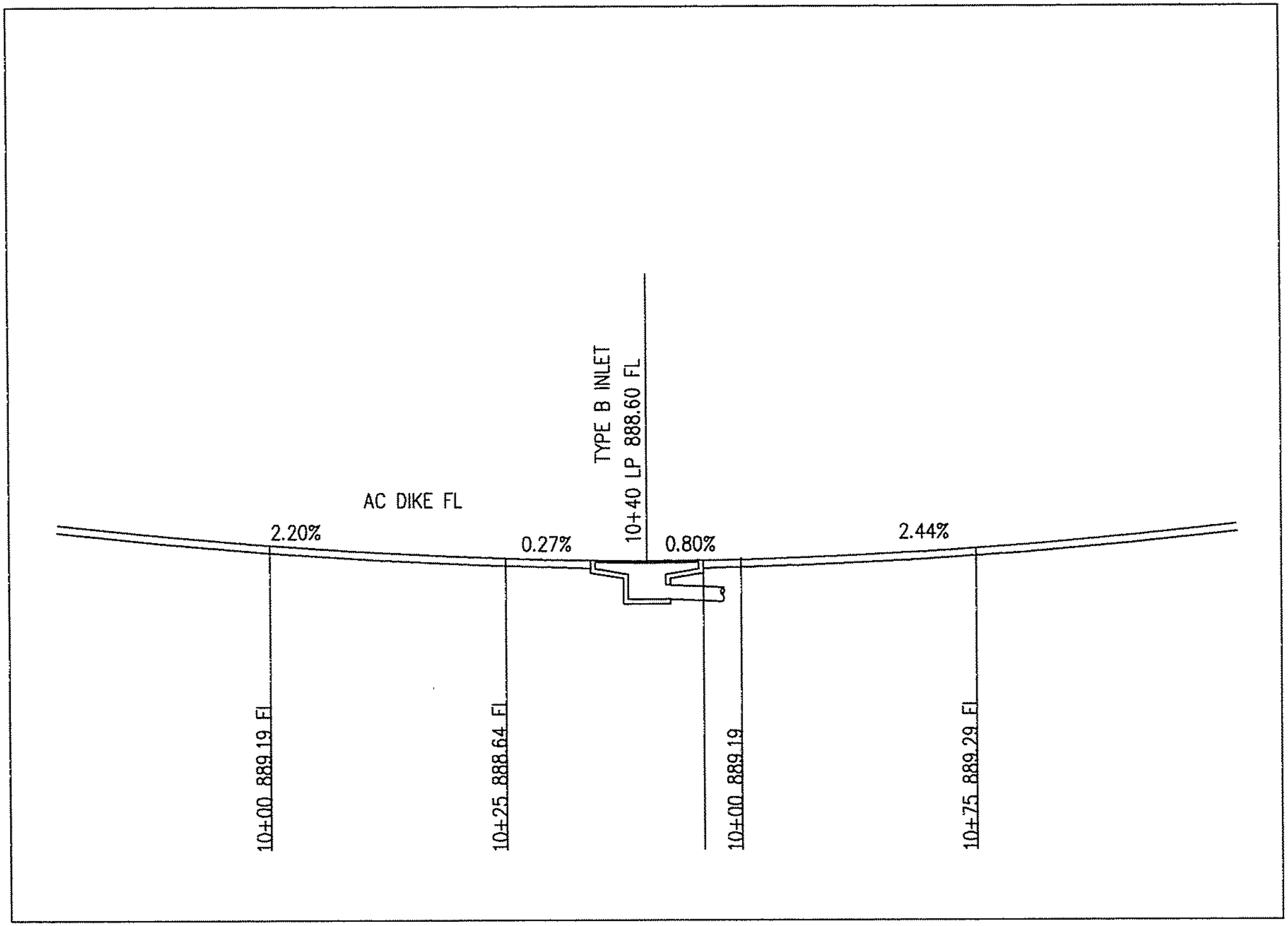
Chairman R.C.E. 15007 Date Dec. 1973

SAN DIEGO REGIONAL STANDARD DRAWING

# CURB INLET - TYPE B

DRAWING NUMBER **D-2**

| Revision | By | Approved | Date |
|---|---|---|---|
| Notes | [illegible] | O.S | 7-79 |
| Reference | [illegible] | M.B. | 10-82 |
| Rebar | [illegible] | M.B | 5-86 |
| Dash line | [illegible] | W.H | 7-88 |
| | | | |


AC DIKE FL
TYPE B INLET
10+40 LP 888.60 FL
2.20%
0.27%
0.80%
2.44%
10+00 889.19 FL
10+25 888.64 FL
10+00 889.19
10+75 889.29 FL

139

# Worksheet for SD subsytem B part 1
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | sd subsystem B part 1 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

**Input Data**

| | | |
|---|---|---|
| Channel Slope | 0.103800 | ft/ft |

Elevation range: 896.10 ft to 896.74 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 896.56 | 0.00 | 5.00 | 0.024 |
| 5.00 | 896.46 | 5.00 | 32.00 | 0.017 |
| 6.25 | 896.44 | 32.00 | 40.00 | 0.024 |
| 7.99 | 896.11 | | | |
| 8.00 | 896.10 | | | |
| 20.00 | 896.34 | | | |
| 32.00 | 896.58 | | | |
| 40.00 | 896.74 | | | |

| | | |
|---|---|---|
| Discharge | 2.30 | cfs |

**Results**

| | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.017 | |
| Water Surface Elevation | 896.23 | ft |
| Flow Area | 0.50 | $ft^2$ |
| Wetted Perimeter | 7.42 | ft |
| Top Width | 7.40 | ft |
| Height | 0.13 | ft |
| Critical Depth | 896.31 | ft |
| Critical Slope | 0.008920 | ft/ft |
| Velocity | 4.64 | ft/s |
| Velocity Head | 0.33 | ft |
| Specific Energy | 896.57 | ft |
| Froude Number | 3.16 | |

Flow is supercritical.

# Worksheet For SD Subsystem B part 2
## Worksheet for Circular Channel

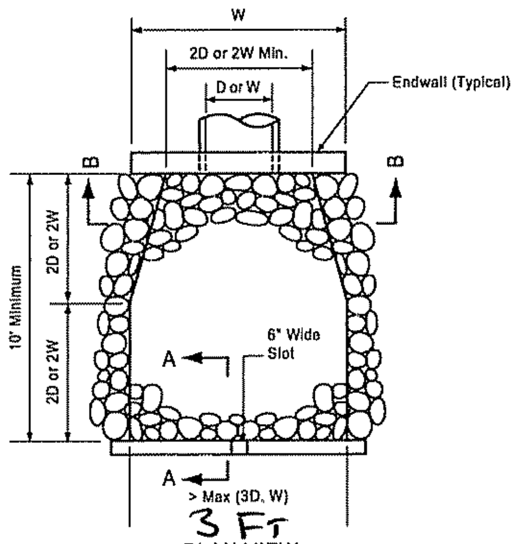
| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | CP1_6E |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Channel Slope | 0.007500 | ft/ft |
| Diameter | 12.00 | in |
| Discharge | 2.30 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.64 | ft |
| Flow Area | 0.53 | ft² |
| Wetted Perimeter | 1.86 | ft |
| Top Width | 0.96 | ft |
| Critical Depth | 0.65 | ft |
| Percent Full | 64.34 | |
| Critical Slope | 0.007318 | ft/ft |
| Velocity | 4.31 | ft/s |
| Velocity Head | 0.29 | ft |
| Specific Energy | 0.93 | ft |
| Froude Number | 1.02 | |
| Maximum Discharge | 3.32 | cfs |
| Full Flow Capacity | 3.09 | cfs |
| Full Flow Slope | 0.004168 | ft/ft |
| Flow is supercritical. | | |

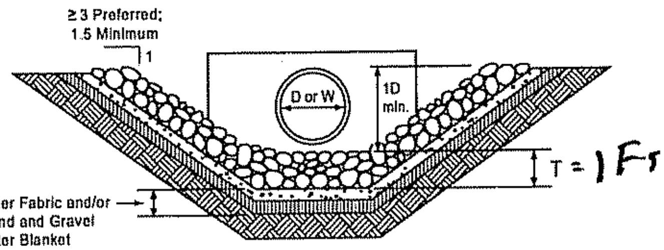
D = 1'
W = 2'

L = 10'




PLAN VIEW

1 FT =




TYPICAL SECTION B-B

# SD Subsystem B part 3
## Worksheet for Triangular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | SD subsystem b part 3 |
| Flow Element | Triangular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.040 | |
| Channel Slope | 0.165000 | ft/ft |
| Left Side Slope | 5.000000 | H : V |
| Right Side Slope | 5.000000 | H : V |
| Discharge | 2.30 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.32 | ft |
| Flow Area | 0.52 | $ft^2$ |
| Wetted Perimeter | 3.29 | ft |
| Top Width | 3.23 | ft |
| Critical Depth | 0.42 | ft |
| Critical Slope | 0.040244 | ft/ft |
| Velocity | 4.41 | ft/s |
| Velocity Head | 0.30 | ft |
| Specific Energy | 0.63 | ft |
| Froude Number | 1.94 | |
| Flow is supercritical. | | |

# Worksheet SD subsytem B part 4
## Worksheet for Rectangular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | SD SUBSYTEM b PART 4 |
| Flow Element | Rectangular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

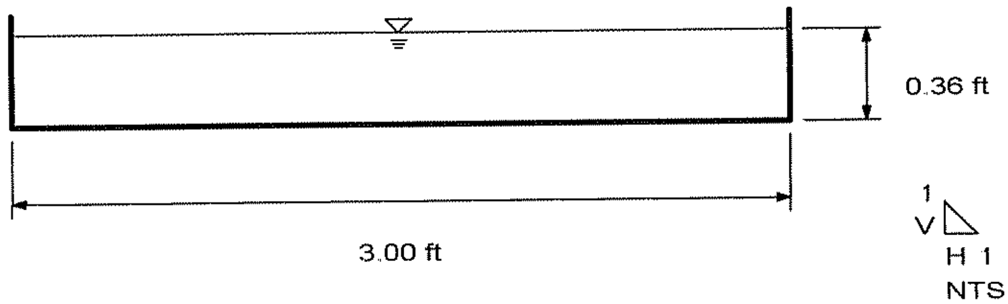
| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.045 | |
| Channel Slope | 0.021400 | ft/ft |
| Bottom Width | 3.00 | ft |
| Discharge | 2.30 | cfs |

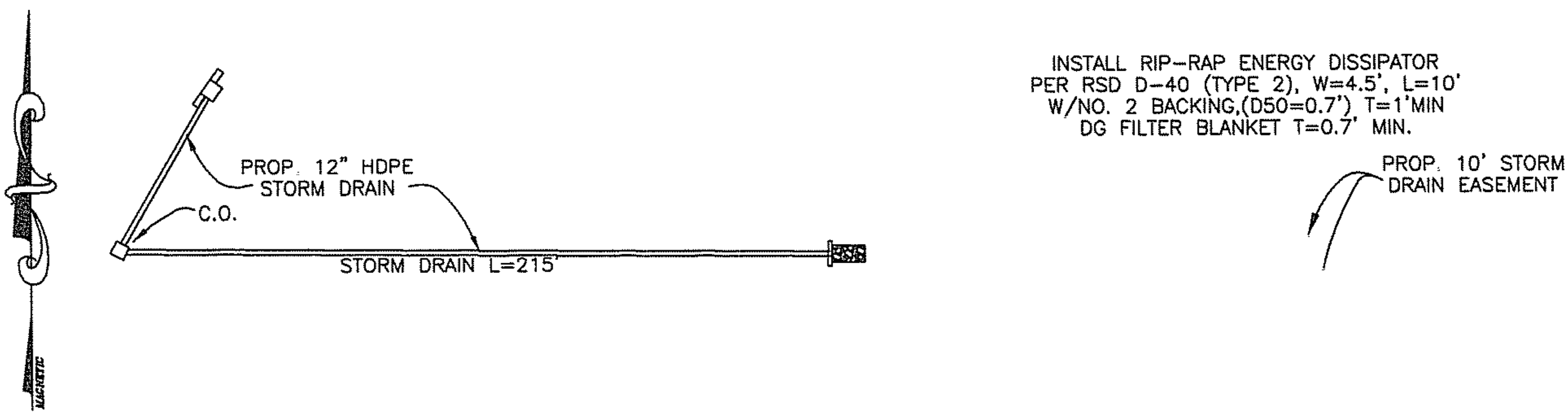
| Results | | | |
|---|---|---|---|
| Depth | 0.36 | ft | |
| Flow Area | 1.08 | $ft^2$ | |
| Wetted Perimeter | 3.72 | ft | |
| Top Width | 3.00 | ft | |
| Critical Depth | 0.26 | ft | |
| Critical Slope | 0.057114 | ft/ft | |
| Velocity | 2.12 | ft/s | ok < 4.31 ft/s |
| Velocity Head | 0.07 | ft | |
| Specific Energy | 0.43 | ft | |
| Froude Number | 0.62 | | |
| Flow is subcritical. | | | |

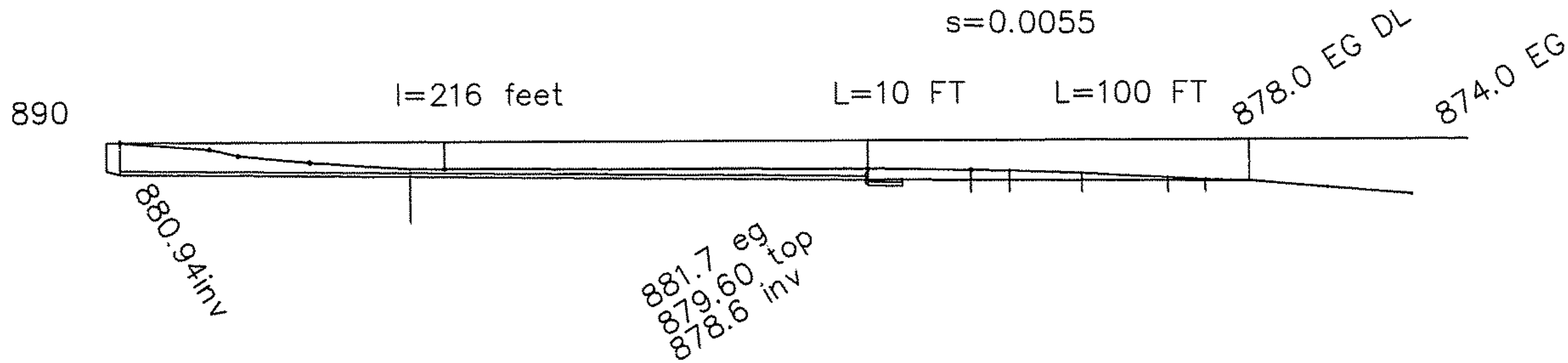
# Cross Section
## Cross Section for Rectangular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | Rip Rap Worksheet for Lot No. 6 |
| Flow Element | Rectangular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Section Data | | |
|---|---|---|
| Mannings Coefficient | 0.045 | |
| Channel Slope | 0.021400 | ft/ft |
| Depth | 0.36 | ft |
| Bottom Width | 3.00 | ft |
| Discharge | 2.30 | cfs |






STORM DRAIN SUB SYSTEM B

HYDRAULIC EXHIBIT FOR: TM 5469

# POST-DEVELOPMENT CONDITIONS

PLATE NO.

NOT TO SCALE

# V Calc's Sta 14+60 CP2 part 1
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V Calc's Street A Sta 14+40 BASIN CP2 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

Input Data

Channel Slope 0.166700 ft/ft

Elevation range: 873.43 ft to 873.74 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 873.74 | 0.00 | 8.00 | 0.024 |
| 5.00 | 873.49 | 8.00 | 20.00 | 0.017 |
| 6.00 | 873.47 | | | |
| 8.00 | 873.43 | | | |
| 20.00 | 873.67 | | | |

Discharge 3.30 cfs

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.020 | |
| Water Surface Elevation | 873.55 | ft |
| Flow Area | 0.66 | ft² |
| Wetted Perimeter | 10.19 | ft |
| Top Width | 10.18 | ft |
| Height | 0.12 | ft |
| Critical Depth | 873.63 | ft |
| Critical Slope | 0.011502 | ft/ft |
| Velocity | 4.97 | ft/s |
| Velocity Head | 0.38 | ft |
| Specific Energy | 873.93 | ft |
| Froude Number | 3.44 | |
| Flow is supercritical. | | |

# V100 Sta 15+ For CP2 part 2
## Worksheet for Triangular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | V100 Estimate for CP2 POSTDEV |
| Flow Element | Triangular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.045 | |
| Channel Slope | 0.100000 | ft/ft |
| Left Side Slope | 4.000000 | H : V |
| Right Side Slope | 4.000000 | H : V |
| Discharge | 3.30 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.46 | ft |
| Flow Area | 0.86 | $ft^2$ |
| Wetted Perimeter | 3.81 | ft |
| Top Width | 3.70 | ft |
| Critical Depth | 0.53 | ft |
| Critical Slope | 0.047800 | ft/ft |
| Velocity | 3.86 | ft/s |
| Velocity Head | 0.23 | ft |
| Specific Energy | 0.69 | ft |
| Froude Number | 1.41 | |
| Flow is supercritical. | | |

# Velocity calc's Worksheet for CP2 part 3
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | e:\program files\engineering\haestad\fmw\ridge cr.fm2 |
| Worksheet | VELOCITY ESTIMATE BASIN S2 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

Input Data

Channel Slope 0.107100 ft/ft

Elevation range: 815.00 ft to 825.00 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 825.00 | 0.00 | 250.00 | 0.030 |
| 70.00 | 820.00 | | | |
| 150.00 | 815.00 | | | |
| 200.00 | 820.00 | | | |
| 250.00 | 825.00 | | | |

Discharge 3.30 cfs

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.030 | |
| Water Surface Elevation | 815.25 | ft |
| Flow Area | 0.82 | $ft^2$ |
| Wetted Perimeter | 6.53 | ft |
| Top Width | 6.51 | ft |
| Height | 0.25 | ft |
| Critical Depth | 815.33 | ft |
| Critical Slope | 0.023974 | ft/ft |
| Velocity | 4.05 | ft/s |
| Velocity Head | 0.25 | ft |
| Specific Energy | 815.51 | ft |
| Froude Number | 2.02 | |
| Flow is supercritical. | | |

# APPENDIX E

4.24

## REFERENCE PLANS AND EXHIBITS

L 9

maps

# APPENDIX F

4.25

## REFERENCE INFORMATION AND REFERENCES

L9

maps

can accelerate the decomposition of metal through rusting (oxidation). Metallic pipe is not recommended for culverts with flow in excess of 10 ft/s when high bed load and/or transport of abrasive material is anticipated without application of a protective coating. When protection is warranted, the invert of the pipe (i.e., the bottom 90 degrees of the pipe) shall be protected on all straight-aways, and the invert and walls (i.e., the lower 180 degrees of the pipe) shall be protected on all curves.

### B.3.1 Corrugated Aluminum Pipe(CAP)

Corrugated aluminum is recommended for sea water applications, but should not be used when excessive wear from abrasive materials are present or expected in the flow.

- Aluminum alloy conduit may be used where the minimum resistivity of the soil, backfill, and effluent and the pH of the water and soil falls within the ranges specified below:

| Resistivity | Acidity (pH) |
|---|---|
| 500 ohm-cm | $5.5<pH<8.5$ |
| 1500 ohm-cm | $5.0<pH<5.5$ or $8.5<pH<9.0$ |

- Pipe gage shall be selected to achieve minimum design life based upon Figure B-1. Minimum pipe thickness shall be 14 ga. Table B-5 may be used to determine addition service life due to application of protective coatings. For sea water applications, specify the next heavier gage than the gage calculated from Figure B-1.
- Minimum cover shall be 2 ft, or 1 ft below pavement subgrade, whichever is greater.
- Maximum cover shall be 15 ft.
- Neoprene gaskets shall conform to ASTM D-1506.

## B.4 CORRUGATED METAL PIPE (CMP)

Corrugated metal pipe conduit is not appropriate for sea water exposure. In cases where a pipe is expected to carry a large amount of debris or abrasive sediment material, it shall have measures to provide sufficient design life for the facility.

- Pipe gage shall be selected to achieve minimum design life based upon Figure B-1. Minimum pipe thickness shall be 14 ga. Table B-5 may be used to determine addition service life due to application of protective coatings.
- When placed under unpaved areas or under flexible pavement, the minimum cover for CMP shall be 2 ft or one-half the pipe diameter ($0.5D_o$), whichever is greater
- When placed under rigid pavements, the minimum cover for CMP shall be 1.2 feet below slab or one-half the pipe diameter ($0.5D_o$), whichever is greater.
- Maximum cover over CMP shall be determined by corrugation type, pipe diameter, and thickness as described in Table B-6 and Table B-7.

## B.5 HIGH DENSITY POLYETHYLENE PIPE (HDPE)

### B.5.1 General Requirements

- HDPE pipe shall conform to current American Association of State Highway and Transportation Officials (AASHTO). Pipes with a diameter of 4 inches through 36 inches shall conform to AASHTO designation M-294, Type S (Smooth Interior).

Pipes with a diameter of 42 inches through 48 inches shall conform to AASHTO designation M-294, Type D.

- The last 16 feet (typically two sections) at each exposed end of a culvert shall be constructed of reinforced concrete pipe (RCP).
- HDPE is not permitted in areas with running ground water or in areas with unstable trench walls.

## B.5.2 HDPE Pipes 48 in Diameter and Smaller

- Pipe shall be backfilled with crushed rock in accordance with Regional Standard Drawing No. S-4, Type C rock envelope, including appropriate filter fabric lining.
- The remainder of the trench shall be backfilled with the specified backfill material compacted to 90 percent Relative Compaction per California Test Method 216, as modified by the County of San Diego or ASTM D-1557, except for the portion in the pavement subgrade, which shall be compacted to 95 percent Relative Compaction.
- Pipe with less than 2 feet of cover under highway loading shall be concrete-encased in accordance with Regional Standard Drawing No. S-7. The portion above the encasement shall be backfilled and compacted in accordance with the paragraph above.
- Maximum pipe cover shall not exceed the amount specified in the current Caltrans Design Manual.

## B.5.3 HDPE Pipes Larger than 48 in

- Maximum fill height over the pipe shall not exceed 19.5 ft.
- 54-in and 60-in diameter corrugated HDPE shall be backfilled with concrete, slurry cement, or other "flowable fill material" satisfying Caltrans specifications. At minimum, this backfill shall be brought to a depth equivalent to 3/4 the pipe diameter.
- Trench width shall be a minimum of 1 ft wider than the outside diameter of the pipe on each side, in accordance with Caltrans Standard Specification 19-3.0062.
- Material placed above the level of the concrete backfill shall meet minimum Caltrans requirements for embankment material. Rocks, broken concrete, or other solid materials larger than 3 inches shall not be placed within 1 foot of the pipe. Compaction shall conform to Caltrans Standard Specification Section 19-5.
- When 54-in or 60-in diameter corrugated HDPE pipe is placed under rigid pavement with 3 feet or less of cover, the pipe shall be backfilled with concrete (or equivalent flowable fill material) to a level a minimum of 6 inches above the soffit of the pipe.
- When 54-in or 60-in diameter corrugated HDPE pipe is placed under flexible pavement with between 2 feet and 3 feet of cover, the pipe shall be backfilled with concrete (or equivalent flowable fill material) to a level a minimum of 6 inches above the soffit of the pipe. Pipes with less than 2 feet of cover require concrete backfill Highway Design Manual Index 854.9.

## B.6 REFERENCES

City of San Diego. Drainage Design Manual. (April 1984). Document No. 768917.

County of San Diego Department of Public Works. (April 1993). Hydraulic Design and Procedure Manual.

County of San Diego Materials Lab. (2004). Memorandum: Requirements for Utilization of HDPE for Public/Private Improvements and Comments Regarding Metallic Pipe Subject to Scour. Intradepartmental Correspondence. January 14, 2004.

**Table 5-13** Maximum Permissible Velocities for Lined and Unlined Channels

| Material or Lining | Maximum Permissible Average Velocity* (ft/sec) |
|---|---|
| **Natural and Improved Unlined Channels** | |
| Fine Sand, Colloidal | 1.50 |
| Sandy Loam, Noncolloidal | 1.75 |
| Silt Loam, Noncolloidal | 2.00 |
| Alluvial Silts, Noncolloidal | 2.00 |
| Ordinary Firm Loam | 2.50 |
| Volcanic Ash | 2.50 |
| Stiff Clay, Very Colloidal | 3.75 |
| Alluvial Silts, Colloidal | 3.75 |
| Shales And Hardpans | 6.00 |
| Fine Gravel | 2.50 |
| Graded Loam To Cobbles When Noncolloidal | 3.75 |
| Graded Silts To Cobbles When Colloidal | 4.00 |
| Coarse Gravel, Noncolloidal | 4.00 |
| Cobbles And Shingles | 5.00 |
| Sandy Silt | 2.00 |
| Silty Clay | 2.50 |
| Clay | 6.00 |
| Poor Sedimentary Rock | 10.0 |
| **Fully-Lined Channels** | |
| Unreinforced Vegetation | 5.0 |
| Reinforced Turf | 10.0 |
| Loose Riprap | per Table 5-2 |
| Grouted Riprap | 25.0 |
| Gabions | 15.0 |
| Soil Cement | 15.0 |
| Concrete | 35.0 |

** Maximum permissible velocity listed here is basic guideline; higher design velocities may be used, provided appropriate technical documentation from manufacturer.*

## Footnotes to Table 1

[1] Estimates are by Bureau of Public Roads unless otherwise noted.

[2] Ranges indicated for closed conduits and for open channels, lined or excavated, are for good to fair construction (unless otherwise stated). For poor quality construction, use larger values of n.

[3] *Friction Factors in Corrugated Metal Pipe*, by M. J. Webster and L. R. Metcalf, Corps of Engineers, Department of the Army; published in Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, vol. 85, No. HY9, Sept. 1959, Paper No. 2148, pp. 35-67.

[4] For important work and where accurate determination of water profiles is necessary, the designer is urged to consult the following references and to select n by comparison of the specific conditions with the channels tested:

*Flow of Water in Irrigation and Similar Channels*, by F. C. Scobey, Division of Irrigation, Soil Conservation Service, U.S. Department of Agriculture, Tech. Bull. No. 652, Feb. 1939; and

*Flow of Water in Drainage Channels*, by C. E. Ramser, Division of Agricultural Engineering, Bureau of Public Roads, U.S. Department of Agriculture, Tech. Bull. No. 129, Nov. 1929.

[5] With channel of an alinement other than straight, loss of head by resistance forces will be increased. A small increase in value of n may be made, to allow for the additional loss of energy.

[6] *Handbook of Channel Design for Soil and Water Conservation*, prepared by the Stillwater Outdoor Hydraulic Laboratory in cooperation with the Oklahoma Agricultural Experiment Station; published by the Soil Conservation Service, U.S. Department of Agriculture, Publ. No. SCS-TP-61, Mar. 1947, rev. June 1954.

[7] *Flow of Water in Channels Protected by Vegetative Linings*, by W. O. Ree and V. J. Palmer, Division of Drainage and Water Control, Research, Soil Conservation Service, U.S. Department of Agriculture, Tech. Bull. No. 967, Feb. 1949.

[8] For calculation of stage or discharge in natural stream channels, it is recommended that the designer consult the local District Office of the Surface Water Branch of the U.S. Geological Survey, to obtain data regarding values of n applicable to streams of any specific locality. Where this procedure is not followed, the table may be used as a guide. The values of n tabulated have been derived from data reported by C. E. Ramser (see footnote 4) and from other incomplete data.

[9] The tentative values of n cited are principally derived from measurements made on fairly short but straight reaches of natural streams. Where slopes calculated from flood elevations along a considerable length of channel, involving meanders and bends, are to be used in velocity calculations by the Manning formula, the value of n must be increased to provide for the additional loss of energy caused by bends. The increase may be in the range of perhaps 3 to 15 percent.

[10] The presence of foliage on trees and brush under flood stage will materially increase the value of n. Therefore, roughness coefficients for vegetation in leaf will be larger than for bare branches. For trees in channel or on banks, and for brush on banks where submergence of branches increases with depth of flow, n will increase with rising stage.

### Table 2.—Permissible velocities for channels with erodible linings, based on uniform flow in continuously wet, aged channels [1]

| Soil type or lining (earth; no vegetation) | Maximum permissible velocities for— | | |
|---|---|---|---|
| | Clear water | Water carrying fine silts | Water carrying sand and gravel |
| | *F.p.s.* | *F.p.s.* | *F.p.s.* |
| Fine sand (noncolloidal) | 1.5 | 2.5 | 1.5 |
| Sandy loam (noncolloidal) | 1.7 | 2.5 | 2.0 |
| Silt loam (noncolloidal) | 2.0 | 3.0 | 2.0 |
| Ordinary firm loam | 2.5 | 3.5 | 2.2 |
| Volcanic ash | 2.5 | 3.5 | 2.0 |
| Fine gravel | 2.5 | 5.0 | 3.7 |
| Stiff clay (very colloidal) | 3.7 | 5.0 | 3.0 |
| Graded, loam to cobbles (noncolloidal) | 3.7 | 5.0 | 5.0 |
| Graded, silt to cobbles (colloidal) | 4.0 | 5.5 | 5.0 |
| Alluvial silts (noncolloidal) | 2.0 | 3.5 | 2.0 |
| Alluvial silts (colloidal) | 3.7 | 5.0 | 3.0 |
| Coarse gravel (noncolloidal) | 4.0 | 6.0 | 6.5 |
| Cobbles and shingles | 5.0 | 5.5 | 6.5 |
| Shales and hard pans | 6.0 | 6.0 | 5.0 |

[1] As recommended by Special Committee on Irrigation Research, American Society of Civil Engineers, 1926.

### Table 3.—Permissible velocities for channels lined with uniform stands of various grass covers, well maintained [1] [2]

| Cover | Slope range | Permissible velocity on— | |
|---|---|---|---|
| | | Erosion resistant soils | Easily eroded soils |
| | *Percent* | *F.p.s.* | *F.p.s.* |
| Bermudagrass | 0–5 | 8 | 6 |
| | 5–10 | 7 | 5 |
| | Over 10 | 6 | 4 |
| Buffalograss; Kentucky bluegrass; Smooth brome; Blue grama | 0–5 | 7 | 5 |
| | 5–10 | 6 | 4 |
| | Over 10 | 5 | 3 |
| Grass mixture | 0–5 | 5 | 4 |
| | 5–10 | 4 | 3 |
| Lespedeza sericea; Weeping lovegrass; Yellow bluestem; Kudzu; Alfalfa; Crabgrass | 0–5 | 3.5 | 2.5 |
| Common lespedeza [3]; Sudangrass [3] | [4] 0–5 | 3.5 | 2.5 |

[1] From *Handbook of Channel Design for Soil and Water Conservation* (see footnote 6, table 1, above).

[2] Use velocities over 5 f.p.s. only where good covers and proper maintenance can be obtained.

[3] Annuals, used on mild slopes or as temporary protection until permanent covers are established.

[4] Use on slopes steeper than 5 percent is not recommended.

### Table 4.—Factors for adjustment of discharge to allow for increased resistance caused by friction against the top of a closed rectangular conduit [1]

| $D/B$ | Factor |
|---|---|
| 1.00 | 1.21 |
| .90 | 1.24 |
| .75 | 1.25 |
| .667 | 1.27 |
| .60 | 1.28 |
| .50 | 1.31 |
| .40 | 1.34 |

[1] Interpolations may be made. See derivation of factors on p. 9.

### Table 5.—Guide to selection of retardance curve

| Average length of vegetation | Retardance curve for— | |
|---|---|---|
| | Good stand | Fair stand |
| 6–10 inches | C | D. |
| 2–6 inches | D | D. |

# Appendix B. Excerpts of Caltrans Specifications

## SECTION 72
## SLOPE PROTECTION

### 72-1 GENERAL

**72-1.01 Description.**—Slope protection consists of rock, concrete, concreted-rock or slope paving. The type of slope protection to be used will be designated in the Engineer's Estimate, the special provisions or shown on the plans. The slope protection shall be placed in conformance with these specifications, the special provisions, and the details and dimensions shown on the plans or directed by the Engineer.

### 72-2 ROCK SLOPE PROTECTION

**72-2.01 Description.**—This work shall consist of placing revetment type rock courses on the slopes.

The mass of the individual pieces of rock in each class shall be as indicated in the table in Section 72-2.02, "Materials," or as specified in the special provisions. The classes of rock slope protection will be designated in the Engineer's Estimate as 8T, 4T, 2T, 1T, 1/2T, 1/4T, Light, Facing, and No. 1, No. 2 or No. 3 Backing.

**72-2.02 Materials.**—The individual classes of rocks used in rock slope protection shall conform to the following, unless otherwise specified in the special provisions, or as shown on the plans.

GRADING OF ROCK SLOPE PROTECTION

**PERCENTAGE LARGER THAN***

| *Rock Mass* | *Method A Placement* | | | | | *Method B Placement* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Classes* | | | | | *Classes* | | | | | | | |
| | | | | | | | | | | | *Backing* | | |
| | *8T* | *4T* | *2T* | *1T* | *1/2T* | *1T* | *1/2T* | *1/4T* | *Light* | *Facing* | *No. 1* | *No. 2* | *No. 3* |
| 14.5-Tonne | 0-5 | — | — | — | — | — | — | — | — | — | — | — | — |
| 7.25-Tonne | 50-100 | 0-5 | — | — | — | — | — | — | — | — | — | — | — |
| 3.6-Tonne | 95-100 | 50-100 | 0-5 | — | — | — | — | — | — | — | — | — | — |
| 1.8-Tonne | — | 95-100 | 50-100 | 0-5 | — | 0-5 | — | — | — | — | — | — | — |
| 900-kg | — | — | 95-100 | 50-100 | 0-5 | 50-100 | 0-5 | — | — | — | — | — | — |
| 450-kg | — | — | — | 95-100 | 50-100 | — | 50-100 | 0-5 | — | — | — | — | — |
| 220-kg | — | — | — | — | 95-100 | 95-100 | — | 50-100 | 0-5 | — | — | — | — |
| 90-kg | — | — | — | — | — | — | 95-100 | — | 50-100 | 0-5 | 0-5 | — | — |
| 34-kg | — | — | — | — | — | — | — | 95-100 | — | 50-100 | 50-100 | 0-5 | — |
| 11-kg | — | — | — | — | — | — | — | — | 95-100 | 90-100 | 90-100 | 25-75 | 0-5 |
| 2.2-kg | — | — | — | — | — | — | — | — | — | — | — | 90-100 | 25-75 |
| 0.4-kg | — | — | — | — | — | — | — | — | — | — | — | — | 90-100 |

* The amount of material smaller than the smallest rock mass listed in the table for any class of rock slope protection shall not exceed the percentage limit listed in the table determined on a mass basis. Compliance with the percentage limit shown in the table for all other rock masses of the individual pieces of any class of rock slope protection shall be determined by the ratio of the number of individual pieces larger than the specified rock mass compared to the total number of individual pieces larger than the smallest rock mass listed in the table for that class.

The material shall also conform to the following quality requirements:

| *Test* | *California Test* | *Requirement* |
|---|---|---|
| Apparent Specific Gravity | 206 | 2.5 min. |
| Absorption | 206 | 4.2% max.* |
| Durability Index | 229 | 52 min.* |

$$\frac{\text{Coarse Durability Index}}{\%\ \text{Absorption} + 1} = \text{Durability Absorption Ratio (DAR)}$$

* Based on the formula contained herein, absorption may exceed 4.2 percent if DAR is greater than 10. Durability Index may be less than 52 if DAR is greater than 24.

Rocks, when conforming to the provisions in this Section 72-2.02, may be obtained from rock excavation of the roadway prism or other excavation being performed under the provisions of the contract, in accordance with the provisions in Section 4-1.05, "Use of Materials Found on the Work."

Rocks shall be of such shape as to form a stable protection structure of the required section. Rounded boulders or cobbles shall not be used on prepared ground surfaces having slopes steeper than 1:2 (vertical:horizontal). Angular shapes may be used on any planned slope. Flat or needle shapes will not be accepted unless the thickness of the individual pieces is greater than 0.33 times the length.

**72-2.025 Rock Slope Protection Fabric.**—Rock slope protection fabric shall be placed prior to placing rock slope protection, when the fabric is shown on the plans, or specified in the special provisions, or ordered by the Engineer.

Rock slope protection fabric shall conform to the provisions in Section 88, "Engineering Fabrics," and shall be placed in accordance with the details shown on the plans and as specified in these specifications.

Prior to placing rock slope protection fabric, the surfaces upon or against which rock slope protection fabric is to be placed, shall be free of loose or extraneous material and sharp objects that may damage the fabric during installation.

Rock slope protection fabric shall be handled and placed in accordance with the manufacturer's recommendations and as directed by the Engineer. Rock slope protection fabric shall be placed loosely upon or against the surface to receive the fabric so that the fabric conforms to the surface without damage when the cover material is placed.

Rock slope protection fabrics shall be joined, at the option of the Contractor, either with overlapped joints or stitched seams.

When fabric is joined with overlapped joints all adjacent borders of the fabric shall be overlapped not less than 600 mm. The fabric shall be placed such that the fabric being placed shall overlap the adjacent section of fabric in the direction the cover material is being placed.

When the fabric is joined by stitched seams, the fabric shall be stitched with yarn of a contrasting color. The size and composition of the yarn shall be as recommended by the fabric manufacturer. The number of stitches per 25 mm of seam shall be approximately 5 to 7. The strength of stitched seams shall be the same as specified for the fabric, except when stitched seams are oriented up and down a slope the strength shall be a minimum of 80 percent of that specified for the fabric.

Equipment or vehicles shall not be operated or driven directly on the rock slope protection fabric.

Rock slope protection fabric damaged during placement shall be replaced or repaired, as directed by the Engineer, by the Contractor at the Contractor's expense. Fabric damaged beyond repair, as determined by the Engineer, shall be replaced. Repairing damaged fabric shall consist of placing new fabric over the damaged area. The minimum fabric overlap from the edge of the damaged area shall be one meter for overlap joints. If the new fabric joints at the damaged areas are joined by stitching, the stitched joints shall conform to the requirements specified herein.

**72-2.03 Placing.**—Rock slope protection shall be placed in accordance with one of the following methods as designated in the Engineer's Estimate.

### Method A Placement

A footing trench shall be excavated along the toe of slope as shown on the plans.

The larger rocks shall be placed in the footing trench.

Rocks shall be placed with their longitudinal axis normal to the embankment face and arranged so that each rock above the foundation course has a 3-point bearing on the underlying rocks. Foundation course is the course placed on the slope in contact with the ground surface. Bearing on smaller rocks which may be used for chinking voids will not be acceptable. Placing of rocks by dumping will not be permitted.

Local surface irregularities of the slope protection shall not vary from the planned slope by more than 0.3-m measured at right angles to the slope.

### Method B Placement

A footing trench shall be excavated along the toe of the slope as shown on the plans.

Rocks shall be so placed as to provide a minimum of voids and the larger rocks shall be placed in the toe course and on the outside surface of the slope protection. The rock may be placed by dumping and may be spread in layers by bulldozers or other suitable equipment.

Local surface irregularities of the slope protection shall not vary from the planned slopes by more than 0.3-m measured at right angles to the slope.

At the completion of slope protection work, the footing trench shall be filled with excavated material and compaction will not be required.

**72-2.04 Measurement.**—Rock slope protection will be measured by the tonne or cubic meter as designated in the Engineer's Estimate.

Quantities of rock slope protection to be paid for by the cubic meter will be determined from the dimensions shown on the plans or the dimensions directed by the Engineer and rock slope protection placed in excess of these dimensions will not be paid for.

Quantities of rock slope protection to be paid for by the tonne will be weighed in accordance with the provisions in Section 9-1.01, "Measurement of Quantities."

Rock slope protection fabric will be measured by the square meter. The quantity to be paid for will be the actual area covered not including additional fabric required for overlaps.

**72-2.05 Payment.**—The contract price paid per cubic meter or per tonne for rock slope protection (the class of rock and method of placement to be designated in the Engineer's Estimate) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the rock slope protection, complete in place, including excavation, and backfilling footing trenches, as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.

The contract price paid per square meter for rock slope protection fabric shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and placing rock slope protection fabric, complete in place, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

## 72-5 CONCRETED-ROCK SLOPE PROTECTION

**72-5.01 Description.**—This work shall consist of placing revetment type concreted-rock courses on the slopes.

The rock slope protection shall be concreted as shown on the plans and as specified in these specifications and the special provisions.

The mass of the individual pieces of rock in each class shall be as indicated in the table in Section 72-5.02, "Materials," or as specified in the special provisions. The classes of concreted-rock slope protection will be designated in the Engineer's Estimate as 1/2T, 1/4T, Light, Facing, and Cobble.

**72-5.02 Materials.**—The individual classes of rocks used in concreted-rock slope protection shall conform to the following, unless otherwise specified in the special provisions or shown on the plans.

GRADING OF CONCRETED-ROCK SLOPE PROTECTION

| *Rock Mass* | PERCENTAGE LARGER THAN* *Classes* | | | | |
|---|---|---|---|---|---|
| | *1/2T* | *1/4T* | *Light* | *Facing* | *Cobble* |
| 900-kg | 0–5 | — | — | — | — |
| 450-kg | 50–100 | 0–5 | — | — | — |
| 220-kg | — | 50–100 | 0–5 | — | — |
| 90-kg | 90–100 | — | 50–100 | 0–5 | — |
| 34-kg | — | 90–100 | 90–100 | 50–100 | 0–5 |
| 11-kg | — | — | — | 90–100 | 95–100 |
| Minimum Penetration of Concrete (millimeters) | 450 | 350 | 250 | 200 | 150 |

* The amount of material smaller than the smallest rock mass listed in the table for any class of concreted-rock slope protection shall not exceed the percentage limit listed in the table determined on a mass bases. Compliance with the percentage limit shown in the table for all other rock masses of the individual pieces of any class of concreted-rock slope protection shall be determined by the ratio of the number of individual pieces larger than the specified rock mass compared to the total number of individual pieces larger than the smallest rock mass listed in the table for that class.

The rock shall also conform to the following quality requirements:

| *Tests* | *California Test* | *Requirements* |
|---|---|---|
| Apparent Specific Gravity | 206 | 2.5 min. |
| Absorption | 206 | 4.2% max.* |
| Durability Index | 229 | 52 min.* |

$$\frac{\text{Coarse Durability Index}}{\text{\% Absorption} + 1} = \text{Durability Absorption Ratio (DAR)}$$

* Based on the formula contained herein, absorption may exceed 4.2 percent if DAR is greater than 10. Durability Index may be less than 52 if DAR is greater than 24.

Rocks, when conforming to the provisions in this Section 72-5.02, may be obtained from rock excavation of the roadway prism or other excavation being performed under the provisions of the contract, in accordance with the provisions in Section 4-1.05, "Use of Materials Found on the Work."

Rocks shall be of such shape as to form a stable protection structure of the required section. Flat or needle shapes will not be accepted unless the thickness of the individual pieces is greater than 0.33-times the length.

Concrete shall be Class 3 concrete or minor concrete conforming to the provisions in Section 90, "Portland Cement Concrete," using 25-mm combined aggregate and mixed as provided for structures. The water content of the concrete shall be such as to permit gravity flow into the interstices with limited spading and brooming. The amount of water used shall be that designated by the Engineer.

**72-5.03 Placing Rock.**—Rock for concreted-rock slope protection shall be placed in accordance with one of the following methods as designated in the Engineer's Estimate.

### Method A Placement

A footing trench shall be excavated along the toe of slope as shown on the plans.

The larger rocks shall be placed in the footing trench.

Rocks shall be placed with their longitudinal axis normal to the embankment face and arranged so that each rock above the foundation course has a 3-point bearing on the underlying rocks. Foundation course is the course placed on the slope in contact with the ground surface. Bearing on smaller rocks which may be used for chinking voids will not be acceptable. Placing of rocks by dumping will not be permitted.

Local surface irregularities of the slope protection shall not vary from the planned slope by more than 0.3-m measured at right angles to the slope.

### Method B Placement

A footing trench shall be excavated along the toe of the slope as shown on the plans.

Rocks shall be so placed as to provide a minimum of voids and the larger rocks shall be placed in the toe course and on the outside surface of the slope protection. The rock may be placed by dumping and may be spread in layers by bulldozers or other suitable equipment.

Local surface irregularities of the slope protection shall not vary from the planned slopes by more than 0.3-m measured at right angles to the slope.

At the completion of slope protection work, the footing trench shall be filled with excavated material and compaction will not be required.

**72-5.04 Placing Concrete.**—The surfaces of the rock to be concreted shall be cleaned of adhering dirt and clay and then moistened. The concrete shall be placed in a continuous operation for any day's run at any one location. Concrete shall be brought to the place of final deposit by use of chutes, tubes, or buckets, or may be placed by means of pneumatic equipment or other mechanical methods. In no case shall concrete be permitted to flow on the slope protection a distance in excess of 3 m.

Immediately after depositing, the concrete shall be spaded and rodded into place with suitable spades, trowels or other approved means until the minimum penetration is that shown in the table entitled "Grading of velocities to non-erosive or pre-project levels. In these cases, the engineer shall apply a reasonable design procedure to determine an appropriate riprap design.

#### 7.3.1.1 San Diego Regional Standard Drawing

*Apron Length and Width.* Riprap apron length and width are a function of the diameter or vertical dimension of the outlet pipe or culvert. The apron length shall be determined using the following equation, with a minimum length of 10 feet:

$$L_a = 4D_O \qquad (7\text{-}1)$$

where ....

$L_a$ = minimum riprap apron length (ft); and
$D_o$ = diameter or width of culvert or storm drain (ft).

Where there is a well-defined channel downstream of the apron, the bottom width of the riprap apron shall be at least equal to the bottom width of the channel. The riprap apron shall extend at least one foot above the maximum tailwater elevation or the computed water surface elevation, whichever is greater. The side slopes of the riprap apron shall be 3H:1V whenever practical, but in no case be steeper than 1.5H:1V.

Where there is no well-defined channel downstream of the apron, the upstream width of the riprap apron shall be equal to twice the width of conduit or the width of the headwall, whichever is greater. The downstream width of the riprap apron shall be at least the width of the upstream end of the apron, plus one conduit diameter ($D_o$) on each side. Figure 7-1 illustrates the layout of the San Diego regional standard riprap apron.

*Riprap Size and Thickness.* Flow energy governs the size of the riprap used for energy dissipation. The San Diego Regional Standard Drawings use exit velocity as a surrogate for flow energy (Table 7-1). Riprap apron thickness shall be at least 1.5 times the nominal $d_{50}$ of the specified riprap. Riprap shall be placed over a geotextile filter fabric, and a filter blanket material shall be placed under the fabric as appropriate. The equivalent diameter of stone ($d_{50}$) shall not exceed the diameter or vertical dimension of the outlet pipe, and the dimensions of the riprap apron shall be adjusted to accommodate the required stone size.

**Table 7-1** Rock Size for Riprap Aprons at Storm Drain Outlets

| Outlet Velocity (ft/s) | Rock Classification | Size of Stone, $d_{50}$ (ft) [a] |
|---|---|---|
| 6-10 | No. 2 Backing | 0.7 |
| 10-12 | ¼ Ton | 1.8 |
| 12-14 | ½ Ton | 2.3 |
| 14-16 | 1 Ton | 2.9 |
| 16-18 | 2 Ton | 3.6 |

*[a] Assumes specific weight of 165 lb/ft³. The designer shall take care to apply a unit weight that is applicable to the type of riprap specified for the project, and adjust their calculations if necessary*

### 7.3.2 Stilling Basins

There are a number of additional types of stilling basins, and it is beyond the scope of this Manual to provide detailed information on each of them. Information about their proper application and design can be obtained from a number of sources, including the FHWA *Hydraulic Design of Energy Dissipaters for Culverts and Channels* (HEC-14), the U.S. Army Corps of Engineers' *Hydraulic Design Criteria* and *Engineer Manuals*, the Bureau of

°200-1.6.1 Selection of Riprap and Filter Blanket Material

| Vel. Ft/Sec (1) | Rock Class (2) | Riprap Thickness "T" | Filter Blanket (3) Upper Layer(s) Opt. 1 Sec. 200 (4) | Opt. 2 Sec. 400 (4) | Opt. 3 (5) | Lower Layer (6) |
|---|---|---|---|---|---|---|
| 6-7 | No. 3 Backing | .6' | 3/16" | C2 | D.G. | — |
| 7-8 | No. 2 Backing | 1.0 | 1/4" | B3 | D.G. | — |
| 8-9.5 | Facing | 1.4 | 3/8" | — | D.G. | — |
| 9.5-11 | Light | 2.0 | 1/2" | — | 3/4", 1 1/2" P.B. | — |
| 11-13 | 1/4 Ton | 2.7 | 3/4" | — | 3/4", 1 1/2" P.B. | Sand |
| 13-15 | 1/2 Ton | 3.4 | 1" | — | 3/4", 1 1/2" P.B. | Sand |
| 15-17 | 1 Ton | 4.3 | 1 1/2" | — | Type B | Sand |
| 17-20 | 2 Ton | 5.4 | 2" | — | Type B | Sand |

Practical use of this table is limited to situations where "T" is less than D.

(1) Average velocity in pipe or bottom velocity in energy dissipator, whichever is greater.

MIRAFI [illegible]X or equivalent



(2) If desired riprap and filter blanket class is not available, use next larger class.

(3) Filter blanket thickness = 1 foot or "T", whichever is less.

(4) Standard Specifications for Public Works Construction.

(5) D.G. = Disintegrated Granite, 1 MM to 10 MM

P.B. = Processed Miscellaneous Base

Type B = Type B bedding material, (minimum 75% crushed particles, 100% passing 2 1/2" sieve, 10% passing 1" sieve)

(6) Sand 75% retained on #200 sieve.

SECTION 201 - CONCRETE, MORTAR AND RELATED MATERIALS

201-1 PORTLAND CEMENT CONCRETE

201-1.1.2 Concrete Specified By Class (Pg. 88)

In "Concrete Class Use Table" modify as follows:

(1) Revise:
Concrete Pavement (not integral with curb) 520-A-2500

To Read:
Concrete Pavement (not integral with curb), Cross Gutter and Alley Aprons 560-C-3250

(2) Revise:
Curb, Integral Curb and Pavement, Gutter, Walk, Alley Aprons 520-C-2500

To Read:
Curb and Gutter (separate or combined) and Walks 520-C-2500

(3) Change concrete class for "Sidehill Surface Drainage Facilities" from "500-C-"500" to "520-C-2500".

1991?

**Table 5-2. California Layered RSP**
SI metric (US customary values shown for OUTSIDE LAYER only)

| OUTSIDE LAYER RSP-CLASS * | INNER LAYERS RSP-CLASS * | BACKING CLASS No. * | RSP-FABRIC TYPE ** |
|---|---|---|---|
| 8 T (8 ton) | 2 T over 1/2 T | 1 | B |
| 8 T (8 ton) | 1 T over 1/4 T | 1 or 2 | B |
| 4 T (4 ton) | 1/2 T | 1 | B |
| 4 T (4 ton) | 1 T over 1/4 T | 1 or 2 | B |
| 2 T (2 ton) | 1/2 T | 1 | B |
| 2 T (2 ton) | 1/4 T | 1 or 2 | B |
| 1 T (1 ton) | LIGHT | NONE | B |
| 1 T (1 ton) | 1/4 T | 1 or 2 | B |
| 1/2 T (1/2 ton) | NONE | 1 | B |
| 1/4 T (1/4 ton) | NONE | 1 or 2 | A |
| LIGHT (LIGHT) | NONE | NONE | A |
| Backing No. 1*** (Backing No. 1) | NONE | NONE | A |

* Rock grading and quality requirements per Section 72-2.02 Materials of the Caltrans *Standard Specifications*. (See Appendix B).

** RSP-fabric Type of geotextile and quality requirements per Section 88-1.04 Rock Slope Protection Fabric of the Caltrans *Standard Specifications*. (See Appendix B). Type A RSP-fabric has lighter mass per unit area and it also has lower toughness (tensile x elongation, both at break) than Type B RSP-fabric. Both types require minimum permittivity of 0.5 per second.

*** "Facing" RSP-Class has same gradation as Backing No. 1.

Material property values were selected for the RSP-fabric in Section 88-1.04 of the Caltrans *Standard Specifications*, by assuming that construction inspectors will limit the maximum height of rockfall during placement to about 1 meter. End dumping of rock down embankments is not recommended, because rocks will damage and dislodge the RSP-fabric and the rock sizes will segregate.

**Determine RSP-Class of Outside Layer.**
With W in metric units, 247 lbs=112 Kgs determine
the RSP-*Class* of the outside layer of the revetment using Table 5-1.
Before proceeding, an explanation of the Caltrans standard RSP gradations and terminology is needed. For this discussion see Table 5-1, which is similar to page 72-1 Section 72-2.02 Materials of the 1995 Caltrans *Standard Specifications*. All the standard gradations are named **RSP-Classes**. Table 5-1 is divided into two sections with a bold dashed vertical line, which separates two construction methods of placing rock. "Method A" is for larger RSP-Classes, and "Method B" is for smaller RSP-Classes. Column headings listed immediately above the bold horizontal line are SI (metric) **names** of RSPClasses, and US Customary names are listed above the SI (metric) names. RSP-Classes are used on typical cross sections and plans and pay item descriptions in the engineer's estimate. In SI (metric) units they are: *8T, 4T, 2T, 1T, 1/2T, 1/4T, Light, Facing, Backing No. 1, Backing No. 2, and Backing No. 3*.
The label for each horizontal row is a STANDARD Rock SIZE or Rock Mass or Rock WEIGHT.
Method A Placement

| | |
|---|---|
| 4 ton | 0-5 |
| 2 ton | 50-100 |
| 1 ton | 95-100 |

Table 5-1. Guide for Determining RSP-Class of Outside Layer
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