HYDROLOGY REPORT
FOR
CORTARO FARMS ROAD
IMPROVEMENTS
UNION PACIFIC RAILROAD TO
THORNYDALE ROAD
(90% PLAN SUBMITTAL)
W.O. # 4TCFIT

October 31, 2002

Prepared by:

MMLA, Inc.
800 E. Wetmore Road, Suite 110
Tucson, AZ 85719

MMLA 99067-01-600

HYDROLOGY REPORT
FOR
CORTARO FARMS ROAD
IMPROVEMENTS
UNION PACIFIC RAILROAD TO
THORNYDALE ROAD
(90% PLAN SUBMITTAL)
W.O. # 4TCFIT

Location:
This project is located in portions of
Sections 25 and 26, Township 12 South, Range 12 East
and Section 30, Township 12 South, Range 13 East,
within Pima County, Arizona

Prepared for:
Pima County Department of Transportation
201 North Stone Avenue, 3rd Floor
Tucson, Arizona 85701

October 31, 2002

Prepared by:

MMLA Inc.
800 E. Wetmore Road, Suite 110
Tucson, AZ 85719

MMLA 99067-01-600

PIMA COUNTY DEPARTMENT OF TRANSPORTATION
REVIEW COMMENT & RESPONSE FORM

Project Name:	Cortaro Farms Road: UP Railroad to Thornydale Road	Project Engineer:	K. Palmer
Project Number:	4TCFIT	Consultant:	MMLA
Submittal:	Drainage (Hydrology) Report	Date:	6/4/02

Item	Page	Reviewer	Comment	Response
1.	6	PE	Table 1: CP3: the area should be 0.5 acre.	Table 1 has been revised.
2.	Fig. 2	PE	Sheets 1 and 2 of 3: watershed area between areas 17 and 18 is not accounted for, please verify.	There is a significant (400'±) overlap in the aerial mapping between Sheets 1 and 2 of Figure 2. The area east of C.P. 18 on Sheet 2 is part of Watershed 17. A concentration point identifier has been added to Sheet 2 in order to clarify the figure.
3.		FPM	There is a discrepancy between the Post-Developed WSEL for Cross-Section 2-A in Table 4 (2346.5 ft) and Figure 3 (2342.8 ft).	The Post-Developed WSEL for Cross-Section 2-A has been revised on Table 4 and Figure 3 to 2343.3.
4.	Fig. 3	FPM	Figure 3 does not display the Post-Developed WSEL for Cross-Section 2-B.	A new cross section (Cross-Section 2-B2) has been delineated at the upstream face of the proposed culvert, a short distance from existing Cross-Section 2-B to more accurately determine the proposed water surface elevation. A Post-Developed WSEL is provided at Cross-Section 2-B2 on Figure 3.
5.	Fig. 3	FPM	Figure 3 does not display Existing nor Post-Developed WSEL's for Cross-Section 24-D.	Cross Section 24-D extends beyond the limits of the available topography and does not appear on Figure 3.
6.		FPM	There is a discrepancy between Existing WSEL for Cross-Section 18-C in Table 4 (2288.8 ft) and Figure 3 (2291.0 ft).	The Existing WSEL for Cross-Section 18-C has been changed to 2293.1 in Table 4 and on Figure 3.
7.	Fig. 3	FPM	There is a discrepancy in drainage area and Q10 and Q100 data between Figure 3 and the Inlet Analysis Worksheet for Concentration Point G.	Figure 3 has been modified to reflect the data from the calculation sheets.
8.	Fig. 3	FPM	Q100 for Concentration Point N should read 10.0 cfs instead of 00.0 cfs.	Figure 3 has been corrected as noted.
9.	Fig. 3	FPM	There is a discrepancy between the Q10 displayed in Figure 3 (4.9 cfs) and the Inlet Analysis Worksheet (7.7 cfs) for Concentration Point Q.	Q10 on Figure 3 has been changed to 7.7 cfs for Concentration Point Q.
10.	Fig. 3	FPM	Figure 3 should show the 100-year discharges at the proposed culverts; only the 100-year discharge for Concentration Point 32 is displayed.	100-year discharges have been provided at the proposed culverts.

PIMA COUNTY DEPARTMENT OF TRANSPORTATION
REVIEW COMMENT & RESPONSE FORM

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Project Number:	4TCFIT	Consultant:	MMLA
Submittal:	Drainage (Hydrology) Report	Date:	6/4/02

Item	Page	Reviewer	Comment	Response
11.	Fig. 3	FPM	No floodplain boundaries are shown on Figure 3 for CP 32 and downstream CP's 26, 21, 20, 19, 18, 16, and 13.	The FEMA floodplain boundaries are provided in the vicinity of C.P. 32 and the floodplain downstream of C.P. 18 are provided on Figure 3. No floodplains are delineated for C.P. 13, 16, 19-21 and 26 because the discharges are less than 100 cfs and are not subject to Pima County regulatory floodplain delineation requirements. The floodplains at the upstream ends of these culverts represent design headwater ponding limits and are illustrated to show that there are no adverse ponding impacts to surrounding properties post construction.
12.	Fig. 3	Arroyo	Figure 3 should be modified to indicate the design discharges at each concentration point.	The design discharges for each concentration point are provided on Figure 3.
13.	Fig. 3	Arroyo	Table 4 indicates a significant increase in WSEL's at certain cross-sections as a result of the project (e.g. WS2: +5.3'; WS18: +2.8' and WS24: +1.1'). Discussion of the impacts to adjacent properties of these increased flow depths should be included within the report.	The increase in water surface elevation in Watershed 2 is due in part to watershed combinations that increase the 100-year discharge from 489 cfs to 511 cfs as well as the addition of the cross drainage structure. The floodplain and headwater ponding limits upstream of the proposed culverts illustrate that there are no adverse impacts to adjacent properties. This is reiterated in Section 3.4 of the drainage report.
14.	Fig. 3	Arroyo	No 100-year flood plain lines are shown downstream of CP18 of Figure 3.	A 100-year floodplain has been delineated downstream of C.P. 18 to the limits of the topograaphy.

PIMA COUNTY DEPARTMENT OF TRANSPORTATION
REVIEW COMMENT & RESPONSE FORM

Project Name:	Cortaro Farms Road: UP Railroad to Thornydale Road			Project Engineer:	K. Palmer
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Submittal:	Drainage (Hydrology) Report			Date:	6/4/02
Item	Page	Reviewer	Comment		Response
15.	Fig. 3	Arroyo	It is unclear how the "developed" 100-year WSEL's and floodplain lines were determined upstream of the proposed culverts since there is no cross-section at the upstream face of the proposed culverts (i.e., the control section for the upstream water surface profile). Additionally, headwater elevations are not provided on the culvert calculation sheets, only headwater depth. At a minimum, a hydraulic cross-section should be evaluated at the upstream face of the culvert, for existing and proposed conditions, to assess the impact of the proposed structure on water surface elevations. If the culvert creates a significant increase in WSEL, a backwater analysis should be performed to assess the upstream limits of the impact.		Design headwater elevations have been added to the Culvert Calculations section of Appendix 9.3. Cross sections have been added at the upstream face of culverts within regulatory floodplains and the proposed water surface elevations have been revised accordingly. Existing cross sections in the vicinity of these culverts are used for water surface elevation comparisons. There are no significant increases in WSEL, especially after the 2.1-foot vertical datum adjustment between NGVD 29 (existing cross-sections) and NAVD 88 (proposed cross-sections) is applied. Culvert design headwaters are compared with open-channel flow depths and the higher water surface is used to establish the floodplain boundaries. These higher water surfaces are projected upstream until either the limits of the available topography or the water surface coincides with existing water surface elevations.

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MMLA
McGovern MacVittie Lodge & Associates, Inc.

October 31, 2002

Joseph J. Antonio, P.E.
Town of Marana Development Services Center
3696 W. Orange Grove Road
Tucson, AZ 85741

Re: Cortaro Farms Road Drainage and TEP Right of Way
Drainage Report for 90% Plan Submittal
Pima County Work Order #4TCFIT
MMLA 99067-01-600

Dear Mr. Antonio:

This letter is provided in response to both the letter received from you, dated August 16, 2002 and the letter received from Dave Wostenberg, dated July 30, 2002. These letters addresed the Town of Marana's concerns regarding drainage facilities within the existing Cortaro Ranch subdivision and IHOP properties that will be altered as a result of the proposed improvements to Cortaro Farms Road. Per a meeting on October 16, 2002, these concerns were addressed and this letter summarizes the outcomes of the hydraulic analyses discussed during this meeting.

Due to changes in the right-of-way limits, the proposed construction activity will only affect the southern boundary of the IHOP basin. The roadway embankment fill slope will replace the existing basin side at a flatter side slope and to a higher top elevation, essentially increasing the basin volume from that which currently exists. Detention basin routings for this revised basin volume show that the post-construction 100-year discharge exiting the basin will decrease from 67 cfs to 66 cfs and the 100-year water surface elevation will decrease from 2162.51 to 2162.41. Flows from this basin will discharge to the west, as it currently does, through the outlet structures currently in place. These routing calculations are provided in Appendix 9.3 of the attached drainage report.

However, the roadway improvements will encroach significantly on the Cortaro Ranch retention basin, reducing the total basin volume from 4.47 acre-feet to 3.42 acre-feet. Due to the post-construction reduction in basin volume, an outlet structure is provided to ensure flows are safely contained within the basin up to a certain depth, then safely discharged when this depth is exceeded. A 5-foot long weir will be installed along the revised southern boundary of this basin,

which will coincide with the outer wall of the 2,670 2- 10' x 4' RCBC that will run between this basin and Cortaro Farms Road. Detention routings have been performed that incorporate the revised basin volume and the new outlet structure. The results of the basin routing, which are also provided in Appendix 9.3 of the attached drainage report, indicate that the maximum basin outflow during the 100-year event will be 48 cfs. The time that this peak discharge exits the basin is 31 minutes from the start of inflow into the basin, well below the 13.07-hour time to peak for the overall 3.15-square-mile watershed that impacts Cortaro Farms Road and flows north along the TEP easement adjacent to the UPRR tracks. The Cortaro Ranch basin outflow will have no appreciable impact on the magnitude of the 100-year peak discharge (740 cfs) or the water surface elevations at this location. The 0.14-square-mile (92.1-acre) watershed area intercepted by the proposed 2-10' x 4' RCBC, with its 9-minute time of concentration, represents a fraction of the overall 3.15-square-mile watershed area. Because of the small size of this sub-watershed, the quicker delivery of this area to its historic concentration point will have a minimal impact on the peak discharge along the TEP easement.

These hydraulic analyses are discussed in further detail in Section 3.9 of the Drainage Report provided as part of the 90% Roadway Plan Submittal.

Thank you for taking the time to review this letter and the attached drainage report. If you have any additional questions or concerns, please do not hesitate to contact me or Sheina Pool at (520) 292-2300.

Sincerely,

MMLA, Inc.

Thomas P. McGovern, P.E.
Principal
tmcgovern@mmla.com

MARANA

July 30, 2002

TOWN OF MARANA • DEVELOPMENT SERVICES CENTER

MMLA
800 E. Wetmore Rd., Suite 110
Tucson, AZ 85706

Attention: Brent Bartz – Project Manager

Re: Cortaro Farms Road Widening

Dear Mr. Bartz,

The Town of Marana has reviewed the 50% Submittal of the drainage report. During our review, items were noted as needing additional information, or revisions.

1) Placement of RCBC along Cortaro Farms Road, west of Hartman Lane will encroach and possibly eliminate some of the drainage improvements of the Cortaro Ranch Subdivsion. If improvements alter or diminish the drainage capacity of this subdivision, direct entry into the RCBC should be considered to account for these flows.
2) Cortaro Ranch Subdivision along Hartman Lane, the expansion of the right-of-way will eliminate some of the drainage improvements for Cortaro Ranch Subdivision. The flows originally handled by these improvements, both current and planned, should be accounted for by allowing direct entry into the RCBC.
3) Placement of RCBC along Cortaro Farms Road west of Cerius Stravenue will encroach and eliminate a portion of the drainage improvements for IHOP. The flows handled by these improvements should be addressed.

Items 2 and 3 have already been noted in previous discussions and correspondence. Item 1, however, had not been noted and has some substantial impacts. A copy of the Cortaro Ranch Master Drainage Report has been included to assist in quantifying these additional flows.

If you have any questions and/or comments please contact me at (520) 297-2920 ext. 227 or Joe Antonio at ext. 232.

Sincerely,

Dave Wostenberg, E.I.T.
Civil Engineering Aide

cc: Keith Palmer, Project Manager, PCDOT
Joe Antonio, Project Manager, Town of Marana

MARANA

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AUG 19 2002

TOWN OF MARANA • DEVELOPMENT SERVICES CENTER

August 16, 2002

Brent Bartz, P.E., Project Manager
MMLA
800 East Wetmore Road, Suite 110
Tucson, Arizona 85706

Re: Cortaro Farms Road Drainage and TEP Right-of-Way

Dear Brent Bartz,

At a meeting held August 14, 2002, Pima County and MMLA representatives made statements that the volume of storm water runoff impacting the 200-foot Tucson Electric Power right-of-way after Pima County's installation of drainage structures remains the same as that under present conditions.

In a letter dated July 11, 2002, Dave Wostenberg, for the Town of Marana, proposed that the drainage from the Cortaro Ranch subdivision and the IHOP have direct entry into the proposed RCBC. This would be necessary because the County's taking of additional right-of-way will eliminate some of the drainage infrastructure of the developments. Specifically the taking will reduce the Retention Basin and eliminate Channelization on the north side of Cortaro Farms Road (west of Hartman Lane) and the west side of Hartman Lane (north of Cortaro Farms). Removal of these structures will result in having to accommodate approximately 200 cfs of additional flows which would have been retained in the southern retention basin.

Has the County accounted for these additional flows?

It seems that the concentration of flows, at the outlet of the 10' x 4' RCBC, into the 200-foot TEP right-of-way would increase velocities and water surface elevations for the immediate vicinity. Please provide an assessment comparing pre-development and post-development velocities and surface elevations for these areas.

If you have any questions please contact me at 520-297-2920, ext. 232.

Thank you for your attention,

Joseph J. Antonio, P.E.
Project Manager

cc: Keith Palmer, P.E., Project Manager, Pima County Transportation & Flood Control
H. Thomas Gill, Jr., Assistant Director of Public Works, Town of Marana
David Wostenberg, E.I.T., Civil Engineering Aide, Town of Marana
Myrlene Francis, Engineering Aide, Town of Marana

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1.0 INTRODUCTION

1.1 Project Location and Description

This document summarizes the drainage analysis for the proposed widening and realignment of Cortaro Farms Road from the Union Pacific Railroad (UPRR) tracks adjacent to the westbound I-10 Frontage Road east to Thornydale Road. The total length of the reconstruction is approximately 2.4 miles. The proposed six- and four-lane roadway will have curb and gutter with a raised landscaped median. The addition of curb along this roadway will necessitate the design of pavement drainage facilities. There are ten existing culvert crossings within the project. Supplemental flood control improvements will be constructed along the roadway where necessary. The project area is located in portions of Sections 25 and 26 in Township 12 South, Range 12 East and Section 30, Township 12 South, Range 13 East within Pima County, Arizona. Refer to Figure 1 for the Location Map.

As part of the ongoing improvements to Cortaro Farms Road, Stantec Consulting Inc. (formerly Cella Barr Associates) has been designing the section of the roadway between the I-10 frontage roads and Cerius Stravenue, a distance of approximately 1,500 feet. Per a meeting between MMLA Inc. and Stantec in January of 2001, several drainage issues were discussed. These issues centered on the findings in the approved Town of Marana Stormwater Master Plan prepared by Arroyo Engineering Inc. Per this report, 740 cfs impacts Cortaro Farms Road east of the Union Pacific Railroad (UPRR) tracks at the beginning of this project. A total of 1,313 cfs impacts the I-10 and Cortaro Farms Road Intersection and is primarily conveyed between the Union Pacific Railroad and the westbound frontage road, with 244 cfs splitting off and being conveyed west down Cortaro Farms Road beneath the interstate. Per the direction of the Town of Marana at this January 2001 meeting, the drainage issues for the roadway section were not a concern for Stantec even though the new roadway fills in the existing drainageway between the railroad line and the frontage road. In this area Stantec is proposing a drainage channel which is directed to an at-grade crossing along Cortaro Farms Road, but does not address any other drainage issues. It should be noted that this channel invert does not provide positive drainage from the lowest point along the southern edge of the roadway. As part of the Arroyo Engineering Stormwater Master Plan, future westward culvert crossings are proposed both north and south of Cortaro Farms that will alleviate some of the ponding that occurs in the project area.

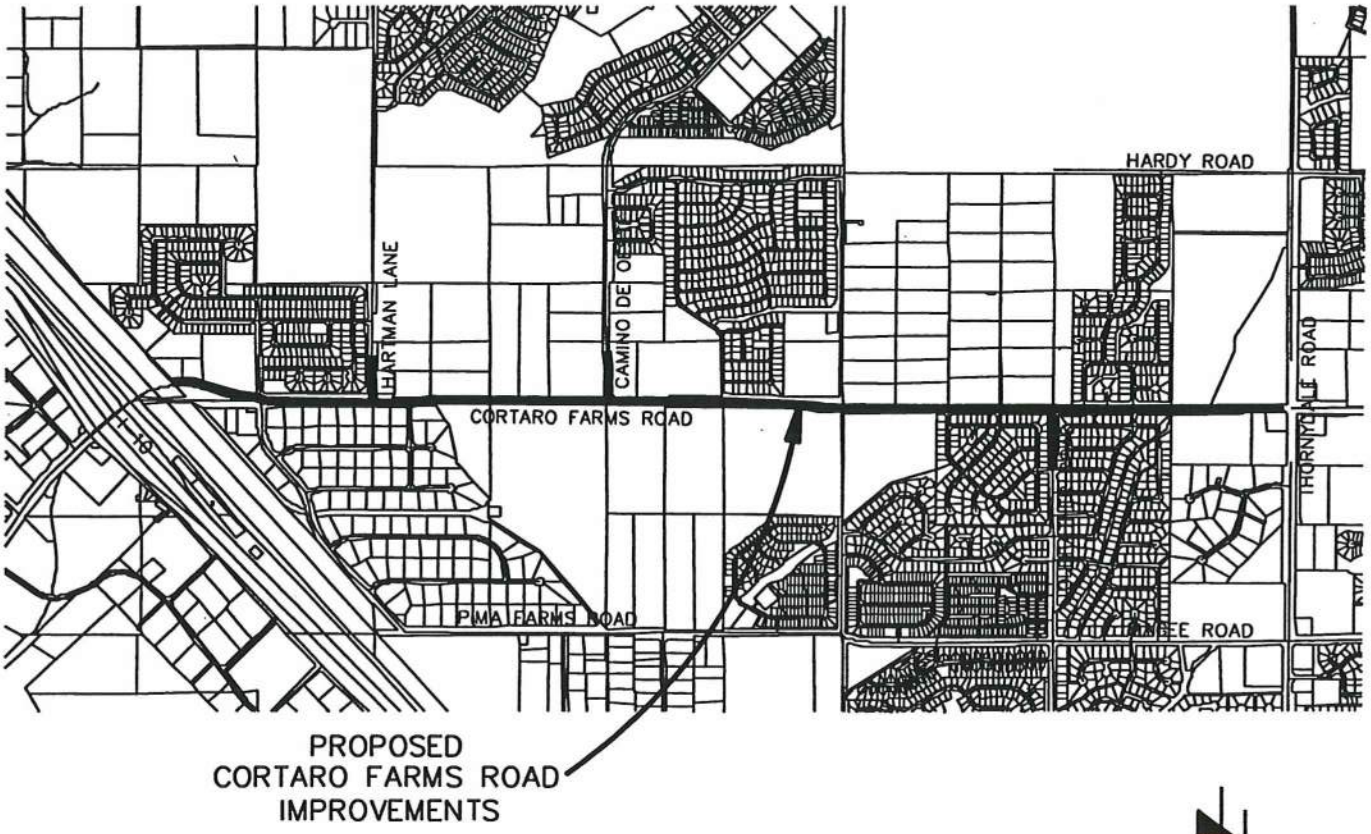
MMLA Inc. acknowledges the fact that the Arizona Department of Transportation may remedy this problem during future I-10 improvements but believes that an interim solution is required. A culvert crossing is proposed at the beginning of the project to provide positive drainage for the flow that collects on the south side of Cortaro Farms Road near the UPRR tracks. A significant component of the drainage that ultimately ponds against the railroad tracks around Cortaro Farms Road currently flows down Hartman Lane, impacting this project at its intersection with Cortaro Farms Road. An additional measure proposed to help alleviate the amount of ponded water at the beginning of the project is to intercept this runoff (Q_{100} = 486 cfs) using a box culvert storm drain system and convey the discharge west along the north side of the proposed right-of-way. The design of these facilities is discussed in further detail in Sections 4 and 5.

1.2 Report Objectives

The purpose of this report is to provide the hydrologic and hydraulic analyses for the design of the proposed drainage structures along Cortaro Farms Road and the intersecting streets. The objectives of the report are to:

- Determine the existing peak 100-year discharges impacting Cortaro Farms Road either from previously submitted reports or by independent hydrologic analysis;
- Evaluate the capacity of existing drainage structures along Cortaro Farms Road;
- Determine proposed peak 100-year discharges within the revised roadway section and, if necessary, re-evaluate offsite watershed boundaries;
- Analyze and, if necessary, re-design cross culverts to comply with discharge and Arizona Game and Fish preferences;
- Provide adequate roadway inlets in order to meet Pima County spread criteria standards;
- Design sufficient storm drain systems to safely convey onsite and offsite discharges impacting the proposed improvements.

The objectives noted above, and the results of the analyses are presented in the following report.



LOCATION MAP

Sections 25 and 26
T–12–S, R–12–E, G and S R M
Section 30
T–12–S, R–13–E, G and S R M
Pima County, Arizona

FIGURE 1

2.0 HYDROLOGIC ANALYSIS

2.1 Methodology

Under existing conditions, watersheds impact Cortaro Farms Road along the north side of the right-of-way. There are 28 locations (Concentration Points 1-22, 24-27, 29 and 30) where runoff impacts this roadway within the project limits. Since there are only ten existing culvert crossings, the remainder of these watershed discharges are conveyed across the roadway surface via sheet flow or existing dip sections. The watersheds impacting this roadway were delineated on 200 scale, 2-foot contour interval topography dated December 1982 and May 1984. Due to the age of these aerial photographs, 400 scale aerial photographs dated October 1998 were consulted. Although these aerials provide a more accurate depiction of the current level of development within the watersheds that impact Cortaro Farms Road, they lack contour information. The boundaries of major developments constructed within these watersheds since 1984 (Cortaro Ridge, Sunset Pointe and Vista Oeste Estates) have been superimposed on the available 200 scale contour maps. Cortaro Ranch, located west of Hartman Lane, is indicated on the map although it is currently under construction. The drainage facilities that serve to redirect runoff within this subdivision will be in place before the proposed roadway improvements are implemented. Where drainage reports were available for these subdivisions, the internal subdivision watershed boundaries were accounted for in the delineation of watersheds that impact the roadway. For the major developments, such as Tortolita Junior High School, Quail Run Elementary School and the Sunset Pointe subdivision, drainage reports are not available and the hydrologic analysis assumes no impervious cover. This is done since site investigations confirm all of these developments incorporate detention facilities, presumably to reduce site discharges to existing values.

2.2 Watershed Characteristics

The drainage area contributing to the project watersheds are limited by Hardy Wash, which is approximately ½ mile north of Cortaro Farms Road and runs roughly parallel to this roadway. The watersheds fall in a southwesterly direction en route to the Santa Cruz River, which is approximately 1000 feet from the west project limit, yet the topography becomes more shallow towards the western end of the project. The geometric watershed properties (area, watercourse length, slope, etc.) were determined from the aforementioned 200 scale topographic maps. The other hydrologic parameters for the project watersheds were gathered from several sources. The representative soils for the site were obtained from the Tucson-Avra Valley Area Soil Study compiled by the United States Department of Agriculture, Soil Conservation Service. These maps indicate that soils with Type A, B and C hydrologic characteristics are present in varying degrees within the delineated watersheds. Additional parameters such as impervious cover, vegetative density and basin factor were obtained by reviewing aerial photography. Vegetative type and density were confirmed by field investigation and regional rainfall intensities were determined from rainfall isopluvials found in the Pima County Hydrology Manual (Reference 9). Peak discharges were calculated using the rational method outlined in this manual.

2.3 Existing Conditions

Table 1 presents a summary of the existing conditions hydrologic analysis. The hydrologic calculation sheets are provided in Appendix 9.1.

Table 1: Summary of Existing Hydrologic Analysis

Concentration Point	Area (ac)	Channel Length (ft)	Length to Centroid (ft)	Basin Factor	Slope (%)	Soil Type	Veg. Density (%)	Imp. (%)	Time of Conc. (min)	100-year Discharge (cfs)
1	3.9	940	470	0.035	1.17	100% B	20	0	6	22
2	33.7	2630	1315	0.035	1.48	100% B	20	0	12	489[1]
3	0.5	275	138	0.035	2.18	100% B	20	0	5	70[1]
4	1.2	350	175	0.022	0.86	100% B	20	50	5	9
5	3.1	435	218	0.022	1.37	100% B	20	50	5	24[2]
6	0.6	1200	600	0.022	0.25	100% B	20	50	8	4
7	1.2	1300	650	0.022	0.23	100% B	20	50	9	8
8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	172[2]
8a	2.2	710	355	0.022	0.50	100% B	20	40	5	16
9	1.3	350	175	0.034	1.83	100% B	20	20	5	9
10	0.9	370	185	0.035	1.89	100% B	20	5	5	5
11	17.5	1660	830	0.034	1.84	100% B	20	10	7	120[1]
12	4.7	1080	540	0.034	2.04	100% B	20	10	5	29
13	5.4	1250	625	0.034	1.84	100% B	20	10	6	32
14	1.1	540	270	0.034	2.04	100% B	20	10	5	7
15	1.0	450	225	0.035	2.22	100% B	20	0	5	6
16	1.0	430	215	0.035	2.79	40% B 60% C	20	0	5	7
16 (comb)	3.1	960	480	0.032	1.98	81% B 19% C	20	4	5	19
17	38.2	3830	1915	0.032	1.84	84% B 16% C	20	8	12	175
18	71.2	4090	2045	0.032	1.86	80% B 20% C	20	7	12	326
19	1.4	380	190	0.025	3.16	100% C	20	0	5	10
20	2.3	560	280	0.025	4.55	100% C	20	0	5	16
21	3.6	760	380	0.025	3.32	100% C	20	5	5	25
22	0.2	100	50	0.040	8.00	100% C	20	0	5	1
23	145.6	4800	2400	0.029	2.02	2% A 37% B 61% C	25	5	12	692
24	14.9	1320	660	0.035	2.65	24% B 76% C	25	0	5	393[1]
25	32.2	2330	1165	0.034	2.36	14% B 86% C	25	10	8	435[1]
26	2.7	580	290	0.040	6.64	30% B 70% C	25	5	5	18
27	17.9	2240	1120	0.034	4.15	6% A 45% B 29% C	25	20	6	117

Concentration Point	Area (ac)	Channel Length (ft)	Length to Centroid (ft)	Basin Factor	Slope (%)	Soil Type	Veg. Density (%)	Imp. (%)	Time of Conc. (min)	100-year Discharge (cfs)
28	8.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6[3]
29	74.2	3580	1790	0.034	3.21	21% A 10% B 69% C	25	5	9	380[1]
29 (comb)	92.1	3580	1790	0.034	3.21	18% A 17% B 65% C	25	10	9	486[1]
30	1.8	N/A	N/A	0.022	N/A	100% B	20	65	5	14[4]
31	3.7	1432	716	0.022	2.44	100% B	20	65	5	28[4]
32	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	740[5]

[1] Result from hydrograph summation or direct summation
[2] Values taken from Cortaro Ridge Report (Reference 3)
[3] Discharge from Vista de Oeste detention basin (Reference 12)
[4] Values taken from Cortaro Ranch Report (Reference 2)
5 Value taken from Town of Marana Storm Water Master Plan (Reference 1)

As indicated in the table, the hydrologic data for four of the project watersheds (Watersheds 5, 8, 30 and 31) were referenced from approved drainage reports compiled by Cella Barr Assoc. (References 2 and 3) and were not re-calculated. The 100-year discharge at C.P. 32 is referenced from the Town of Marana Storm Water Master Plan (Reference 1). This discharge, which is the result of a HEC-1 routing analysis, is the magnitude of runoff estimated to impact the south side of Cortaro Farms Road directly east of the UPRR tracks. Since several sources of information were used to determine discharges impacting the project, in the instances where watersheds combined, the hydrographs from each watershed were summed together. These hydrograph summations also incorporated a lag time in order to take into account the distance between concentration points. Unless otherwise indicated, where hydrograph summations are used, the hydrologic parameters listed in Table 1 refer to the downstream-most watershed. In the case where a watershed's contributing discharge during the 100-year event is less than 5 cfs, no hydrograph was generated and no lag time was calculated. This discharge is summed directly with the discharge at the downstream concentration point. The hydrograph summations are provided in Appendix 9.1. The 100-year discharges presented in Table 1 take into account any required summations.

2.4 Post-Development Hydrology

All of the offsite watersheds impacting Cortaro Farms Road are located within areas designated by Pima County as critical basins. As such, any new development within critical basins, regardless of density, must incorporate detention and/or retention facilities to reduce post-development

discharges to values below those under existing conditions. As a result, the design discharges determined for the existing conditions hydrologic analysis are appropriate for use in the proposed drainage design and another analysis was not performed.

2.5 Pima County 100-Year Floodplain

Of the 29 watersheds identified for this project, 10 generate discharges in excess of 100 cfs. Since this is the threshold at which a watercourse is subject to Pima County regulations, any encroachment into the designated floodplain limits will require prior approval. Although ten watersheds generate regulatory discharges, only eight of these watersheds (Watersheds 2, 11, 17, 18, 24, 25, 27 and 29) contain floodplains that will impact Cortaro Farms Road. Watersheds 8 and 23 represent existing subdivisions, with flows exiting the watersheds via detention basin outlet structures.

Since there is no downstream water surface controlling the starting elevation of these watercourses, the floodplains were generated by use of a normal depth hydraulic analysis. Manning's equation was used to determine a water surface elevation at each of the specified cross sections and the floodplains were delineated by interpolating water surface extents between the cross sections. The hydraulic calculation sheets are provided in Appendix 9.2 and the 100-year floodplain limits are delineated on Figure 2.

2.6 100-Year FEMA Floodplain

The Flood Insurance Rate Maps (FIRM) (Map Numbers 04019C1605 K and 01049C1610 K, February 8, 1999) for the limits of the Cortaro Farms Road reconstruction were consulted to determine if any floodplains regulated by the Federal Emergency Management Agency (FEMA) impact the project. These maps indicate that two different flood zones are present within the project limits. The Cortaro Farms Road right-of-way is impacted by Zone AH flooding from Cerius Stravenue to the western project limits. The Zone AH designation indicates areas with flooding depths between 1 and 3 feet, where this flooding is due primarily to ponding. This ponding results from regional drainage being impeded by the Union Pacific Railroad Tracks en route to the Santa Cruz River. These floodplain limits are delineated on Figure 2. The remainder of Cortaro Farms Road is located within Zone X, indicating that the area is located outside of the 500-year

floodplain. A copy of the FIRM panels illustrating the different FEMA zone designations for this project is provided in Appendix 9.2.

3.0 HYDRAULIC ANALYSIS

3.1 Methodology

The existing and proposed culverts for this project were analyzed using culvert modeling software based on the Federal Highway Administration's Hydraulic Design Series Number 5 nomographs. All hydraulic calculation sheets are provided in Appendix 9.3. The existing culvert locations are indicated on Figure 2. The locations of both the proposed culverts and the existing culverts that will remain after construction are illustrated on Figure 3

3.2 Existing Cross Drainage System

There are 11 existing culvert crossings within the proposed construction limits. The majority of the crossings are relatively small corrugated metal pipe (CMP) crossings, which would indicate nuisance conveyance or culvert and dip crossing combinations. Table 2 provides a comparison of the 100-year discharges calculated at the culvert crossings with the existing culvert capacity. Since as-built information was not available for five of the existing culverts, the length, slope and available headwater used for the hydraulic analysis were estimated from available topography. The existing culverts are identified in Table 2 and the existing capacities are subject to verification.

Table 2: Analysis of Existing Culverts

Concentration Point	Approx. Centerline Station	Structure	100-year Discharge (cfs)	Available Headwater (ft)	Existing Culvert Capacity (cfs)	Type of Control
8	212+70	3-36" x 22" CMP	75	N/A	N/A	N/A
12	198+20	24" CMP*	29	3	17	Outlet
13	196+60	24" CMP*	32	3	17	Outlet
16	189+50	2-24" RCP	19	3.7	49	Inlet
18	182+20	3-8' x 4' RCBC	326	5	740	Inlet
19	179+70	24" RCP	10	4	23	Inlet
20	175+40	24" RCP	16	4	29	Inlet
21	169+70	36" RCP	25	4	56	Inlet
24	160+00	2-24" CMP*	393	3	33	Outlet
25	149+50	3-30" CMP*	435	3.5	83	Outlet
26	145+00	18" CMP*	18	4	10.5	Outlet

* Culvert properties estimated (as-built information not available)

Along primary arterials, such as Cortaro Farms Road, Pima County requires that the 100-year discharge must be fully contained within culvert crossings along the improved roadway (Reference 11). The conveyance capacity of the existing culverts at Concentration Points 12, 13 and 24-26 is lower than the associated 100-year discharge, most likely due to discharges being conveyed across Cortaro Farms in culvert/dip crossing combinations. Because the proposed alignment will no longer incorporated dip crossings, the proposed culvert analysis presented in the next section assumes that any drainage collecting at the northern edge of the right-of-way will be fully contained within the proposed culvert.

Although the entrance is not within the Pima County right-of-way, the 3-36" x 22" corrugated metal pipe arch (CMPA) culvert crossing at C.P. 8 is included in this inventory. These pipes, along with an overflow weir, serve as the outlet for an existing detention basin within the Cortaro Ridge subdivision. According to calculations provided in Reference 4, these pipes have a capacity of 75 cfs for the 100-year basin routing. The remaining 97 cfs that makes up the total basin outflow of 172 cfs will exit the basin via the overflow weir and impact Cortaro Farms Road. Accommodations for this weir discharge will be accounted for in the proposed culvert analysis. As for the existing 3-36" x 22" CMPA, the proposed improvements will have no impact on the flow entering these pipes.

3.3 Proposed Cross Drainage System

Due to constraints imposed by the proposed alignment, only the existing 3 –8' x 4' RCBC at Station 182+11 will remain after construction. This culvert will be extended to the limits of the proposed right-of-way. All the other existing culverts, as well as six additional crossings, will be sized and replaced with structures that will fully-contain 100-year discharges, and will be compatible with the designated wildlife corridors within the project limits. Per the direction of Arizona Game and Fish, pipe crossings should have a minimum diameter of 36 inches and box culvert height should be a minimum of 5 feet within the wildlife corridors. In addition to these height restrictions, the culvert material is to be smooth walled; this essentially limits the pipe material to RCP or spiral-ribbed pipe (SRP). At locations where inlet treatment is required to better direct runoff towards the culvert inlet, channelization will be minimized in corridor areas in order to limit the destruction of vegetation.

A one cell 8' x 4' RCBC is proposed at C.P. 8 to convey the discharge from both the 3 – 36" x 22" CMPA and the Cortaro Ridge detention basin weir. This culvert (Q_{100} = 170 cfs) will cross Cortaro Farms and outlet into an existing concrete channel.

Under existing conditions, a 100-year discharge of 486 cfs collects at the intersection of Cortaro Farms Road and Hartman Lane (Concentration Point 29). This discharge is conveyed along the Cortaro Farms RIGHT-OF-WAY, impacting properties on both the north and south sides of Cortaro Farms. With the development of the Cortaro Ranch subdivision northwest of this intersection and the absence of any other drainage improvements, future flooding will impact Cortaro Farms Road and the existing developments south of the roadway. In order to mitigate flooding hazards, an additional culvert has been designed to convey this discharge west to the project limits. A channel will be constructed along the east side of Hartman Lane, upstream of the intersection, to direct 380 cfs of this runoff to the proposed culvert. The design of this channel will be explained in further detail in section 3.6. The remaining runoff, contributed by Watershed 27, will circumvent this channel and will be intercepted in the northeast corner of the Hartman Lane / Cortaro Farms Road intersection.

Under existing conditions there is no cross drainage structure designed to accommodate the discharge impacting Cortaro Farms at C.P. 32 (Q_{100} = 740 cfs). Discharges collecting at this location pond against the south side of the roadway and eventually weir over the roadway. The proposed 13 - 38" x 24" HERCP culverts at this location are designed to accommodate the 25-year discharge of 481 cfs. This structure was not sized for the 100-year discharge of 740 cfs because such a structure at this location will not be necessary once the drainage improvements along the UPRR tracks are installed per the Town of Marana Storm Water Master Plan recommendations (Reference 1).

Table 3 summarizes the proposed culvert configurations and the locations are provided on Figure 3. The culvert sizing has taken into account the effects of ponding on existing developments due to the inlet headwater. There will be no adverse impacts to existing properties as a result of the proposed culverts. The hydraulic calculation sheets, as well as the alternative culvert analyses are provided in Appendix 9.3.

Table 3: Summary of Proposed Culverts

Concentration Point	Approx. Centerline Station	100-year Discharge (cfs)	Proposed Structure(s)	Slope (%)	Outlet Velocity (fps)	Design Headwater (ft)	Available Headwater (ft)	Type of Control
2	224+56	511	156' 2-12' x 5' RCBC[1]	1.09	14.5	3.7	6.0	Inlet
3	222+00	70	158' 2-36" RCP	1.65	12.2	3.0	4.5	Inlet
8	212+57	172	174' 8' x 4' RCBC	0.42	10.0	3.8	5.0	Inlet
11	202+65	125[2]	192' 2-36" RCP	0.69	8.8	4.5	5.0	Inlet
12	198+40	32[4]	131' – 30" RCP	0.69	8.5	3.4	3.5	Inlet
13	196+00	32	146' – 48" RCP[1]	1.07	10.0	2.4	4.5	Inlet
16	189+38	19	130' 2-36" RCP[1]	1.99	9.0	1.3	3.5	Inlet
18	182+16	326	180' 3-8' x 4' RCBC[3]	1.81	14.1	2.8	5.0	Inlet
19	179+38	10	121' – 36" RCP	3.83	11.6	1.4	3.0	Inlet
20	172+74	16	149' – 36" RCP	1.17	8.7	1.8	2.4	Inlet
21	168+82	25	210' – 36" RCP[1]	4.27	15.7	2.4	5.0	Inlet
24	158+88	393	298' 2-10' x 5' RCBC[1]	2.13	17.2	3.9	4.0	Inlet
25	149+39	435	144' 2-8' x 5' RCBC[1]	1.00	14.5	4.4	6.0	Inlet
26	144+62	18	126' – 36" RCP[1]	3.48	13.3	2.0	6.0	Inlet
32	107+87	481[5]	158' 13-38" x 24" HERCP	0.25	7.5	3.4	3.7	Inlet

[1] Sized per Arizona Game and Fish recommendation
[2] Includes Watershed 10 discharge
[3] Extension of existing culvert
[4] Q_{100} = C.P. 12 (29 cfs) + C.P. 11 Bypass (3 cfs) = 32 cfs
[5] Design discharge = Q_{25}

3.4 Pima County 100-Year Floodplain (Post-Development)

Five of the ten Pima County regulated watercourses defined in Section 2.5 (Watersheds 2, 11, 18, 24 and 25) will be impacted by the proposed cross culvert drainage system. The culvert at C.P. 8 (Q_{100} = 172 cfs) conveys discharge from an existing detention basin and is not subject to regulatory floodplain requirements. For the aforementioned five watersheds, the post-development 100-year floodplain around the proposed structures will vary from the existing floodplain. In order to determine the post-development floodplain limits, the existing floodplain upstream of the proposed culvert will be compared with the design headwater elevation of that culvert. In the event the headwater elevation is higher than the existing water surface elevation, the design headwater elevation will be carried back to the upstream point where the existing water surface elevation controls. Since the culvert design involved increasing the peak discharge only in Watersheds 2 and 11, the floodplain characteristics in all other watersheds will be the same as under existing conditions downstream of the culvert energy dissipator. Because Watersheds 2 and 11

incorporate the discharge from adjacent watersheds, Cross Sections 2-A, 2-B and 11-A were reanalyzed. Table 4 summarizes the existing and post-development floodplain characteristics for the affected cross sections. Any additional hydraulic calculation sheets are provided in Appendix 9.3 and the post-development 100-year floodplain limits are delineated on Figure 3. The existing water surface elevations within the project have been uniformly increased by 2.1 feet. This accounts for the vertical elevation difference between the NGVD 1929, which was the basis of the existing conditions topography and NAVD 1988, the basis of the topography used for the proposed improvements. This elevation difference is reflected in the floodplain delineations depicted on Figure 3.

Table 4: Existing and Post-Developed Floodplain Comparison

Watershed	Cross Section	Existing Q_{100} (cfs)	Developed Q_{100} (cfs)	Existing WSEL * (ft)	Developed WSEL * (ft)	Proposed 100-Year HW_{Elev} (ft)	Controlling Developed WSEL (ft)
2	2-A	489	511	2343.3	2343.3	----	2343.3
	2-A2	489	511	2343.4	2340.9	----	2340.9
	2-B	489	----	2344.5	----	----	----
	2-B2	----	511	----	2343.9	2346.5	2346.5
	2-C	489	489	2350.7	2350.7	2346.5	2350.7
11	11-A	120	----	2324.4	----	----	----
	11-A2		120	----	2319.2	2321.1	2321.1
	11-B	120	120	2328.4	2328.4	2321.1	2328.4
18	18-C	326	----	2293.1	----	----	----
	18-C2	----	326	----	2289.6	2291.6	2291.6
	17-A	175	175	2298.5	2298.5	2291.6	2298.5
24	24-B2	----	393	----	2234.8	2237.6	2237.6
	24-C	393	393	2238.7	2238.7	2237.6	2238.7
25	25-C	435	----	2216.8	----	----	----
	25-C2	----	435	----	2207.9	2211.1	2211.1
	25-D	435	435	2224.2	2224.2	2211.1	2224.2

* Adjusted to NAVD 88 where appropriate

3.5 Cortaro Ridge Drainage Swale System

Along the north side of the Cortaro Farms right-of-way, adjacent to the Cortaro Ridge subdivision, a culvert and drainage swale system is proposed to convey offsite runoff that impacts the roadway under existing conditions, as well as a small portion of the pavement drainage. This drainage system will start at Bayou Drive (STA 218+00 ±), cross Hummer Drive and will terminate in the existing detention basin at the northeast corner of Cortaro Farms Road and Delta Way. The hydraulic calculations for the swale are provided in Appendix 9.3.

3.6 Hartman Lane Channel

Under existing conditions, Watershed 29 generates a 100-year discharge of 380 cfs that originates near Camino de Oeste and Hardy Wash, flows southwest towards Hartman Lane and turns south at Hartman Lane, ultimately impacting the Hartman Lane / Cortaro Farms Road intersection. In order to prevent this discharge from impacting the proposed roadway intersection and surrounding properties, a trapezoidal gunite-lined channel will be constructed along the east side of Hartman Lane. This channel will contain a 12-foot bottom with 1:1 side slopes and will have a maximum flow depth of 2.0 feet for the 100-year discharge of 380 cfs. The channel profile will match the 1.81% grade proposed for Hartman Lane. This channel is designed to intercept this discharge and convey it south to the entrance of the proposed 2,670' 2- 10' x 4' RCBC that will be constructed along the north side of the Cortaro Farms right-of-way. A drop inlet will be constructed to transition from the channel terminus to the culvert entrance. Due to the undeveloped nature of the contributing watershed, this drop inlet will act as a sediment trap and should be maintained regularly to preserve the efficiency of this drainage system. The proposed plan and profile as well as the hydraulic calculations for this channel are provided in Appendix 9.3. The design of the receiving culvert is discussed in further detail in Section 6.0.

3.7 Sediment Transport

Sediment deposition is a maintenance problem observed at only two of the existing culvert crossings along Cortaro Farms Road: the 2-24" CMP at C.P. 24 and the 3-30" CMP at C.P. 25. For all the other existing culvert crossings, no excessive aggradation or degradation is noted at the inlets or outlets. Since the proposed culverts designed as replacements will either match or exceed existing slopes, no upstream sediment mitigation measures are warranted. Measures to prevent erosion downstream of the proposed culverts will be provided. The design of these measures is discussed in further detail in Section 3.8.

3.8 Erosion Protection

In accordance with the Pima County Drainage Standards (Reference 8), erosion protection will be provided at most of the proposed culvert outlets in order to mitigate the effects of increased downstream velocities. The culverts at Concentration Points 3, 8, 11 and 12 will not require

outlet protection since they discharge into existing concrete channels. Since the culvert outlet velocities are 1.5 times greater than existing stream velocities and/or exceed 10 fps, riprap protection will be provided. In order to mitigate the amount of disturbance required, plunge basins are specified at all locations where riprap protection is warranted. Concrete aprons placed between the culvert outlet and the plunge basin will allow wildlife navigating these crossings to safely circumvent the plunge basins. Table 5 summarizes the plunge basin configuration at each proposed culvert outlet. This configuration is based on the typical plunge basin schematic found in Reference 8 and is provided in Appendix 9.3. Existing stream hydraulic calculations were generated downstream of the culverts conveying discharges less than 100 cfs and were therefore not part of the existing floodplain analysis. All hydraulic calculations generated to size these structures are provided in Appendix 9.3. The erosion protection measures are also illustrated on Figure 3.

Table 5: Summary of Proposed Erosion Protection

C.P.	Approx. Centerline Station	100-year Discharge (cfs)	Proposed Culvert	Outlet Velocity (fps)	Existing Stream Velocity (fps)	Proposed Scour Protection	D_{50} (in)
2	224+56	511	156' 2-12' x 5' RCBC*	14.5	4.1	Plunge Basin 21'L x 56'W x 1.0'D	12
3	222+00	70	158' 2-36" RCP	12.2	N/A	N/A	N/A
8	212+57	172	174' 8' x 4' RCBC	10.0	N/A	N/A	N/A
11	202+65	125[2]	192' 2-36" RCP	8.8	N/A	N/A	N/A
12	198+40	32[4]	131' – 30" RCP	8.5	N/A	N/A	N/A
13	196+00	32	146' – 48" RCP*	10.0	2.7	Plunge Basin 18'L x 12'W x 1.0'D	6
16	189+38	19	130' 2-36" RCP*	9.0	2.9	Plunge Basin 15'L x 20'W x 1.0'D	6
18	182+16	326	180' 3-8' x 4' RCBC	14.1	3.9	Plunge Basin 18'L x 58'W x 1.0'D	9
19	179+38	10	121' – 36" RCP	11.6	2.8	Plunge Basin 15'L x 12'W x 1.0'D	6
20	172+74	16	149' – 36" RCP	8.7	4.0	Plunge Basin 15'L x 12'W x 1.0'D	6
21	168+82	25	210' – 36" RCP*	15.7	6.2	Plunge Basin 21'L x 18'W x 2.0'D	6
24	158+88	393	298' 2-10' x 5' RCBC*	17.2	4.6	Plunge Basin 24'L x 51'W x 1.5'D	9

C.P.	Approx. Centerline Station	100-year Discharge (cfs)	Proposed Culvert	Outlet Velocity (fps)	Existing Stream Velocity (fps)	Proposed Scour Protection	D_{50} (in)
25	149+39	435	144' 2-8' x 5' RCBC*	14.5	8.0	Plunge Basin 21'L x 40'W x 1.0'D	9
26	144+62	18	126' – 36" RCP*	13.3	1.8	Plunge Basin 18'L x 15'W x 1.5'D	6

*Wildlife Corridor

3.9 Detention / Retention Basin Analysis

Two existing detention/retention basins will be modified as a result of the proposed roadway improvements: the basin south of the existing IHOP restaurant and the Cortaro Ranch subdivision basin. Both basins are located at the Cortaro Farms Road intersection with Cerius Stravenue. Due to changes in the right-of-way limits, the proposed construction activity will only affect the southern boundary of the IHOP basin. The roadway embankment fill slope will replace the existing basin side at a flatter side slope and to a higher top elevation, essentially increasing the basin volume from that which currently exists. Detention basin routings for this revised basin volume show that the post-construction 100-year discharge exiting the basin will decrease from 67 cfs to 66 cfs and the 100-year water surface elevation will decrease from 2162.51 to 2162.41. These routing calculations are provided in Appendix 9.3.

However, the roadway improvements will encroach significantly on the Cortaro Ranch retention basin, reducing the total basin volume from 4.47 acre-feet to 3.42 acre-feet. The existing basin was designed to retain the 100-year runoff volume of 3.59 acre-feet entering it, with four dry wells emptying the basin within a 24-hour period. Since no emergency outflow structure is incorporated into this existing basin, flow volumes exceeding the basin volume will breach the southern and western basin boundaries and impact Cortaro Farms Road. Due to the post-construction reduction in basin volume, an outlet structure is provided to ensure flows are safely contained within the basin up to a certain depth, then safely discharged when this depth is exceeded. A 5-foot long weir will be installed along the revised southern boundary of this basin, which will coincide with

the outer wall of the 2,670 2- 10' x 4' RCBC that will run between this basin and Cortaro Farms Road. Detention routings have been performed that incorporate the revised basin volume and the new outlet structure. The existing 100-year runoff hydrograph entering the basin is referenced from the Cortaro Ranch report. Although the roadway improvements will divert approximately 13 cfs (Watersheds 31a – 31d) of basin inflow during the 100-year event into the storm drain system, this represents less than 10% of the total basin inflow hydrograph (Q_{100} = 180 cfs) and the hydrograph was not regenerated. The results of the basin routing, which are provided in Appendix 9.3, indicate that the maximum basin outflow during the 100-year event will be 47 cfs. The time that this peak discharge exits the basin is 31 minutes from the start of inflow into the basin. If the receiving box

culvert is flowing at capacity and the maximum flow velocity in the culvert is 8.8 fps, then the total travel time from the point where the basin discharge enters the box culvert to the culvert outfall approximately 1,310 feet downstream is approximately 2.5 minutes. This arrival time for the basin peak discharge is far below the 13.07-hour time to peak for the overall watershed that impacts, and flows north along Cortaro Farms Road adjacent to the UPRR tracks. The Cortaro Ranch basin outflow will have no appreciable impact on the magnitude of the 100-year peak discharge (740 cfs) at this location.

4.0 INLET ANALYSIS

4.1 Existing Pavement Drainage Pattern

Under existing conditions, Cortaro Farms Road essentially follows the existing topography. The roadway is continuously –graded from east to west, with dip sections provided at locations where watershed conveying runoff from north to south cross the roadway. This drainage pattern can be seen on the Figure 2. Other than the cross culverts, there are no existing inlet or storm drainage facilities within the roadway.

4.2 Proposed Pavement Drainage

4.2a Proposed Cross Section and Profile

As part of the proposed improvements to Cortaro Farms Road, a curbed median will be installed and the pavement section will be curbed. The pavement will consist of 6 travel lanes from the beginning of the project at the UPRR tracks to Hartman Lane. After Hartman Lane, the pavement will narrow to 4 travel lanes for the remainder of the project. The pavement will be superelevated from the beginning of the project and will have several superelevation transitions until approximately 300 feet east of Cerius Stravenue. From this point to the end of the project, the pavement section will have a 2% normal crown. Although the number and width of the travel lanes will vary, an 8-foot multi-use lane will be maintained over the project. The cross slope of this multi-use lane will vary between 2% and 4%. The proposed roadway will be continuously graded and will incorporate three sag vertical curves between the start of the project and Spanish Bayonet.

4.2b Spread Criteria

The addition of curbs will require both hydrologic analyses to quantify the pavement flows and hydraulic analyses to minimize the spread of water across traffic lanes. As a result, several onsite watersheds were delineated in order to quantify discharges at logical locations, such as sumps, intersections, and superelevation transitions. The onsite watersheds are delineated on Figure 3. The hydrologic calculation sheets for these watersheds are provided in Appendix 9.4. Table 6 presents a summary of the parameters used in designing the pavement drainage structures. The last column defines the maximum allowable spread for the designated roadway section. The maximum spread width is defined for the proposed 6-lane and 4-lane divided roadway in the Pima County Roadway Design Manual (Reference 11). The maximum spread along the outside of the 6-lane

divided roadway is 19 feet, which consists of the 8-foot multi-use lane and the 11-foot travel lane. Along the 4-lane roadway section, the spread is limited to 10 feet, which is comprised of the multi-use lane and a 2-foot encroachment into the travel lane. Per direction from Pima County, the maximum spread adjacent to a median will differ from that presented in the Roadway Design Manual. In sections that are superelevated, ponding along a median can be increased to 6 feet, approximately one-half of the inside travel lane. If a left turn bay is adjacent to the median, the maximum spread may cover the entire left turn lane, or 14 feet.

Table 6: Summary of Pavement Watersheds

Watershed	Area (ac)	From Station (approx.)	To Station (approx.)	Low Point (approx.)	Maximum Allowable Spread (ft)
OS-1	0.27	235+50	234+22	234+22	10
OS-2	0.28	235+50	234+22	234+22	10
OS-3	0.15	106+25	107+50	107+50	6
OS-4	0.18	106+02	107+50	107+50	19
A	2.19	234+22	217+80	217+80	10
B	2.30	234+22	218+50	218+50	10
C	0.39	217+80	214+55	214+90	10
D	0.41	217+40	214+25	214+25	10
E	0.22	214+55	212+80	212+80	10
E1	0.09	212+35	211+90	212+25	---
F	0.34	213+20	209+80	209+80	10
G	1.06	211+90	203+35	203+35	10
H	0.71	208+65	203+40	203+40	10
I	1.37	203+35	191+75	191+75	10
J	0.62	202+30	197+70	197+70	10
K	8.03	196+50	136+90	136+90	10
L	1.28	190+65	181+60	181+60	10
M	0.29	181+60	179+60	179+60	10

Watershed	Area (ac)	From Station (approx.)	To Station (approx.)	Low Point (approx.)	Maximum Allowable Spread (ft)
N	1.03	179+60	172+35	172+35	10
O	1.83	172+35	160+30	160+30	10
P	3.19	159+20	139+40	139+40	10
Q	1.22	139+40	132+15	133+39	10
Q1	0.19	47+00	48+85	48+85	12
Q2	0.32	41+50	44+50	44+50	12
Q3	0.84	45+35	130+07	49+00	12
R	1.10	136+90	133+07	133+39	10 (136+90 to 134+25) 19 (134+25 to 130+07)
S	1.91	130+07	117+16	121+88	19
S1	½ Existing W.S. 30 (Cerius Stravenue)			119+20	---
S2	0.27	117+16	118+80	118+80	14
T	1.72	130+78	119+45	121+88	19
U	0.31	117+16	114+79	114+79	19
V	0.46	117+16	114+23	114+23	14 (117+16 to 115+60) 6 (115+60 to 114+23)
W	1.19	114+79	107+50	108+32	6
X	0.69	107+50	114+23	108+32	19

4.3 Inlet Sizing Methodology

Each watershed presented in Table 4 is divided into sub-watersheds in order to calculate incremental discharges. This is done to better analyze the spread at key locations, such as changes in the pavement width, longitudinal slope, or cross slope and to size an appropriate inlet if the spread is approached or exceeded. The discharges for each sub-watershed were calculated using the following rational equation:

$$Q = C*i*A$$

where Q = Design discharge (cfs)
C = Runoff coefficient
i = Rainfall intensity for design storm (in/hr)
A = Drainage area (ac)

The primary goal of the pavement drainage analysis is to control the spread of water onto travel lanes at all locations during the 10-year storm. The 100-year storm will be used only to analyze the limits of ponding in sag vertical curves. C is a function of the level of development and the rainfall depth for the design storm under consideration. Using the rainfall depths determined for the analysis of the offsite watersheds in conjunction with the impervious nature of all the paved watersheds, C will have a value of 0.94 and 0.96 for the 10 and 100-year design storms, respectively. The pavement hydrology sheets are provided in Appendix 9.4.

The spread and depth of flow in the gutter were calculated using the Federal Highway Administration's Visual Urban drainage design program, assuming a Manning's "n" of 0.016. The same software, which is based on HEC-22, was also used to design the inlet structures placed in each watershed. All inlets on a continuous grade were designed with a minimum efficiency of 0.75 to account for clogging. A clogging factor of 50% is used to design inlets located in sumps. The inlets are placed at locations where either the maximum spread is approached or reached or where significant amounts of water could cross travel lanes, such as at superelevation transitions and intersections. At these locations, the inlets are designed for 100% interception in order to limit the amount of runoff crossing travel lanes. Some of the inlets approaching sag vertical curves

have been oversized in order to reduce the amount of ponded water at these low points. Also at superelevation transitions and locations where the spread is limited adjacent to a median, slotted drain is specified in order to avoid spacing inlets short distances apart. Slotted drain will consist of 18" CMP, unless otherwise noted. The inlet types and locations are also indicated on the sub-watershed sheets. The catch basin type, location and identification number is summarized in Table 7. Although Catch Basins A1 – A4 were designed as part of the project, these inlets will be constructed as part of the Thornydale Road Improvements designed by Parsons-Brinckerhoff. The inlet locations are depicted on the storm drain summary sheets provided in Appendix 9.5.

Table 7: Inlet Design Summary

Watershed	Inlet ID	Location	Structure	$Q_{intercept}$ (cfs)
OS-1	CB-A1	234+12	PCDOT Type 3, 4' Wing	1.44
OS-2	CB-A2	234+12	PCDOT Type 3, 4' Wing	1.17
A	CB-A4	232+00	PCDOT Type 3, 4' Wing	1.62
	CB-A7	229+50	PCDOT Type 3, 4' Wing	1.80
	CB-A9	227+50	PCDOT Type 3, 4' Wing	1.76
	CB-B1	224+00	PCDOT Type 3, 8' Wing	2.88
	CB-C2	221+00	PCDOT Type 3, 8' Wing	2.65
	CB-C4	218+60	PCDOT Type 3, 8' Wing	2.36
		217+80	12' Depressed Curb	6.31
		217+95	11' Depressed Curb	5.46
B	CB-A3	232+75	PCDOT Type 3, 4' Wing	1.76
	CB-A5	231+25	PCDOT Type 3, 4' Wing	1.81
	CB-A6	229+75	PCDOT Type 3, 4' Wing	1.73
	CB-A8	228+00	PCDOT Type 3, 4' Wing	1.80
	CB-A10	225+05	PCDOT Type 3, 8' Wing	2.73
	CB-C1	221+00	PCDOT Type 3, 8' Wing	2.85
	CB-C3	218+60	PCDOT Type 3, 8' Wing	1.88
C	CB-C5	215+65	PCDOT Type 3, 4' Wing	1.37
		215+25	5' Depressed Curb	2.52
		214+90	5' Depressed Curb	2.57
D	CB-C6	215+05	PCDOT Type 3, 4' Wing	1.82
	CB-C7	214+28	PCDOT Type 3, 4' Wing	0.76
E	SC-1	213+00	9' Sidewalk Scupper	1.39
E1	CB-C8	212+25 (48+66)	PCDOT Type 4 w/ 2 EF-1 Grates	5.02
F	SC-2	209+85	13' Sidewalk Scupper	2.14
G	CB-D1	208+00	PCDOT Type 3, 8' Wing	2.77
	CB-D3	205+05	PCDOT Type 3, 8' Wing	2.32
	SC-3	203+40	11' Sidewalk Scupper	1.59
H	CB-D2	205+50	PCDOT Type 3, 8' Wing	2.77
	CB-D4	203+42	PCDOT Type 3, 8' Wing	1.70
I	CB-E1	200+50	PCDOT Type 3, 4' Wing	1.76
	CB-E3	198+00	PCDOT Type 3, 4' Wing	1.79
	CB-F1	195+50	PCDOT Type 3, 4' Wing	1.81
	CB-F2	191+77	PCDOT Type 3, 8' Wing	2.83
J	CB-E2	200+00	PCDOT Type 3, 8' Wing	2.02

Watershed	Inlet ID	Location	Structure	$Q_{intercept}$ (cfs)
	CB-E4	197+70	PCDOT Type 3, 8' Wing	1.89
K	CB-G2	187+00	PCDOT Type 3, 12' Wing	6.73
	CB-H1	179+00	PCDOT Type 3, 12' Wing	6.35
	CB-K2	166+00	PCDOT Type 3, 16' Wing	9.03
	CB-L3	157+00	PCDOT Type 3, 16' Wing	8.40
	CB-M2	148+00	PCDOT Type 3, 16' Wing	8.67
	CB-N3	139+00	PCDOT Type 3, 16' Wing	7.64
	CB-N4	137+00	PCDOT Type 3, 8' & 12' Wings	3.74
L	CB-G1	187+00	PCDOT Type 3, 12' Wing	3.13
	CB-G3	182+85	PCDOT Type 3, 8' Wing	2.81
	SC-4	181+60 (48+75)	4' Sidewalk Scupper	2.12
M	SC-5	179+60	12' Sidewalk Scupper	1.83
N	CB-I1	176+00	PCDOT Type 3, 8' Wing	2.72
	CB-J1	172+37	PCDOT Type 3, 8' & 12' Wings	3.76
O	CB-K1	168+00	PCDOT Type 3, 12' Wing	3.63
	CB-K3	163+50	PCDOT Type 3, 12' Wing	3.70
	CB-K4	160+45	PCDOT Type 3, 8' & 12' Wings	4.19
P	CB-L1	159+01	PCDOT Type 3, 8' Wing	1.83
	CB-L2	158+05	PCDOT Type 3, 8' Wing	2.76
	CB-L4	153+00	PCDOT Type 3, 12' Wing	3.68
	CB-M1	148+00	PCDOT Type 3, 12' Wing	3.88
	CB-N1	143+00	PCDOT Type 3, 12' Wing	3.98
	CB-N2	139+51	PCDOT Type 3, 8' & 12' Wings	3.96
Q	CB-N5	135+50	PCDOT Type 3, 8' Wing	2.78
	CB-N6	133+39	PCDOT Type 5, 86' Slotted Drain	4.96
Q1	CB-X4	48+82	PCDOT Type 5, 15' Slotted Drain	1.20
Q2	SC-6	44+24	35' Sidewalk Scupper	2.02
Q3	CB-N8	131+00	PCDOT Type 5	0.64
	CB-X3	48+73	PCDOT Type 5, 68' Slotted Drain	5.65
R	CB-N7	133+39	PCDOT Type 5, 86' & 89' Slotted Drain	6.94
S	CB-O1	122+75	PCDOT Type 5, 15' Slotted Drain	5.73
	CB-S2	118+67	PCDOT Type 5, 10' Slotted Drain	1.32
	CB-Q2	120+15	PCDOT Type 5, 10' Slotted Drain	5.17
	CB-P2	121+88	PCDOT Type 5, 10' Slotted Drain	4.07
S1	CB-R1	119+18 (48+93)	PCDOT Type 3, 16' Wing	4.25
S2	CB-S1	118+77	PCDOT Type 5, 110' Slotted Drain	1.70
T	CB-O2	122+75	PCDOT Type 5, 20' Slotted Drain	7.95
	CB-Q1	120+25	PCDOT Type 5, 10' Slotted Drain	0.44
	CB-P1	121+88	PCDOT Type 5, 10' Slotted Drain	2.45
U	CB-T2	115+15	PCDOT Type 5, 45' Slotted Drain	1.64
V	CB-T1	114+70	PCDOT Type 5, 90' Slotted Drain	2.46
W	CB-U1	112+70	PCDOT Type 5, 150' Slotted Drain	2.45
	CB-V1	110+50	PCDOT Type 5, 150' Slotted Drain	2.58
	CB-W2	108+32	PCDOT Type 5, 150' Slotted Drain	4.63
X	CB-W1	108+44	PCDOT Type 5, 106' Slotted Drain	4.29
	SC-7	108+32	4' Sidewalk Scupper	1.63

5.0 PRELIMINARY STORM DRAIN ANALYSIS (Design Considerations)

Since there are no existing storm drains servicing Cortaro Farms Road, storm drain systems will

be constructed with this project in order to convey the onsite-generated discharges. Due to the presence of several existing underground utilities in the existing Cortaro Farms Road right-of-way, the design of the storm drain will focus on limiting the number utility crossings. To achieve this, the majority of the storm drains will be aligned along the proposed roadway gutter, not along the proposed median as previously submitted. All of these storm drains will outfall into existing or proposed drainage structures within or adjacent to the roadway. Per Pima County guidelines, all of the storm drains will be designed for the 10-year event. The higher of the critical depth within the downstream-most pipe segment or the 10-year water surface elevation within the outfall structure will be used as the starting water surface for the hydraulic grade line calculations.

6.0 FINAL STORM DRAIN ANALYSIS

Thirty-one separate storm drain systems will be constructed with this project in order to convey the onsite and offsite discharges that will impact the proposed roadway alignment. The locations of the storm drain systems are illustrated in Figure 3. The hydraulic grade line calculations, as well as the plan and profile sheets for the storm drains are provided in Appendix 9.5. Because the storm drain alignment is predominantly along the north and south curb lines of Cortaro Farms Road, different downstream elevations may control depending on where the storm drain ties in to the receiving culvert. For storm drains that tie into culverts at the north, or upstream ends, the water surface elevation in the culvert is taken to be the 10-year headwater elevation. At the south, or downstream end, the culvert water surface is the 10-year tailwater elevation. The applicable water surface elevation within each culvert that serves as an outlet is compared with the critical flow depth in the downstream-most pipe segment. The higher water surface elevation is used as the start for the hydraulic grade line calculations. . Table 8 summarizes the starting water surface elevation used for each storm drain system. The proposed 2,670-foot 2 – 10' x 4' RCBC along the northern right-of-way from Hartman Lane to the UPRR tracks is also modeled as a storm drain. Since the storm drain systems from the beginning of the project to approximately Hartman Lane will discharge into this culvert, the 10-year hydraulic grade elevation in this culvert is used the starting elevation for analysis. This culvert / storm drain has been designed to convey the 100-year discharge of 486 cfs that impacts Cortaro Farms at Hartman Lane under existing conditions. This discharge includes the flow contribution from Watershed 27 which circumvents the Hartman Lane collector channel, but still impacts the Cortaro Farms Road / Hartman Lane intersection. Due to the sheet flow

characteristics at the outfall of this culvert, critical depth is used is the starting water surface for the hydraulic grade line calculations. The results of this analysis are also presented in Appendix 9.5.

Table 8: Storm Drain Design: Starting Water Surface

Storm Drain	Critical Depth Elevation at Outfall	10-Yr Water Surface Elevation at Outfall Culvert	Controlling Water Surface
A – North	2344.68	2345.17	Culvert
A – South	2343.69	2342.77	Critical
B	2342.78	2343.04	Culvert
C – North	2332.08	2333.59	Culvert
C-North2	2332.00	2333.59	Culvert
C – South	2331.98	2332.03	Culvert
D – North	2319.22	2321.27	Culvert
D – South	2317.56	2318.58	Culvert
E1	2314.29	2315.65	Culvert
E2	2313.61	2314.08	Culvert
E3	2312.90	2313.02	Culvert
E4	2313.50	2314.08	Culvert
F	2306.23	2306.17	Critical
G	2290.30	2290.56	Culvert
H	2287.00	2286.04	Critical
I	2276.99	2277.24	Culvert
J	2266.92	2267.55	Culvert
K	2235.33	2236.20	Culvert
L	2209.38	2209.45	Culvert
M	2195.26	2195.17	Critical
N	2160.24	2160.35*	Culvert
N2	2158.46	2160.21*	Culvert
O	2157.84	2158.36*	Culvert
P	2157.26	2158.17*	Culvert
Q	2156.85	2157.78*	Culvert
R	2157.55	2157.56*	Culvert
S	2156.34	2157.45*	Culvert
T	2155.41	2156.60*	Culvert
U	2155.11	2156.15*	Culvert
V	2154.67	2155.64*	Culvert
W	2154.74	2155.16*	Culvert
X1&X2	2162.58	2162.83*	Culvert
X3	2160.69	2160.70*	Culvert
X4	2160.94	2160.70*	Critical
X5	2161.32	2160.69*	Critical
Y	----	2160.00**	Basin**

* 10-Year HGL Elevation in Proposed 2-10' x 4' x 2700' RCBC

** Water Surface at Existing Cortaro Ranch Retention Basin

7.0 CONCLUSION

This drainage report for Cortaro Farms Road summarizes the existing drainage conditions along the roadway and presents the design strategy for the proposed realignment. Thirteen new culvert crossings will be required, in addition to the existing 3 – 8' x 4' RCBC at Quail Run Elementary School. Since Cortaro Farms is an environmentally sensitive roadway, the culvert design, including inlet and outlet treatment, will minimize disturbance to native vegetation, provide for additional vegetation, and/or promote the travel of wildlife through these corridors. A proposed major drainage improvement involves the installation of a gunite channel along the eastern right-of-way of Hartman Lane that will intercept the 100-year discharge of 380 cfs. This discharge will be conveyed to a proposed 2 – 10' x 4' RCBC which will parallel the northern right-of-way of the proposed alignment for approximately 2,670 feet before discharging. New pavement drainage facilities have been provided which meet Pima County spread criteria. The final storm drain analysis recommends the use of 31 separate storm drain systems to convey onsite and offsite flows that impact the proposed roadway alignment to a safe outlet. All of the storm drains will outfall into existing or proposed drainage structures. This investigation was conducted according to federal, state, and local guidelines, and is based on the best available information.

8.0 REFERENCES

1) Arroyo Engineering, Inc., *Town of Marana Stormwater Master Plan*, February 2000.

2) Cella Barr Associates, *Cortaro Ranch Drainage Report*, CBA File No. 105685-05-0300, June 14, 1996.

3) Cella Barr Associates, *Hydrology Report for Cortaro Ridge Subdivision*, CBA File No. 03124-01-30, Approved April 27, 1983.

4) Cella Barr Associates, *Hydrology Report for Cortaro Ridge Subdivision (Addendum)*, CBA File No. 03124-01-30, July 25, 1983.

5) Cella Barr Associates, *Hydrology Report for Cortaro Ridge Subdivision, Lots 125 through 224*, CBA File No. 03353-01-30-00, March 20, 1984.

6) Johnson-Brittain and Associates, *Final Drainage Report for Thornydale Road, Cortaro Farms Road to Linda Vista Boulevard*, W.O. 4TTCLV, JBA Job No. 3238, April 28, 1998.

7) Pima County Department of Transportation and Flood Control District Inc, *Cortaro Farms Road, Camino de Oeste to Thornydale Road, Safety Improvements Project,* As-Built July 1989.

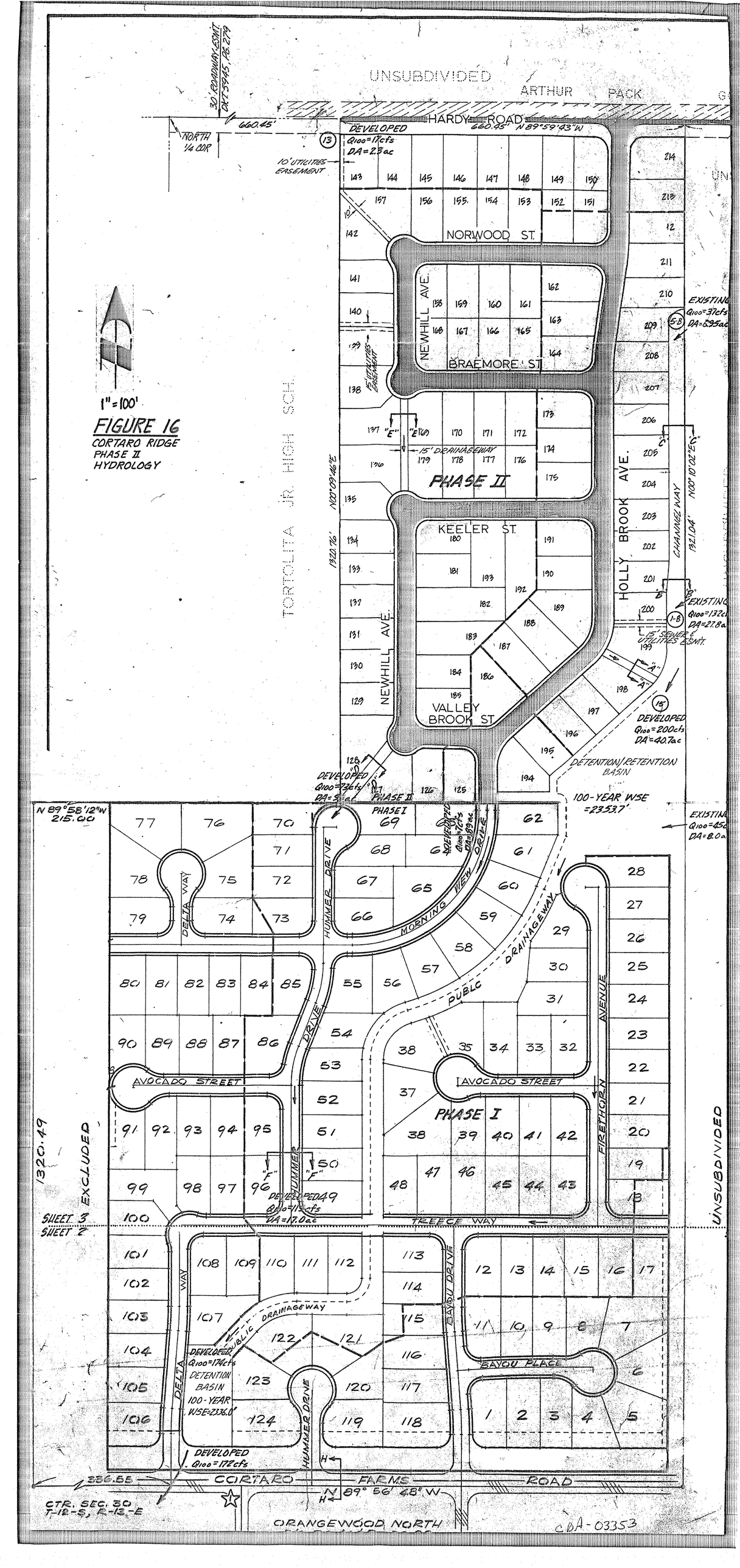
8) Pima County Department of Transportation and Flood Control District Inc., *Drainage and Channel Design Standards for Local Drainage for Flood Plain Management within Pima County, Arizona*, May 1984.

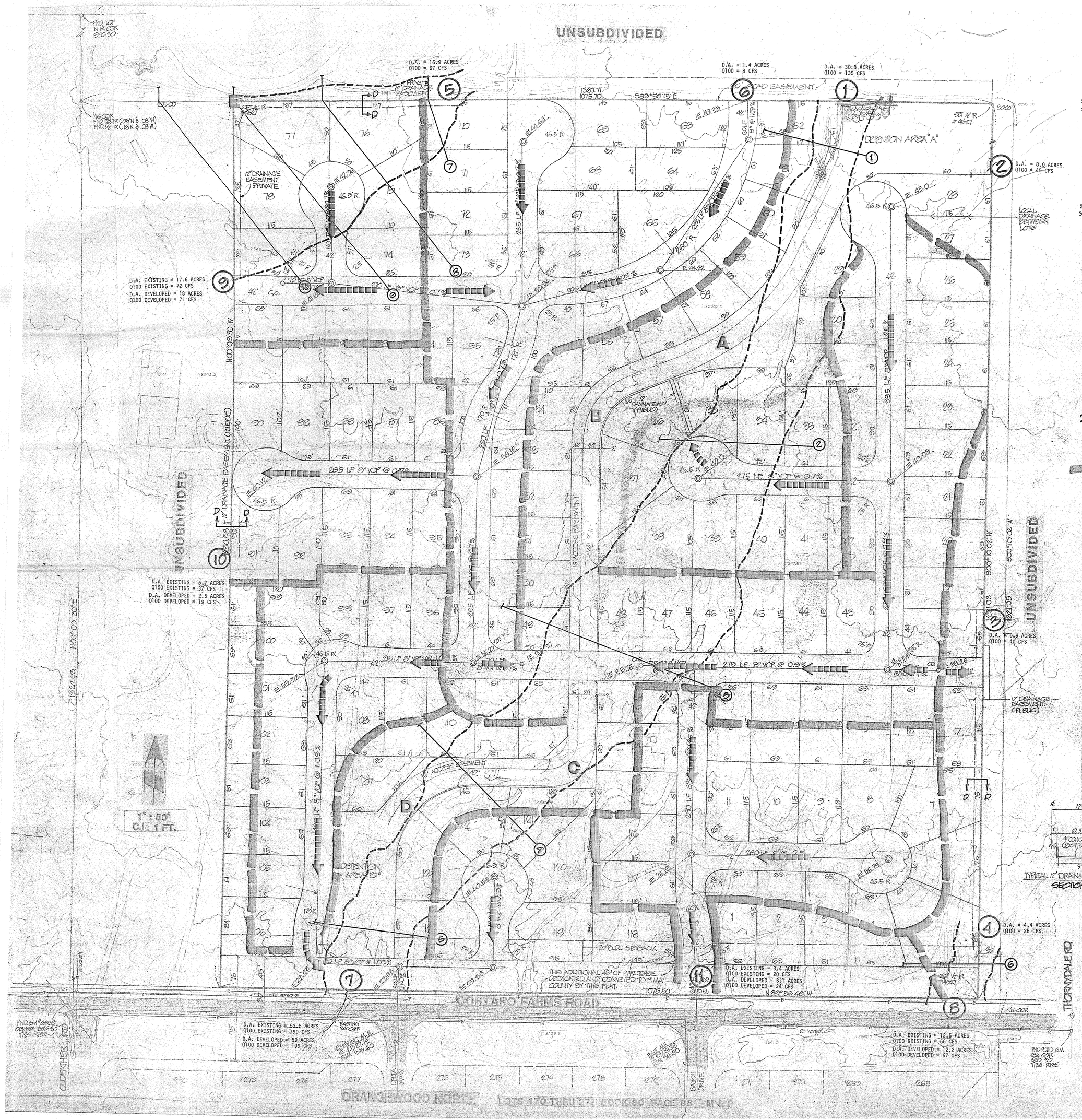
9) Pima County Department of Transportation and Flood Control District Inc., *Hydrology Manual for Engineering Design and Floodplain Management Within Pima County, Arizona*, Pima County Department of Transportation, September 1979.

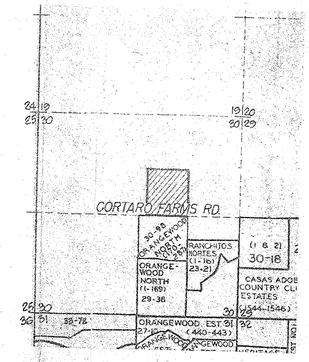
10) Pima County Department of Transportation and Flood Control District Inc., *Pima County Storm Drain Design Guidelines and Standard Plans*, March 1981.

11) Pima County Department of Transportation and Flood Control District Inc., *Roadway Design Manual*, September 1998.

12) The WLB Group, Inc., *Addendum to the Drainage Report for Vista Oeste Estates,* WLB No. 193065-A-001-0400, Approved August 15, 1994.


UNSUBDIVIDED
ARTHUR PACK
30' ROADWAY EASMT DKT 5945 PG. 279
HARDY ROAD
660.45'
N 89°59'43"W
NORTH 1/4 COR
DEVELOPED
Q100=17cfs
DA=2.3ac
10' UTILITIES EASEMENT
NORWOOD ST.
NEWHILL AVE.
BRAEMORE ST.
5' UTILITIES EASEMENT
"E"
15' DRAINAGEWAY
PHASE II
KEELER ST.
VALLEY BROOK ST.
HOLLY BROOK AVE.
CHANNEL WAY
N00°09'46"E
1320.76'
N00°10'02"E
192.04'
EXISTING
Q100=37cfs
DA=6.95ac
EXISTING
Q100=132cfs
DA=27.8ac
15' SEWER & UTILITIES ESMT.
DEVELOPED
Q100=200cfs
DA=40.7ac
DETENTION/RETENTION BASIN
100-YEAR WSE =2353.7'
DEVELOPED
Q100=73cfs
DA=3.1ac
PHASE II
PHASE I
DEVELOPED
Q100=76cfs
DA=3.8ac
EXISTING
Q100=45cfs
DA=8.0ac
N 89°58'12"W
215.00
DELTA WAY
HUMMER DRIVE
MORNING VIEW DRIVE
DRAINAGEWAY
PUBLIC
AVOCADO STREET
AVOCADO STREET
FIRETHORN AVENUE
PHASE I
"F"
"F"
DEVELOPED
Q100=118cfs
DA=17.0ac
TREECE WAY
1320.49
EXCLUDED
SHEET 3
SHEET 2
UNSUBDIVIDED
DELTA WAY
HUMMER DRIVE
PUBLIC DRAINAGEWAY
BAYOU DRIVE
BAYOU PLACE
DEVELOPED
Q100=174cfs
DETENTION BASIN
100-YEAR WSE=2336.0'
DEVELOPED
Q100=172cfs
336.65
CORTARO FARMS ROAD
N 89° 56' 48" W
CTR. SEC. 30
T-12-S, R-13-E
ORANGEWOOD NORTH
TORTOLITA JR. HIGH SCH.
1" = 100'
FIGURE 16
CORTARO RIDGE
PHASE II
HYDROLOGY
CDA-03353





LOCATION MAP

SECTION 30 and PORTIONS OF SECTIONS 19,20,29,31 and 32, T12S,R13E,G&SRB&M, PIMA COUNTY,ARIZONA.

3" : 1 MILE

CROSS SECTION LOCATIONS

CONCENTRATION POINTS

100 YEAR FLOODPRONE AREAS

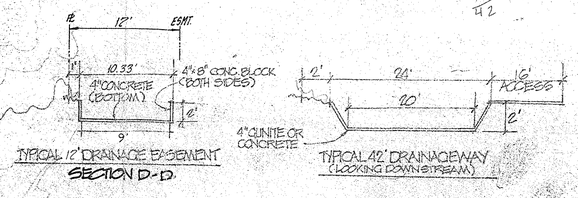
FLOW ARROWS

ONSITE DRAINAGE BASINS

A CHANNEL BEND

FIGURE 4

TENTATIVE PLAT FOR CORTARO RIDGE SHOWING CONCENTRATION POINTS,CROSS SECTION LOCATIONS, EXISTING 100 YR FLOODPRONE AREAS AND ONSITE DRAINAGE SCHEME



TENTATIVE PLAT OF

CORTARO RIDGE

LOTS 1 THRU 124

BEING A SUBDIVISION OF THE SW 1/4, NE 1/4, SECTION 30, T12S,R13E, G&SRB&M,PIMA COUNTY,ARIZONA

SCALE 1" : 50' MARCH ,1983

CO9-83-10
CO12-83-17

CELLA BARR ASSOCIATES

03124-01-30

GENERAL NOTES

1. AREA OF SUBDIVISION: 20.03 ACRES.
2. EXISTING ZONING: SR PROPOSED ZONING: CR-4 PER ORDINANCE NO. 1983-47
3. MILES OF NEW PUBLIC STREETS: 0.68 MILES.
4. NUMBER OF LOTS: 100
5. ALL PUBLIC ROADS WITHIN OR ADJACENT TO THIS SUBDIVISION SHALL BE CONSTRUCTED IN ACCORDANCE WITH APPROVED PLANS; CONSTRUCTION PLANS SHALL BE SUBMITTED TO PIMA COUNTY DEPARTMENT OF TRANSPORTATION AND FLOOD CONTROL DISTRICT FOR REVIEW AND APPROVAL.
6. HARDY ROAD IS THE NEAREST PAVED ACCESS MAINTAINED BY PIMA COUNTY WHICH SERVES THIS SUBDIVISION, IT IS ADJACENT TO THIS SUBDIVISION.
7. ALL WEATHER ACCESS WILL BE PROVIDED TO ALL LOTS WITHIN THIS SUBDIVISION.
8. THE DEVELOPER HOLDS PIMA COUNTY, ITS SUCCESSORS AND ASSIGNEES, HARMLESS IN THE EVENT OF FLOODING.
9. DRAINAGE WILL REMAIN IN ITS NATURAL STATE AND WILL NOT BE ALTERED, DISTURBED OR OBSTRUCTED OTHER THAN AS SHOWN ON THIS PLAT.
10. EXISTING 100-YEAR FLOOD LIMITS, AS SHOWN ON THIS PROPERTY ARE TO BE REMOVED UPON COMPLETION OF CONSTRUCTION.
11. ALL DRAINAGEWAYS AND DRAINAGE EASEMENTS SHOWN AND LABELED HEREON WHICH ARE TO BE CONSTRUCTED IN CONJUNCTION WITH THE DEVELOPMENT OF THIS PROJECT SHALL ENTIRELY CONTAIN THEIR RESPECTIVE 100-YEAR FLOOD LIMITS UPON COMPLETION OF CONSTRUCTION.
12. ALL DRAINAGE IMPROVEMENTS ON OR ADJACENT TO THIS PROJECT WHICH ARE TO BE CONSTRUCTED IN CONJUNCTION WITH THE DEVELOPMENT OF THIS PROJECT, SHALL BE CONSTRUCTED ACCORDING TO PLANS AS REVIEWED AND APPROVED BY THE PIMA COUNTY DEPARTMENT OF TRANSPORTATION AND FLOOD CONTROL DISTRICT.
13. ONSITE AND OFFSITE SANITARY SEWERS WILL BE PUBLIC AND WILL BE DESIGNED AND CONSTRUCTED TO PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT'S STANDARDS (DESIGN, SPECIFICATIONS, AND DETAILS).
14. APPROVAL OF CONSTRUCTION PLANS BY THE PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT FOR ALL PUBLIC SANITARY SEWERS WILL BE OBTAINED PRIOR TO THE ADOPTION OF THE ZONING ORDINANCE BY THE BOARD OF SUPERVISORS.
15. AN ALLEY WAIVER IS REQUESTED.
16. CONTOUR INTERVAL 1' BY PHOTOGRAMMETRIC METHOD.
17. OWNER/DEVELOPER: PULTE HOME CORP.
717 S. ALVERNON
TUCSON, ARIZONA 85711
(602)323-2564
18. ALL INTERIOR STREETS SHALL BE PUBLIC STREETS.
19. BASIS OF BEARING: THE CENTERLINE OF CORTARO FARMS ROAD AS RECORDED ON PLAT OF "ORANGEWOOD NORTH" IN BOOK 30, M&P, PG. 98, AND BEING N 89°56'48" W.
20. BASIS OF ELEVATION IS MANHOLE RIM AT THE INTERSECTION OF CORTARO FARMS ROAD AND DELTA WAY AND BEING 2,336.16.
21. NO GRADING TO OCCUR UNTIL 30 DAYS PRIOR TO CONSTRUCTION.
22. DENSITY IS LIMITED TO FIVE UNITS PER ACRE.
23. (5) - CONCENTRATION POINTS. (HYDROLOGY)
24. ~~~→ DIRECTION OF FLOW. (HYDROLOGY)
25. - - - - DRAINAGE BASIN (HYDROLOGY)
26. THE PIMA COUNTY BOARD OF SUPERVISORS, NOVEMBER 1, 1983, APPROVED THE CR-4 SMALL LOT OPTION AND WAIVED THE RECREATION FACILITY REQUIREMENTS.
27. (1) RATED CROSS-SECTIONS (HYDROLOGY)

UNSUBDIVIDED

1" = 50'

CONTOUR INTERVAL 1 FT.
TOPOGRAPHY BY AERIAL METHODS

THORNYDALE RD.
EAST LINE SEC. 30
E1/4 COR
(R. 1320.48')

1/16 COR
(R. 1321.04' N00°10'03"E)
EXCL.
1/16 COR

EXIST DA-6.95 AC
EXIST Q100 - 37 cfs
5-B
10' SITE SETBACK
S00°10'02"W 1321.04'
EXISTING D.A. = 27.8 AC
EXISTING Q100 = 132 cfs
1-B
DRAINAGEWAY, SANITARY SEWER & UTILITIES DEDICATED TO PIMA COUNTY
14
EXIST DA- 25.5 AC
EXIST Q100 - 169 cfs
100 YEAR FLOOD PLAIN LINE
DEVDA-5.17 AC
DEV Q100 - 28 cfs
DRAINAGE EASEMENT
DETENTION BASIN, SANITARY SEWERS & UTILITIES TO BE DEDICATED TO PIMA COUNTY
15
DEV DA = 40.7 AC
DEV Q100 = 200 cfs
"A"
EXCL.
FARMS ROAD
CORTARO
(R. 1320.48' - N89°56'48"W)
EXIST DA- 30.8 AC
EXIST Q100 - 195 cfs
20' UTILITY & ACCESS EASEMENT
EXIST MH
IE
EXIST PAVING
MORNING VIEW DR.
PROPOSED SEWER AS PER 93-12
DEVEL. D.A. = .97 AC
DEVEL. Q100 = 7 cfs
EXIST D.A = 1.64 AC
EXIST Q100 = 6 cfs
10' SITE SETBACK
EXIST DA- 20.3 AC
EXIST Q100 - 100 cfs
DEV DA - 20.3 AC
DEV Q100 - 147 cfs
HUMMER DR.
* TO BE REMOVED ON FORMAL TENTATIVE PLAT.
(R. 1320.49' - N89°58'15"W)
CORTARO RIDGE LOTS 1 THRU 125 (BK. 30 M&P, PG. 32')
(R. 1320.50' - N89°56'48"W)
N89°58'15"W 660.35'
CENTER SECTION 30
1/16 COR
(R. 1320.49' - N00°09'30"E)

EXIST DA- 2.08 AC
EXIST Q100 - 9 cfs
3
EXIST DA- 1.51 AC
EXIST Q100 - 9 cfs
4
EXISTING D.A. = 4.91 AC
EXISTING Q100 = 24 cfs
12
DEVELOPED D.A. = 4.29 AC
DEVELOPED Q100 = 31 cfs
1320.76' N00°09'46"E
5-A
EXIST DA- 15.6 AC
EXIST Q100 - 74 cfs
11
DEVELOPED D.A = 5.63 AC
DEVELOPED Q100 = 41 cfs
7
EXIST DA 1.7 AC
EXIST Q100 - 7 cfs
8*
2
EXISTING D.A. = .89 AC
EXISTING Q100 = 5 cfs
13
DEVELOPED D.A. = 2.30 AC
DEVELOPED Q100 = 17 cfs
INTERNAL DRAINAGE CHANELS
A-A
A-A'
A-B'
12' DRAINAGE EASEMENT (LOOKING DOWNSTREAM)

TORTOLITA JR. HIGH SCHOOL

UNSUBDIVIDED
ARTHUR PACK PARK
HARDY ROAD
S89°59'43"E 663.45'
NORTH LINE SEC. 30
N1/4 COR.
CORTARO FARMS RD.
NORWOOD STREET
BRAEMORE STREET
KEELER STREET
NEWHILL COURT
VALLEY BROOK STREET
NEWHILL AVENUE
MORNING VIEW DRIVE
THIS 30' ROW TO BE DEDICATED TO PIMA COUNTY BY THIS PLAT
EXIST WATER
IE DRAINAGE EASEMENT
PEDESTRIAN PATHWAY
10' SITE SETBACK
100 YR FLOOD PLAIN LINE
IE ACCESS EASEMENT
UTILITY EASEMENT
LOT NUMBERS 1 THRU 224

SECTION D-D
EXIST. PAVEMENT
NEW PAVEMENT

LOCATION PLAN
SECTION 30, T12S-R13E, G&SRB&M, PIMA COUNTY, ARIZONA
ARTHUR PACK PARK
UNSUBDIVIDED
HARDY ROAD
THORNYDALE RD.
CORTARO FARMS RD.
ORANGEWOOD NORTH (FI-169) 29-38
ORANGEWOOD EST.
RANCHITOS NORTE-S (FI-161) 23-27

SECTION A-A

SECTION B-B

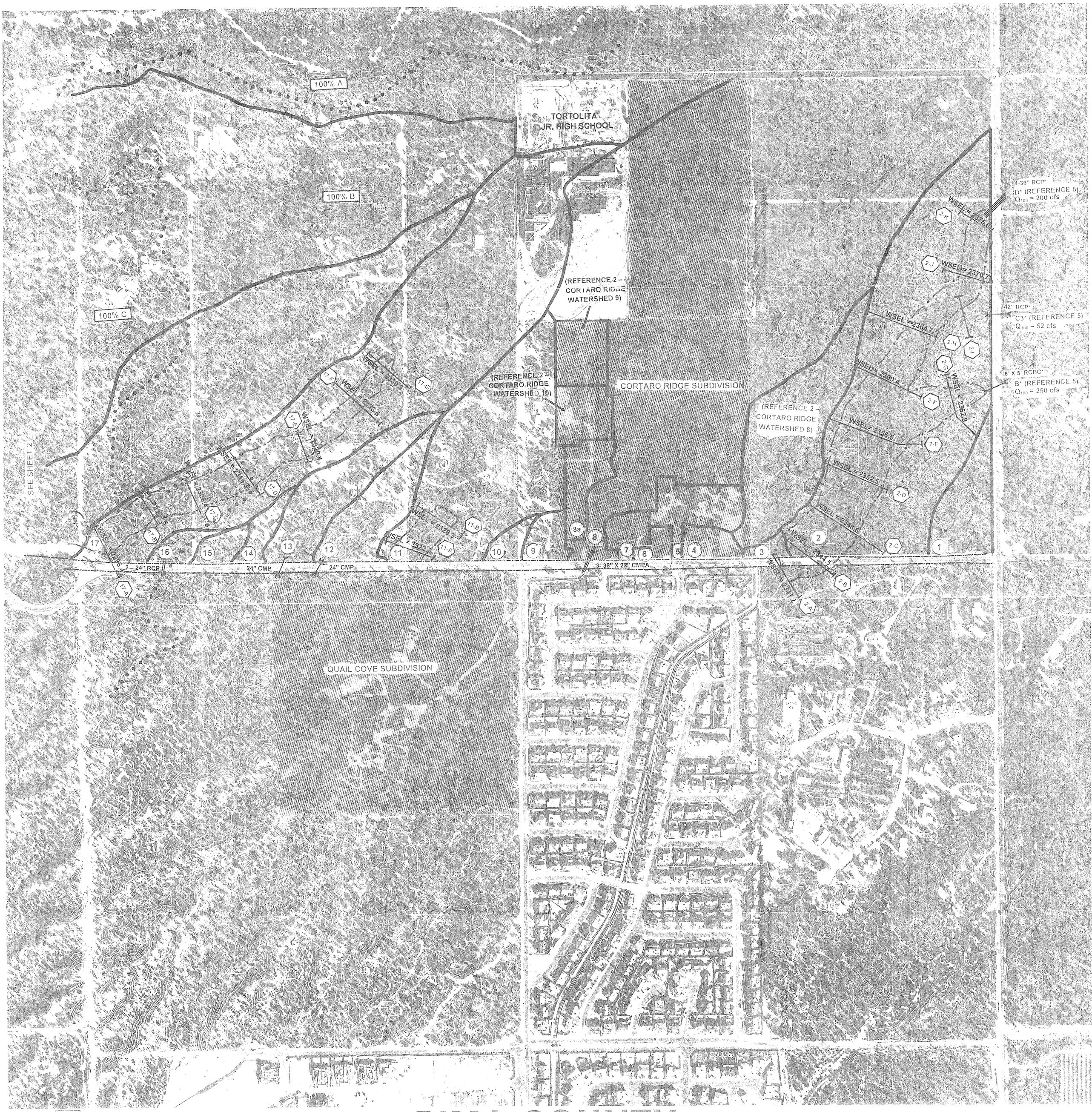
STREET SECTION

SECTION C-C

FIGURE 8
(HYDROLOGY)

TENTATIVE PLAT for CORTARO RIDGE
LOTS 125 THROUGH 224
CO9-83-95
CO12-83-112
A SUBDIVISION OF THE N1/2, W1/2, E1/2, NE1/4, SECTION 30, T12S-R13E, G&SRB&M, PIMA COUNTY, ARIZONA
NOVEMBER 1983 SCALE: 1" = 50'

CELLA BARR ASSOCIATES
2078 North Sixth Avenue
Tucson, Arizona 85705
(602) 624-2401



Cooper Aerial Survey Co.
TUCSON, ARIZONA

1" = 200'

PIMA COUNTY

Dec. 13, 1982

SECTION 30
T12S R13E

19-44

LEGEND:

- Watershed Boundary
- 100-Year Floodplain
- 1-A — Cross Section Designation
- Soil Boundary
- 100% B — Soil Classification
- Existing Cortaro Farms R.O.W.
- 1 — Concentration Point

* Future Construction

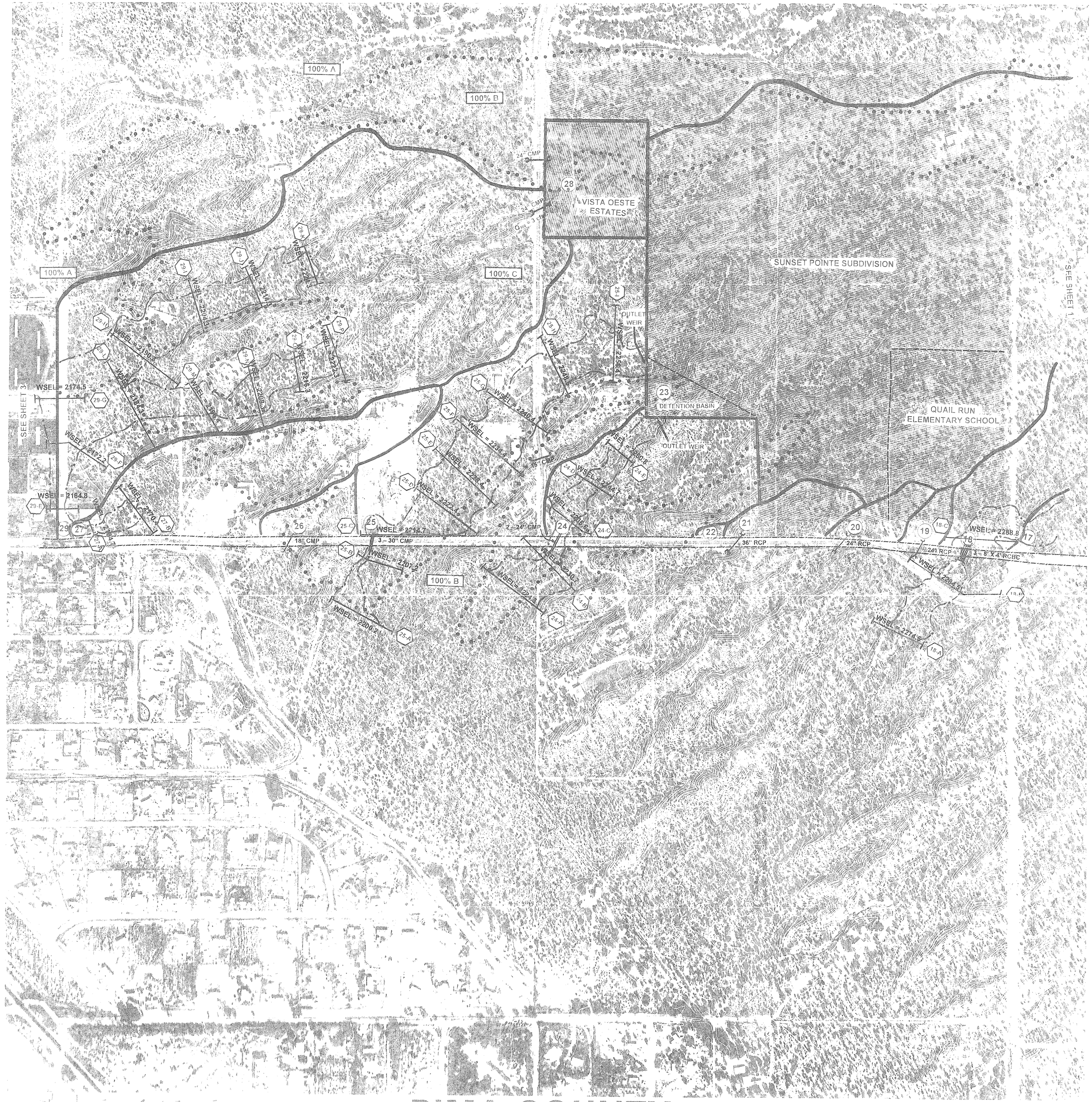
Concentration Point	Area (ac)	Tc (min)	Q_{100} (cfs)
1	3.9	6	22
2	53.7	12	489
3	0.5	5	70
4	1.2	5	9
5	3.1	5	24
6	0.6	8	4
7	1.2	9	8
8	N/A	N/A	172
8a	2.2	5	16
9	1.3	5	9
10	0.9	5	5
11	17.5	7	120
12	4.7	5	29
13	5.4	6	32
14	1.1	5	7
15	1.0	5	6
16	1.0	5	7
16 (comb)	3.1	5	19
17	38.2	12	175

CORTARO FARMS ROAD
OFFSITE WATERSHED MAP
Figure 2

SHEET 1 OF 3

MMLA
McGovern MacVittie Lodge & Associates, Inc.

MMLA JOB NO. 99067-01-106



PIMA COUNTY

1" = 200'

Dec. 28, 1982

SECTION OF 1-28" PIPE

18-44

LEGEND:

- Watershed Boundary
- 100-Year Floodplain
- 1-A — Cross Section Designation
- Soil Boundary
- 100% B — Soil Classification
- Existing Cortaro Farms R.O.W.
- 1 — Concentration Point

Concentration Point	Area (ac)	Tc (min)	Q_{100} (cfs)
18	71.2	12	326
19	1.4	5	10
20	2.3	5	16
21	3.6	5	25
22	0.2	5	1
23	145.6	12	692
24	14.9	5	393
25	32.2	8	435
26	2.7	5	18
27	17.9	6	117
28	8.7	N/A	6
29	74.2	9	380
29 (comb)	92.1	9	486

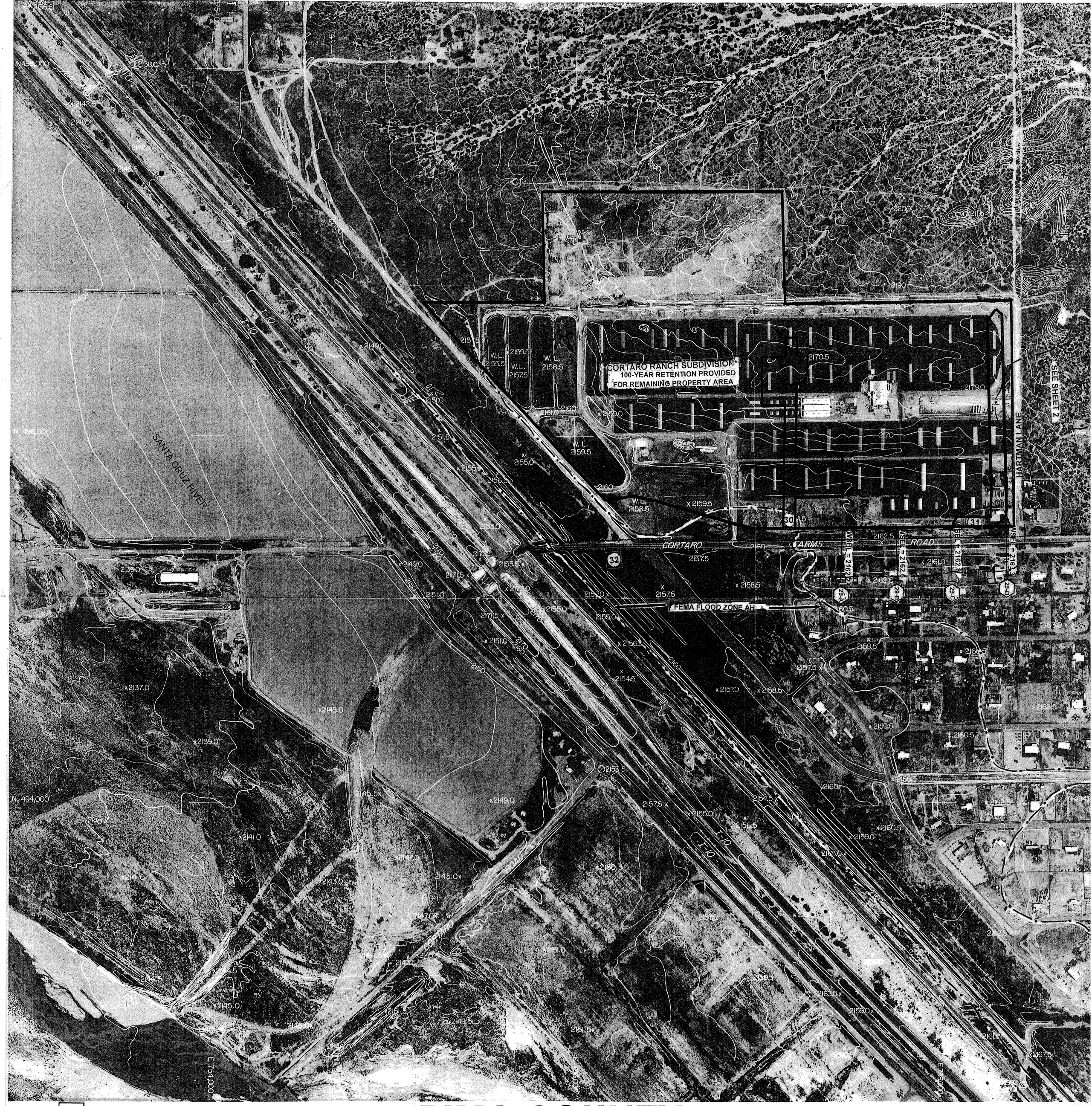
CORTARO FARMS ROAD
OFFSITE WATERSHED MAP
Figure 2

SHEET 2 OF 3

MMLA

McGavern Merrithe Loope & Associates, Inc.

MMLA JOB NO. 99067-01-106



PIMA COUNTY

Cooper Aerial Survey Co.
TUCSON, ARIZONA

1" = 200' C.I. 2'

MAY 4, 1984

SECTION 26
T12S R12E

17-44

LEGEND:

- Watershed Boundary
- 100-Year Floodplain
- 1-A Cross Section Designation
- Soil Boundary
- 100% B Soil Classification
- Existing Cortaro Farms R.O.W.
- 1 Concentration Point

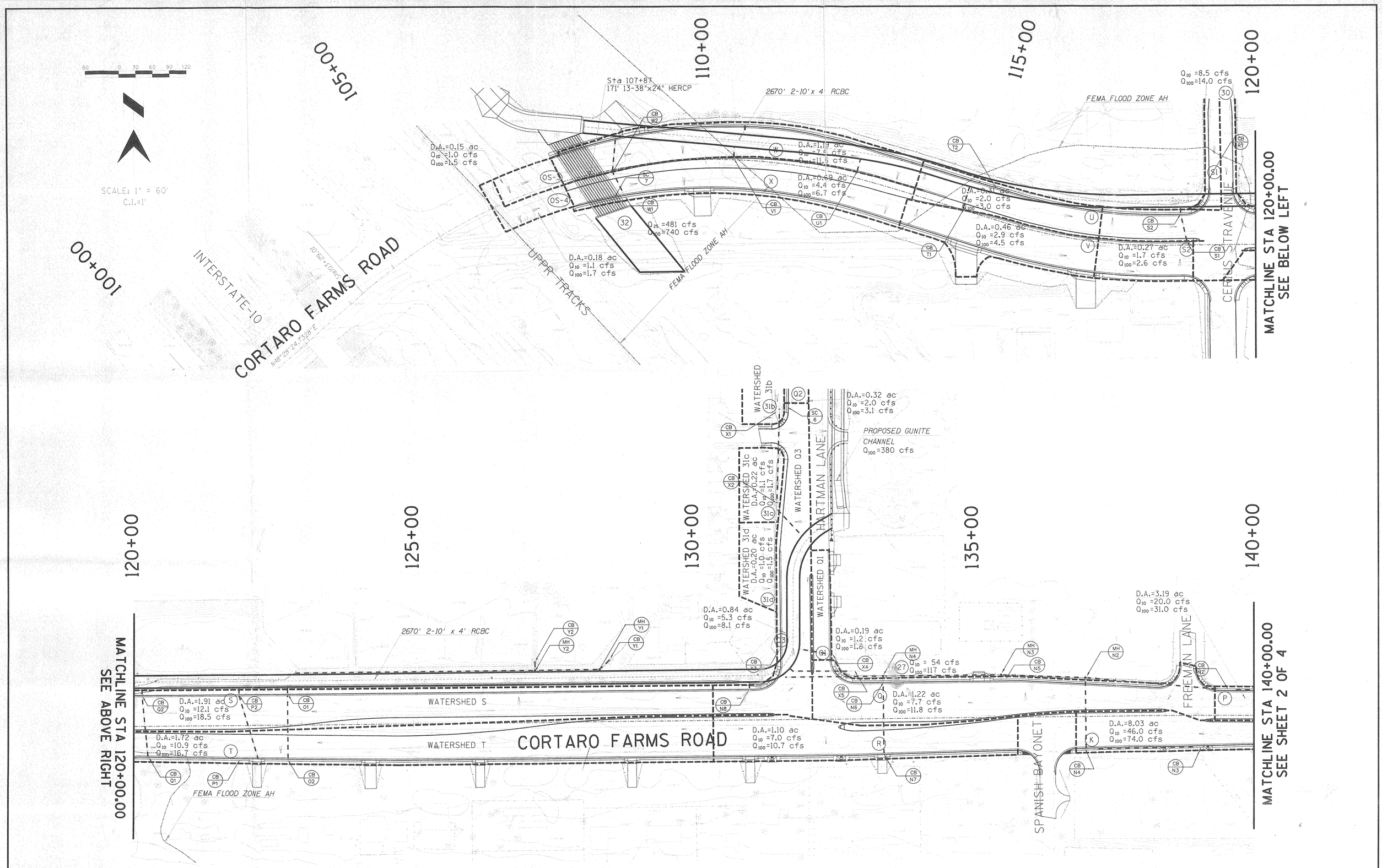
* Future Construction

Concentration Point	Area (ac)	Tc (min)	Q_{100} (cfs)
30	1.8	5	14
31	3.7	5	28
32	N/A	N/A	740

CORTARO FARMS ROAD OFFSITE WATERSHED MAP
Figure 2

SHEET 3 OF 3

MMLA
McGovern MacVittie Lodge & Associates, Inc.
MMLA JOB NO. 99067-01-106



LEGEND:

- Watershed Boundary
- (X) Concentration Point
- Flow Arrow
- Existing Floodplain Boundary
- Developed Floodplain Boundary
- (2-B) Cross Section Designation

Two working days before you dig
CALL FOR THE BLUE STAKES
1-800-STAKE-IT
BLUE STAKE CENTER
CALL COLLECT

NO.	REVISION	DATE

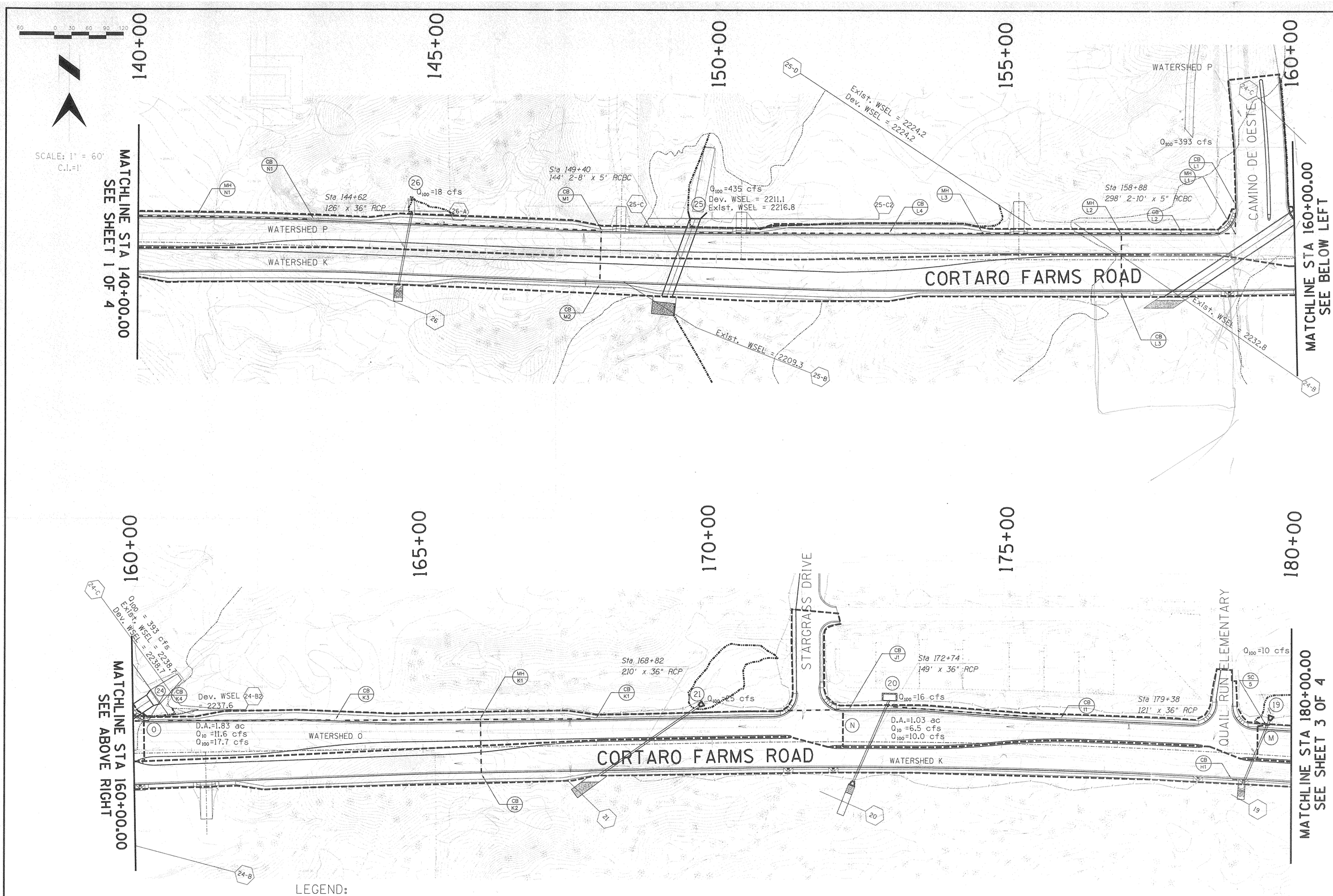
MMLA
800 E. Wetmore Rd.
Suite 110
Tucson, AZ 85719
Tel (520) 292-2300
Fax (520) 292-1290

ONSITE WATERSHED MAP
FOR
CORTARO FARMS ROAD
STA 100+00.00 TO STA 140+00.00
FIGURE 3

PROJ NO: 99067-01-600
DATE: 10/18/02
SCALE: HORIZ 1" = 60'
VERT N/A
1 OF 4

Engineering • Planning • Environmental • Surveying • Water Resources

VIEW NAME: W501.pdgn
04/30/02



LEGEND:

- Watershed Boundary
- (X) Concentration Point
- Flow Arrow
- Existing Floodplain Boundary
- Developed Floodplain Boundary
- (2-B) Cross Section Designation

Two working days before you dig, CALL FOR THE BLUE STAKES
1-800-STAKE-IT
BLUE STAKE CENTER
CALL COLLECT

VIEW NAME: WS02J.dgn
04/30/02

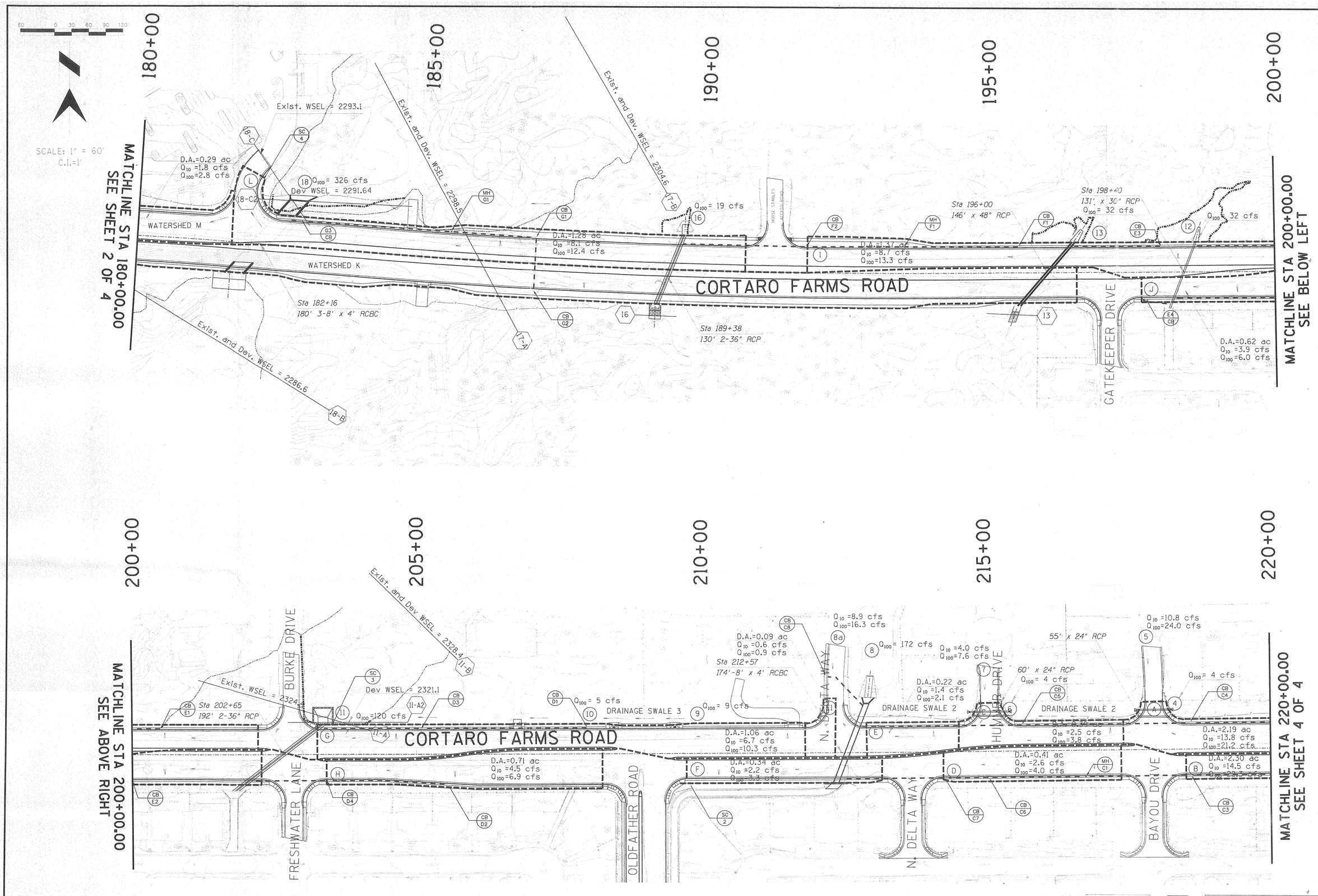
NO.	REVISION	DATE

MMLA
800 E. Wetmore Rd.
Suite 115
Tucson, AZ 85719
Tel (520) 292-2300
Fax (520) 292-1290

ONSITE WATERSHED MAP
FOR
CORTARO FARMS ROAD
STA 140+00.00 TO STA 180+00.00
FIGURE 3

PROJ NO: 99067-01-600 SCALE: HORIZ 1" = 60'
DATE: 10/18/02 VERT N/A

Engineering • Planning • Environmental • Surveying • Water Resources



LEGEND:

- Watershed Boundary
- (X) Concentration Point
- Flow Arrow
- Existing Floodplain Boundary
- Developed Floodplain Boundary
- (2-B) Cross Section Designation

Two working days before you dig. CALL FOR THE BLUE STAKES 1-800-STAKE-IT BLUE STAKE CENTER CALL COLLECT

NO. | REVISION | DATE

MMLA

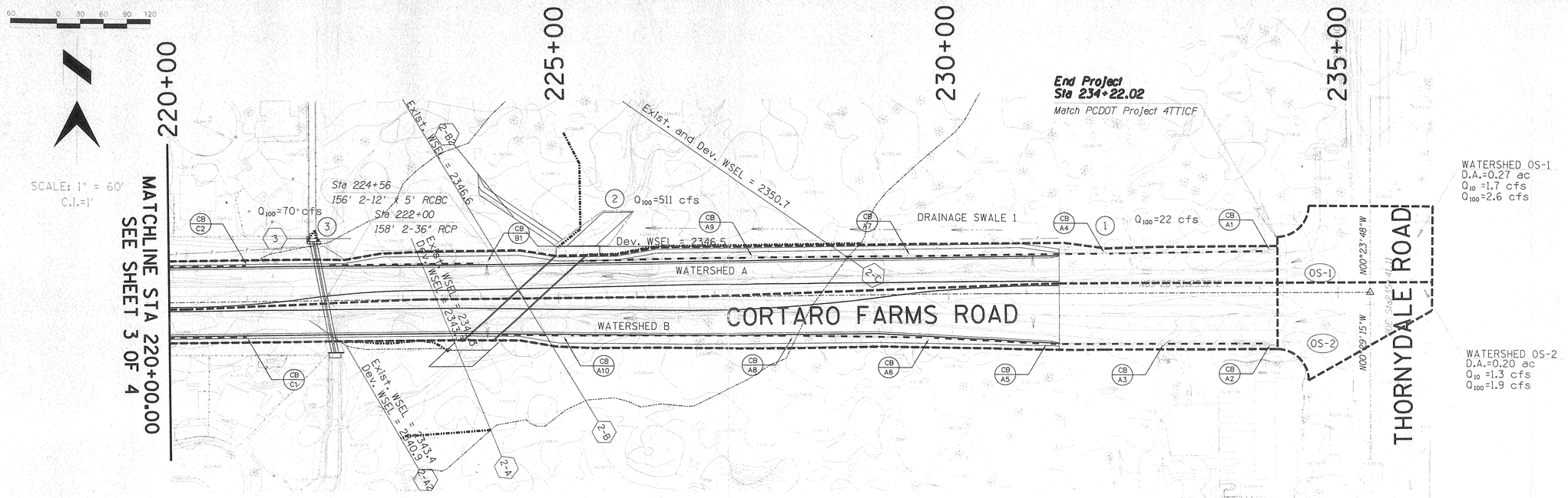
800 E. Wetmore Rd. Suite 110
Tucson, AZ 85719
Tel (520) 292-2300
Fax (520) 292-1290

ONSITE WATERSHED MAP
FOR
CORTARO FARMS ROAD
STA 180+00.00 TO STA 220+00.00
FIGURE 3

PROJ NO: 99067-01-600 | SCALE: HORIZ 1" = 60' VERT N/A | 3 OF 4
DATE: 10/18/02

Engineering • Planning • Environmental • Surveying • Water Resources

VIEW NAME: WSØ3J.dgn
04/30/02



LEGEND:

- Watershed Boundary
- (X) Concentration Point
- Flow Arrow
- Existing Floodplain Boundary
- Developed Floodplain Boundary
- (2-B) Cross Section Designation

Two working days before you dig, CALL FOR THE BLUE STAKES
1-800-STAKE-IT
BLUE STAKE CENTER
CALL COLLECT

VIEW NAME: WS24J.dgn
4/30/02

NO. REVISION DATE

MMLA
800 E. Wetmore Rd.
Suite 110
Tucson, AZ 85719
Tel (520) 292-2300
Fax (520) 292-1290

ONSITE WATERSHED MAP
FOR
CORTARO FARMS ROAD
STA 220+00.00 TO STA 235+00.00
FIGURE 3

PROJ NO: 99067-01-600
DATE: 10/18/02
SCALE: HORIZ 1" = 60'
VERT N/A

4 OF 4

Engineering • Planning • Environmental • Surveying • Water Resources

□E□-1RESERVOIR ROUTING□-0□F

PROJECT: CORTARO FARMS ROAD
BASIN: REVISED IHOP DETENTION BASIN
PREPARED BY: SP

JOB #: 99067-01
Q100
DATE: 10-14-2002

□E□-1WORKING TABLE□-0□F

Routing interval (t) = 1.00 min

STAGE (ft)	DISCHARGE (cfs)	STORAGE (af)	S/t+O/2 (cfs)
2160.80	0.0	0.00	0.0
2161.10	0.5	0.03	22.0
2161.35	0.7	0.07	51.2
2161.60	3.9	0.09	67.3
2162.03	14.5	0.15	116.2
2162.60	92.9	0.23	213.4
2163.00	206.4	0.31	328.3

□E□-1ROUTING TABLE□-0□F

TIME STEP	TIME (min)	INFLOW (cfs)	S/t+O/2 (cfs)	OUTFLOW (cfs)	STORAGE (af)	STAGE (ft)
0	0.0	0.0	0.0	0.0	0.00	2160.80
1	1.0	1.0	0.5	0.0	0.00	2160.81
2	2.0	4.0	3.0	0.1	0.00	2160.84
3	3.0	7.0	8.4	0.2	0.01	2160.91
4	4.0	11.0	17.2	0.4	0.02	2161.03
5	5.0	16.0	30.3	0.6	0.04	2161.17
6	6.0	20.0	47.7	0.7	0.07	2161.32
7	7.0	25.0	69.6	4.4	0.09	2161.62
8	8.0	31.0	93.2	9.5	0.12	2161.83
9	9.0	38.0	118.2	16.2	0.15	2162.04
10	10.0	45.0	143.5	36.6	0.17	2162.19
11	11.0	54.0	156.5	47.0	0.18	2162.27
12	12.0	62.0	167.5	55.9	0.19	2162.33
13	13.0	68.0	176.6	63.2	0.20	2162.38
14	14.0	66.0	180.4	66.3	0.20	2162.41
15	15.0	62.0	178.1	64.4	0.20	2162.39
16	16.0	58.0	173.7	60.9	0.20	2162.37
17	17.0	54.0	168.8	56.9	0.19	2162.34
18	18.0	50.0	163.9	53.0	0.19	2162.31
19	19.0	46.0	158.9	49.0	0.19	2162.28
20	20.0	42.0	153.9	45.0	0.18	2162.25
21	21.0	39.0	149.5	41.4	0.18	2162.23
22	22.0	35.0	145.1	37.8	0.17	2162.20
23	23.0	32.0	140.8	34.3	0.17	2162.17
24	24.0	29.0	136.9	31.2	0.17	2162.15
25	25.0	26.0	133.2	28.2	0.16	2162.13
26	26.0	24.0	129.9	25.6	0.16	2162.11
27	27.0	22.0	127.3	23.5	0.16	2162.10
28	28.0	19.0	124.3	21.1	0.16	2162.08
29	29.0	17.0	121.2	18.6	0.15	2162.06
30	30.0	16.0	119.1	16.9	0.15	2162.05
31	31.0	14.0	117.2	15.4	0.15	2162.04
32	32.0	12.0	114.9	14.2	0.15	2162.02
33	33.0	11.0	112.1	13.6	0.15	2161.99
34	34.0	10.0	109.0	12.9	0.14	2161.97
35	35.0	9.0	105.5	12.2	0.14	2161.94
36	36.0	8.0	101.8	11.4	0.13	2161.90
37	37.0	7.0	98.0	10.5	0.13	2161.87
38	38.0	7.0	94.4	9.8	0.12	2161.84
39	39.0	6.0	91.1	9.1	0.12	2161.81
40	40.0	6.0	88.1	8.4	0.12	2161.78
41	41.0	5.0	85.2	7.8	0.11	2161.76
42	42.0	5.0	82.4	7.2	0.11	2161.73
43	43.0	5.0	80.3	6.7	0.11	2161.71
44	44.0	4.0	78.1	6.2	0.10	2161.70
45	45.0	4.0	75.9	5.7	0.10	2161.68

□E□-1ROUTING TABLE□-0□F
(continued)

TIME STEP	TIME (min)	INFLOW (cfs)	S/t+O/2 (cfs)	OUTFLOW (cfs)	STORAGE (af)	STAGE (ft)
46	46.0	4.0	74.2	5.4	0.10	2161.66

PEAK OUTFLOW = 66.3 cfs
AT TIME = 14.0 min.
MAX. STAGE AT 2162.41 ft.
MAX. STORAGE VOLUME = 0.20 ac-ft
□fs
AT TIME = 14.0 min.
MAX. STAGE AT 2162.41 ft.
MAX. STORAGE VOLUME =

□E□-1RESERVOIR ROUTING□-0□F

PROJECT: CORTARO FARMS ROAD
BASIN: REVISED CORTARO RANCH RET. BASIN
PREPARED BY: SP

JOB #: 99067-01
Q100
DATE: 10-21-2002

□E□-1WORKING TABLE□-0□F

Routing interval (t) = 1.00 min

STAGE (ft)	DISCHARGE (cfs)	STORAGE (af)	S/t+O/2 (cfs)
2156.00	0.0	0.00	0.0
2157.00	0.0	0.43	311.4
2158.00	0.0	0.94	679.5
2159.00	0.0	1.50	1086.8
2159.50	0.0	1.79	1302.4
2160.00	5.5	2.10	1528.0
2161.00	28.4	2.74	2004.9
2162.00	61.0	3.42	2514.1

□E□-1ROUTING TABLE□-0□F

TIME STEP	TIME (min)	INFLOW (cfs)	S/t+O/2 (cfs)	OUTFLOW (cfs)	STORAGE (af)	STAGE (ft)
0	0.0	0.0	0.0	0.0	0.00	2156.00
1	1.0	2.0	1.0	0.0	0.00	2156.00
2	2.0	8.3	6.2	0.0	0.01	2156.02
3	3.0	16.9	18.8	0.0	0.03	2156.06
4	4.0	26.6	40.6	0.0	0.06	2156.13
5	5.0	36.8	72.3	0.0	0.10	2156.23
6	6.0	47.8	114.6	0.0	0.16	2156.37
7	7.0	59.7	168.3	0.0	0.23	2156.54
8	8.0	73.2	234.8	0.0	0.32	2156.75
9	9.0	88.5	315.6	0.0	0.43	2157.01
10	10.0	105.8	412.7	0.0	0.57	2157.28
11	11.0	124.9	528.1	0.0	0.73	2157.59
12	12.0	144.7	662.9	0.0	0.91	2157.95
13	13.0	163.3	816.8	0.0	1.13	2158.34
14	14.0	178.0	987.5	0.0	1.36	2158.76
15	15.0	171.6	1162.3	0.0	1.60	2159.18
16	16.0	161.6	1328.9	0.6	1.83	2159.56
17	17.0	151.7	1484.9	4.4	2.04	2159.90
18	18.0	141.8	1627.2	10.3	2.23	2160.21
19	19.0	132.1	1753.8	16.3	2.40	2160.47
20	20.0	122.6	1864.8	21.7	2.55	2160.71
21	21.0	113.4	1961.1	26.3	2.68	2160.91
22	22.0	104.6	2043.8	30.9	2.79	2161.08
23	23.0	96.2	2113.3	35.3	2.89	2161.21
24	24.0	88.2	2170.1	39.0	2.96	2161.32
25	25.0	80.6	2215.5	41.9	3.02	2161.41
26	26.0	73.5	2250.7	44.1	3.07	2161.48
27	27.0	66.8	2276.7	45.8	3.10	2161.53
28	28.0	60.7	2294.6	47.0	3.13	2161.57
29	29.0	54.9	2305.5	47.6	3.14	2161.59
30	30.0	49.7	2310.1	47.9	3.15	2161.60
31	31.0	44.9	2309.5	47.9	3.15	2161.60
32	32.0	40.5	2304.3	47.6	3.14	2161.59
33	33.0	36.5	2295.2	47.0	3.13	2161.57
34	34.0	33.0	2283.0	46.2	3.11	2161.55
35	35.0	29.8	2268.1	45.3	3.09	2161.52
36	36.0	26.9	2251.2	44.2	3.07	2161.48
37	37.0	24.4	2232.7	43.0	3.05	2161.45
38	38.0	22.1	2212.9	41.7	3.02	2161.41
39	39.0	20.2	2192.3	40.4	2.99	2161.37
40	40.0	18.4	2171.2	39.1	2.96	2161.33
41	41.0	16.9	2149.9	37.7	2.94	2161.28
42	42.0	15.6	2128.4	36.3	2.91	2161.24
43	43.0	14.4	2107.1	34.9	2.88	2161.20
44	44.0	13.4	2086.1	33.6	2.85	2161.16
45	45.0	12.5	2065.4	32.3	2.82	2161.12

□E□-1ROUTING TABLE□-0□F
(continued)

TIME STEP	TIME (min)	INFLOW (cfs)	S/t+O/2 (cfs)	OUTFLOW (cfs)	STORAGE (af)	STAGE (ft)
46	46.0	11.7	2045.3	31.0	2.80	2161.08
47	47.0	11.0	2025.6	29.7	2.77	2161.04
48	48.0	10.3	2006.5	28.5	2.74	2161.00
49	49.0	9.6	1987.9	27.6	2.72	2160.96
50	50.0	9.0	1969.7	26.7	2.69	2160.93
51	51.0	8.4	1951.7	25.8	2.67	2160.89
52	52.0	7.9	1934.0	25.0	2.65	2160.85
53	53.0	7.3	1916.6	24.2	2.62	2160.82
54	54.0	6.7	1899.4	23.3	2.60	2160.78
55	55.0	6.1	1882.5	22.5	2.58	2160.74
56	56.0	5.5	1865.8	21.7	2.56	2160.71
57	57.0	4.9	1849.3	20.9	2.53	2160.67
58	58.0	4.4	1833.0	20.1	2.51	2160.64
59	59.0	3.8	1816.9	19.4	2.49	2160.61
60	60.0	3.2	1801.0	18.6	2.47	2160.57
61	61.0	2.7	1785.4	17.9	2.45	2160.54
62	62.0	2.2	1770.0	17.1	2.43	2160.51
63	63.0	1.8	1754.8	16.4	2.41	2160.48
64	64.0	1.4	1740.0	15.7	2.39	2160.44
65	65.0	1.1	1725.6	15.0	2.37	2160.41
66	66.0	0.0	1711.2	14.3	2.35	2160.38
67	67.0	0.0	1696.9	13.6	2.33	2160.35
68	68.0	0.0	1683.3	13.0	2.31	2160.33
69	69.0	0.0	1670.3	12.3	2.29	2160.30
70	70.0	0.0	1658.0	11.7	2.28	2160.27
71	71.0	0.0	1646.3	11.2	2.26	2160.25
72	72.0	0.0	1635.1	10.6	2.24	2160.22
73	73.0	0.0	1624.4	10.1	2.23	2160.20
74	74.0	0.0	1614.3	9.6	2.22	2160.18
75	75.0	0.0	1604.7	9.2	2.20	2160.16
76	76.0	0.0	1595.5	8.7	2.19	2160.14
77	77.0	0.0	1586.8	8.3	2.18	2160.12
78	78.0	0.0	1578.4	7.9	2.17	2160.11
79	79.0	0.0	1570.5	7.5	2.16	2160.09
80	80.0	0.0	1563.0	7.2	2.15	2160.07
81	81.0	0.0	1555.8	6.8	2.14	2160.06
82	82.0	0.0	1549.0	6.5	2.13	2160.04
83	83.0	0.0	1542.5	6.2	2.12	2160.03
84	84.0	0.0	1536.3	5.9	2.11	2160.02
85	85.0	0.0	1530.4	5.6	2.10	2160.01
86	86.0	0.0	1524.8	5.4	2.10	2159.99
87	87.0	0.0	1519.3	5.3	2.09	2159.98
88	88.0	0.0	1514.1	5.2	2.08	2159.97
89	89.0	0.0	1508.9	5.0	2.07	2159.96

PEAK OUTFLOW	=	47.9	cfs
AT TIME	=	30.0	min.
MAX. STAGE AT		2161.60	ft.
MAX. STORAGE VOLUME	=	3.15	ac-ft

Cortaro Farms Road
Worksheet for Broad Crested Weir

Project Description	
Worksheet	Cortaro Ranch Basin Weir
Type	Broad Crested Weir
Solve For	Discharge

Input Data		
Headwater Elevation	2,162.00	ft
Crest Elevation	2,159.50	ft
Tailwater Elevation	2,159.70	ft
Crest Surface Type	Paved	
Crest Breadth	1.00	ft
Crest Length	5.00	ft

Results		
Discharge	61.01	cfs
Headwater Height Above Crest	2.50	ft
Tailwater Height Above Crest	0.20	ft
Discharge Coefficient	3.09	US
Submergence Factor	1.00	
Adjusted Discharge Coefficient	3.09	US
Flow Area	12.5	ft^2
Velocity	4.88	ft/s
Wetted Perimeter	10.00	ft
Top Width	5.00	ft

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McGovern, MacVittie Lodge & Associates
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

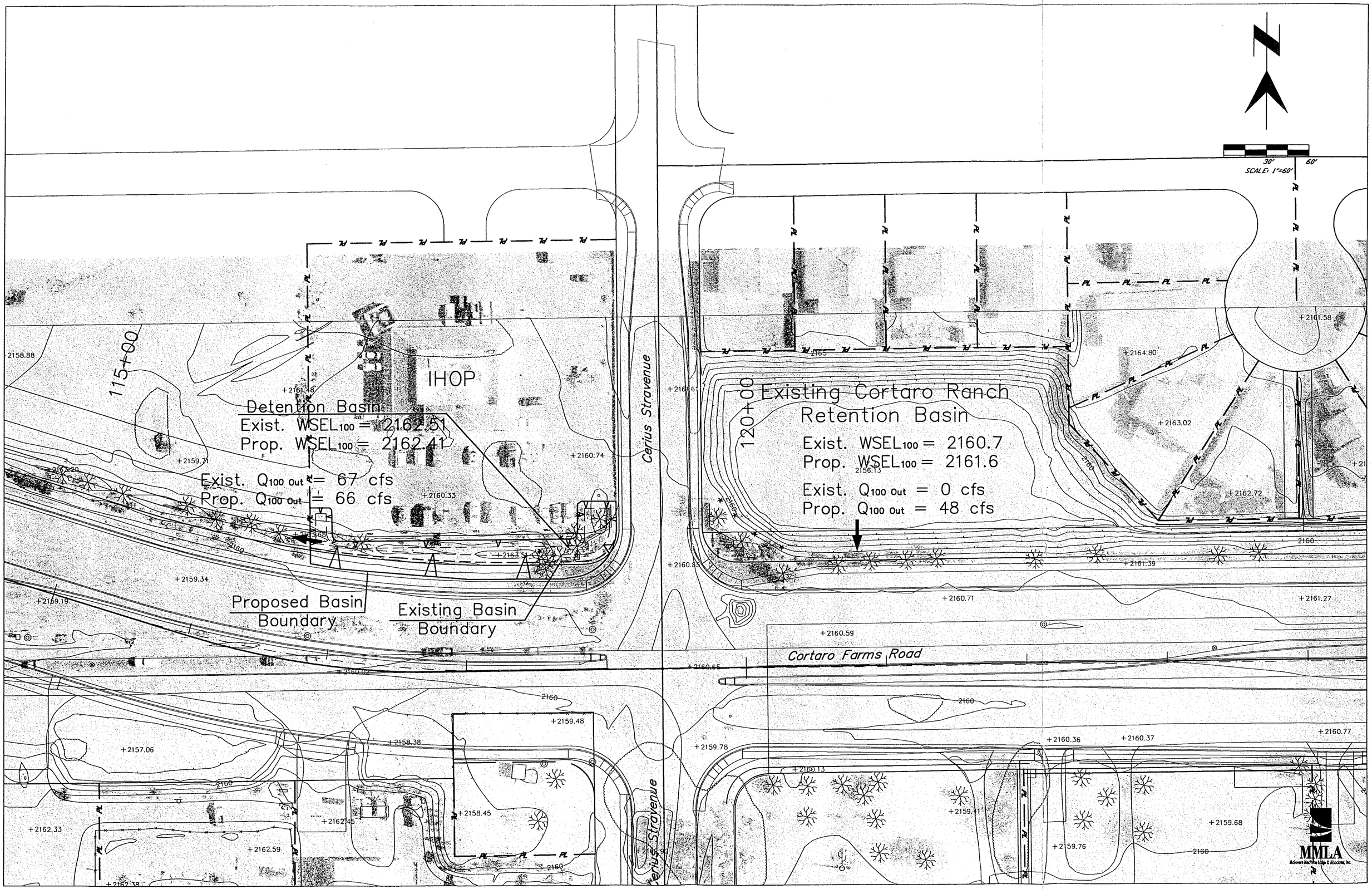
Table
Rating Table for Broad Crested Weir

Project Description	
Worksheet	Cortaro Ranch Basin Weir
Type	Broad Crested Weir
Solve For	Discharge

Input Data		
Crest Elevation	2,159.50	ft
Tailwater Elevation	2,159.70	ft
Crest Surface Type	Paved	
Crest Breadth	1.00	ft
Crest Length	5.00	ft

Attribute	Minimum	Maximum	Increment
Headwater Elevation (ft)	2,159.50	2,162.00	0.50

Headwater Elevation (ft)	Discharge (cfs)	Velocity (ft/s)
2,159.50	N/A	N/A
2,160.00	5.46	2.18
2,160.50	15.44	3.09
2,161.00	28.36	3.78
2,161.50	43.66	4.37
2,162.00	61.01	4.88



SCALE: 1"=60'
30'
60'
IHOP
115+00
120+00
Detention Basin
Exist. WSEL100 = 2162.51
Prop. WSEL100 = 2162.41
Exist. Q100 Out = 67 cfs
Prop. Q100 Out = 66 cfs
Existing Cortaro Ranch
Retention Basin
Exist. WSEL100 = 2160.7
Prop. WSEL100 = 2161.6
Exist. Q100 Out = 0 cfs
Prop. Q100 Out = 48 cfs
Proposed Basin
Boundary
Existing Basin
Boundary
Cerius Stravenue
Cortaro Farms Road
MMLA

HYDROLOGIC CALCULATIONS

EXISTING CONDITIONS

WATERSHED 1

OJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 1

WATERSHED AREA (A): 3.90 acres

LENGTH OF WATERCOURSE (Lc): 940. ft

LENGTH TO CENTER OF GRAVITY (Lca): 470. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft 940.

INCREMENTAL CHANGE IN ELEV (Hi) - ft 11.0

MEAN SLOPE (Sc): .0117 ft BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): NATURAL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.144	.293	.376	.464	.529	.581
Tc (FUNCTION OF i) :	26.69	20.09	18.17	16.70	15.86	15.27
SOLUTION OF Tc (MINUTES):	18	11	9	8	7	6
RAINFL INT. @ Tc (IN/HR):	2.624	4.304	5.442	6.755	8.100	9.558
RUNOFF RATE @ Tc (IN/HR):	.378	1.260	2.048	3.137	4.283	5.550
PEAK DISCHARGE (CFS) :	1.48	4.95	8.05	12.33	16.84	21.82

WATERSHED 2

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 2

WATERSHED AREA (A): 33.70 acres

LENGTH OF WATERCOURSE (Lc): 2630. ft

LENGTH TO CENTER OF GRAVITY (Lca): 1315. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
2630.	39.0

MEAN SLOPE (Sc): .0148 ft BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): NATURAL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.144	.293	.376	.464	.529	.581
Tc (FUNCTION OF i) :	45.01	33.88	30.64	28.17	26.74	25.76
SOLUTION OF Tc (MINUTES):	36	21	18	15	13	12
RAINFL INT. @ Tc (IN/HR):	1.762	3.183	4.024	5.151	6.274	7.255
RUNOFF RATE @ Tc (IN/HR):	.253	.932	1.514	2.392	3.318	4.213
PEAK DISCHARGE (CFS) :	8.61	31.64	51.44	81.26	112.71	143.11

PIMA COUNTY HYDROGRAPH

Project: Cortaro Road
Hydrograph Location: C.P. 2

Job#: 99067-01
Preparer: SP
DATE: 01-08-2001

Qp100 = 143.00 cfs. Tc = 12.0 min. Tp = 18.70 min. delta T = 1.000 min.

1	T= 0.00 min.	Q 100 = 0.00 cfs.	ðST= 0.0 cu.ft.
2	T= 1.00 min.	Q 100 = 0.86 cfs.	ðST= 25.7 cu.ft.
3	T= 2.00 min.	Q 100 = 3.92 cfs.	ðST= 169.0 cu.ft.
4	T= 3.00 min.	Q 100 = 8.41 cfs.	ðST= 539.0 cu.ft.
5	T= 4.00 min.	Q 100 = 13.75 cfs.	ðST= 1203.7 cu.ft.
6	T= 5.00 min.	Q 100 = 19.55 cfs.	ðST= 2202.7 cu.ft.
7	T= 6.00 min.	Q 100 = 25.66 cfs.	ðST= 3558.9 cu.ft.
8	T= 7.00 min.	Q 100 = 32.02 cfs.	ðST= 5289.2 cu.ft.
9	T= 8.00 min.	Q 100 = 38.73 cfs.	ðST= 7411.8 cu.ft.
10	T= 9.00 min.	Q 100 = 45.92 cfs.	ðST= 9951.2 cu.ft.
11	T= 10.00 min.	Q 100 = 53.75 cfs.	ðST= 12941.3 cu.ft.
12	T= 11.00 min.	Q 100 = 62.40 cfs.	ðST= 16425.9 cu.ft.
13	T= 12.00 min.	Q 100 = 71.96 cfs.	ðST= 20456.7 cu.ft.
14	T= 13.00 min.	Q 100 = 82.46 cfs.	ðST= 25089.3 cu.ft.
15	T= 14.00 min.	Q 100 = 93.78 cfs.	ðST= 30376.4 cu.ft.
16	T= 15.00 min.	Q 100 = 105.64 cfs.	ðST= 36359.0 cu.ft.
17	T= 16.00 min.	Q 100 = 117.56 cfs.	ðST= 43055.2 cu.ft.
18	T= 17.00 min.	Q 100 = 128.80 cfs.	ðST= 50446.1 cu.ft.
19	T= 18.00 min.	Q 100 = 138.34 cfs.	ðST= 58460.6 cu.ft.
20	T= 19.00 min.	Q 100 = 140.63 cfs.	ðST= 66829.8 cu.ft.
21	T= 20.00 min.	Q 100 = 134.64 cfs.	ðST= 75087.9 cu.ft.
22	T= 21.00 min.	Q 100 = 128.61 cfs.	ðST= 82985.3 cu.ft.
23	T= 22.00 min.	Q 100 = 122.58 cfs.	ðST= 90520.8 cu.ft.
24	T= 23.00 min.	Q 100 = 116.57 cfs.	ðST= 97695.3 cu.ft.
25	T= 24.00 min.	Q 100 = 110.63 cfs.	ðST= 104511.5 cu.ft.
26	T= 25.00 min.	Q 100 = 104.78 cfs.	ðST= 110974.1 cu.ft.
27	T= 26.00 min.	Q 100 = 99.04 cfs.	ðST= 117088.9 cu.ft.
28	T= 27.00 min.	Q 100 = 93.44 cfs.	ðST= 122863.4 cu.ft.
29	T= 28.00 min.	Q 100 = 87.98 cfs.	ðST= 128306.0 cu.ft.
30	T= 29.00 min.	Q 100 = 82.69 cfs.	ðST= 133426.4 cu.ft.
31	T= 30.00 min.	Q 100 = 77.59 cfs.	ðST= 138234.8 cu.ft.
32	T= 31.00 min.	Q 100 = 72.67 cfs.	ðST= 142742.4 cu.ft.
33	T= 32.00 min.	Q 100 = 67.95 cfs.	ðST= 146960.8 cu.ft.
34	T= 33.00 min.	Q 100 = 63.43 cfs.	ðST= 150902.2 cu.ft.
35	T= 34.00 min.	Q 100 = 59.13 cfs.	ðST= 154579.1 cu.ft.
36	T= 35.00 min.	Q 100 = 55.04 cfs.	ðST= 158004.2 cu.ft.
37	T= 36.00 min.	Q 100 = 51.16 cfs.	ðST= 161190.4 cu.ft.
38	T= 37.00 min.	Q 100 = 47.50 cfs.	ðST= 164150.4 cu.ft.
39	T= 38.00 min.	Q 100 = 44.06 cfs.	ðST= 166897.4 cu.ft.
40	T= 39.00 min.	Q 100 = 40.82 cfs.	ðST= 169443.8 cu.ft.
41	T= 40.00 min.	Q 100 = 37.80 cfs.	ðST= 171802.4 cu.ft.
42	T= 41.00 min.	Q 100 = 34.97 cfs.	ðST= 173985.3 cu.ft.
43	T= 42.00 min.	Q 100 = 32.34 cfs.	ðST= 176004.7 cu.ft.
44	T= 43.00 min.	Q 100 = 29.90 cfs.	ðST= 177872.1 cu.ft.
45	T= 44.00 min.	Q 100 = 27.65 cfs.	ðST= 179598.7 cu.ft.
46	T= 45.00 min.	Q 100 = 25.57 cfs.	ðST= 181195.5 cu.ft.
47	T= 46.00 min.	Q 100 = 23.66 cfs.	ðST= 182672.5 cu.ft.
48	T= 47.00 min.	Q 100 = 21.91 cfs.	ðST= 184039.8 cu.ft.
49	T= 48.00 min.	Q 100 = 20.31 cfs.	ðST= 185306.6 cu.ft.
50	T= 49.00 min.	Q 100 = 18.85 cfs.	ðST= 186481.6 cu.ft.
51	T= 50.00 min.	Q 100 = 17.53 cfs.	ðST= 187573.0 cu.ft.

52	T=	51.00	min.	Q 100 =	16.32	cfs.	ðST=	188588.6 cu.ft.
53	T=	52.00	min.	Q 100 =	15.23	cfs.	ðST=	189535.3 cu.ft.
54	T=	53.00	min.	Q 100 =	14.25	cfs.	ðST=	190419.6 cu.ft.
55	T=	54.00	min.	Q 100 =	13.36	cfs.	ðST=	191247.7 cu.ft.
56	T=	55.00	min.	Q 100 =	12.55	cfs.	ðST=	192024.9 cu.ft.
57	T=	56.00	min.	Q 100 =	11.82	cfs.	ðST=	192755.9 cu.ft.
58	T=	57.00	min.	Q 100 =	11.16	cfs.	ðST=	193445.3 cu.ft.
59	T=	58.00	min.	Q 100 =	10.56	cfs.	ðST=	194096.8 cu.ft.
60	T=	59.00	min.	Q 100 =	10.01	cfs.	ðST=	194713.9 cu.ft.
61	T=	60.00	min.	Q 100 =	9.51	cfs.	ðST=	195299.4 cu.ft.
62	T=	61.00	min.	Q 100 =	9.04	cfs.	ðST=	195855.8 cu.ft.
63	T=	62.00	min.	Q 100 =	8.61	cfs.	ðST=	196385.3 cu.ft.
64	T=	63.00	min.	Q 100 =	8.20	cfs.	ðST=	196889.6 cu.ft.
65	T=	64.00	min.	Q 100 =	7.81	cfs.	ðST=	197369.9 cu.ft.
66	T=	65.00	min.	Q 100 =	7.44	cfs.	ðST=	197827.3 cu.ft.
67	T=	66.00	min.	Q 100 =	7.08	cfs.	ðST=	198262.7 cu.ft.
68	T=	67.00	min.	Q 100 =	6.72	cfs.	ðST=	198676.6 cu.ft.
69	T=	68.00	min.	Q 100 =	6.37	cfs.	ðST=	199069.3 cu.ft.
70	T=	69.00	min.	Q 100 =	6.02	cfs.	ðST=	199441.0 cu.ft.
71	T=	70.00	min.	Q 100 =	5.67	cfs.	ðST=	199791.7 cu.ft.
72	T=	71.00	min.	Q 100 =	5.32	cfs.	ðST=	200121.4 cu.ft.
73	T=	72.00	min.	Q 100 =	4.97	cfs.	ðST=	200430.0 cu.ft.
74	T=	73.00	min.	Q 100 =	4.61	cfs.	ðST=	200717.4 cu.ft.
75	T=	74.00	min.	Q 100 =	4.26	cfs.	ðST=	200983.4 cu.ft.
76	T=	75.00	min.	Q 100 =	3.90	cfs.	ðST=	201228.1 cu.ft.
77	T=	76.00	min.	Q 100 =	3.55	cfs.	ðST=	201451.6 cu.ft.
78	T=	77.00	min.	Q 100 =	3.20	cfs.	ðST=	201653.8 cu.ft.
79	T=	78.00	min.	Q 100 =	2.85	cfs.	ðST=	201835.2 cu.ft.
80	T=	79.00	min.	Q 100 =	2.52	cfs.	ðST=	201996.3 cu.ft.
81	T=	80.00	min.	Q 100 =	2.20	cfs.	ðST=	202137.8 cu.ft.
82	T=	81.00	min.	Q 100 =	1.90	cfs.	ðST=	202260.7 cu.ft.
83	T=	82.00	min.	Q 100 =	1.62	cfs.	ðST=	202366.1 cu.ft.
84	T=	83.00	min.	Q 100 =	1.36	cfs.	ðST=	202455.6 cu.ft.
85	T=	84.00	min.	Q 100 =	1.15	cfs.	ðST=	202530.9 cu.ft.
86	T=	85.00	min.	Q 100 =	0.96	cfs.	ðST=	202594.2 cu.ft.
87	T=	86.00	min.	Q 100 =	0.83	cfs.	ðST=	202648.0 cu.ft.

Filename: cr2.in

SUMMARY OF ROUTING CALCULATIONS

Johnson Brittain & Associates

(REFERENCE 5)

TIME TO PEAK (Tp) FOR REFERENCED HYDROGRAPHS

THORNYDALE RD
JBA No 3238
Apr 24, 1998

100 yr Return Frequency

Pt	Precipitation Cw	i	A	Tl	Qp	Inflow Hydrographs From Pt	No	Dist	Vel	Storage Qinpk	Vstopk	WSEpk	Qoutpk		Outflow Hydrographs To Pt	Qok
N	.664	1.70	1555.200	78.27	1767.1					1768.0 (Tp= 78.21)			1768.0 (Tp= 78.21)			
Descrp: Existing to POC N																
G4	.591	4.17	211.000	31.82	524.7					530.5 (Tp= 31.72)			530.5 (Tp= 31.72)		M	181.5
Descrp: Existing to POC G4 (SPLITS AT SHANNON)															G	349.0
M	.616	4.46	340.800	29.81	943.6	G4	1	8000	6.0	967.9 (Tp= 29.38)			967.9 (Tp= 29.38)			
Descrp: Existing to POC M																
J	.744	9.36	12.400	14.19	87.1					83.6 (Tp= 14.94)			83.6 * (Tp= 14.94)			
Descrp: Existing to POC J																
I	.723	9.36	8.700	14.19	59.4					57.0 (Tp= 14.94)			57.0 * (Tp= 14.94)			
Descrp: Existing to POC I																
G	.614	3.98	328.000	33.40	807.0	G4	2	9500	6.0	854.5 (Tp= 32.98)			854.5 (Tp= 32.98)			
Descrp: Existing to POC G																
E	.620	4.17	557.700	31.82	1456.0					1472.0 (Tp= 31.72)			1472.0 (Tp= 31.72)			
Descrp: Existing to POC E (INCLUDES F AREA)																
D	.644	8.01	37.900	16.58	197.0					198.4 (Tp= 16.31)			198.4 (Tp= 16.31)			
Descrp: Existing to POC D (INCLUDES D1 AREA)																
C	.616	5.33	150.900	24.92	499.6					504.3 (Tp= 24.64)			504.3 (Tp= 24.64)		LOST	226.7
Descrp: Existing to POC C															B	241.7
															C3	36.0
C2	.726	9.82	10.500	13.53	75.5					73.7 (Tp= 14.00)			73.7 * (Tp= 14.00)		C2B	72.7
Descrp: Flow to W Sunnyvale Detention Basin															C3	1.0
C3	.591	9.82	.140	13.53	.8	C2	2	150	6.0	36.6 (Tp= 26.99)			36.6 (Tp= 26.99)			
Descrp: Flow to Thornydale at POC C2						C	3	700	6.0							

B	.591	9.82	4.500	13.53	26.3		C	2	750	6.0	246.9 (Tp= 27.01)	246.9 (Tp= 27.01)
Descrp: Existing to POC B												

* These discharges do not include detention basins installed for the adjacent developments. The discharges used for design were taken from the following drainage reports:

POC	Development	Q100	Reference #
J	Park Lane Subdiv	48 cfs	15
I	Walgreens	43 cfs	14
C2	Sunnyvale Subdiv	1 cfs	11

C.P. B* (REFERENCE 6)
CULVERT @ 29+55

SOLUTION
==========

1 Cells X 5 High X 6 Wide
Discharge 250.00CFS
Length (Ft) 170 Slope 0.50%
Manning's 'n' 0.012
Entrance Type:
1:1 BEVELS, NORMAL OR 45 HDWL SKEW Ke=0.2 HEC 13 Charts 8 & 9
Inlet Control HW/D 1.22
Inlet Control HW = 6.10
Ke 0.20
H 1.80
Critical Depth 3.79
Dc+D/2 4.39
Tailwater 3.86
H0 4.39
L*S0 0.85
Outlet HW 5.35
INLET Control Governs HW= 6.10
Outlet Velocity 12.01fps
Normal Depth 3.47

TAILWATER FROM MANNINGS (SEE OUTPUT) NORMAL DEPTH.

INV = 2359.81
HW = 6.10

WSE = 2365.91

NOTE TAILWATER FROM NORMAL DEPTH CALC IS GREATER THAN HEC-2 AND CULVERT IS STILL UNDER INLET CONTROL

PIMA COUNTY HYDROGRAPH

Project: Cortaro Road
Hydrograph Location: B*

Job#: 99067-01
Preparer: SP
DATE: 01-08-2001

Qp100 = 250.00 cfs. Tc = 25.0 min. Tp = 27.00 min. delta T = 1.000 min.

1	T=	0.00	min.	Q 100 =	0.00	cfs.	ÐST= 0.0 cu.ft.
2	T=	1.00	min.	Q 100 =	0.57	cfs.	ÐST= 17.0 cu.ft.
3	T=	2.00	min.	Q 100 =	3.18	cfs.	ÐST= 129.4 cu.ft.
4	T=	3.00	min.	Q 100 =	7.39	cfs.	ÐST= 446.6 cu.ft.
5	T=	4.00	min.	Q 100 =	12.75	cfs.	ÐST= 1050.7 cu.ft.
6	T=	5.00	min.	Q 100 =	18.89	cfs.	ÐST= 1999.7 cu.ft.
7	T=	6.00	min.	Q 100 =	25.57	cfs.	ÐST= 3333.3 cu.ft.
8	T=	7.00	min.	Q 100 =	32.60	cfs.	ÐST= 5078.4 cu.ft.
9	T=	8.00	min.	Q 100 =	39.90	cfs.	ÐST= 7253.3 cu.ft.
10	T=	9.00	min.	Q 100 =	47.41	cfs.	ÐST= 9872.4 cu.ft.
11	T=	10.00	min.	Q 100 =	55.14	cfs.	ÐST= 12948.9 cu.ft.
12	T=	11.00	min.	Q 100 =	63.15	cfs.	ÐST= 16497.7 cu.ft.
13	T=	12.00	min.	Q 100 =	71.51	cfs.	ÐST= 20537.8 cu.ft.
14	T=	13.00	min.	Q 100 =	80.32	cfs.	ÐST= 25092.9 cu.ft.
15	T=	14.00	min.	Q 100 =	89.68	cfs.	ÐST= 30192.8 cu.ft.
16	T=	15.00	min.	Q 100 =	99.67	cfs.	ÐST= 35873.3 cu.ft.
17	T=	16.00	min.	Q 100 =	110.39	cfs.	ÐST= 42175.1 cu.ft.
18	T=	17.00	min.	Q 100 =	121.88	cfs.	ÐST= 49143.4 cu.ft.
19	T=	18.00	min.	Q 100 =	134.17	cfs.	ÐST= 56825.1 cu.ft.
20	T=	19.00	min.	Q 100 =	147.22	cfs.	ÐST= 65266.9 cu.ft.
21	T=	20.00	min.	Q 100 =	160.94	cfs.	ÐST= 74511.8 cu.ft.
22	T=	21.00	min.	Q 100 =	175.17	cfs.	ÐST= 84595.0 cu.ft.
23	T=	22.00	min.	Q 100 =	189.66	cfs.	ÐST= 95539.8 cu.ft.
24	T=	23.00	min.	Q 100 =	204.08	cfs.	ÐST= 107352.1 cu.ft.
25	T=	24.00	min.	Q 100 =	218.00	cfs.	ÐST= 120014.6 cu.ft.
26	T=	25.00	min.	Q 100 =	230.85	cfs.	ÐST= 133480.1 cu.ft.
27	T=	26.00	min.	Q 100 =	241.97	cfs.	ÐST= 147664.7 cu.ft.
28	T=	27.00	min.	Q 100 =	250.00	cfs.	ÐST= 162423.7 cu.ft.
29	T=	28.00	min.	Q 100 =	241.76	cfs.	ÐST= 177176.4 cu.ft.
30	T=	29.00	min.	Q 100 =	234.49	cfs.	ÐST= 191463.7 cu.ft.
31	T=	30.00	min.	Q 100 =	227.18	cfs.	ÐST= 205313.9 cu.ft.
32	T=	31.00	min.	Q 100 =	219.87	cfs.	ÐST= 218725.6 cu.ft.
33	T=	32.00	min.	Q 100 =	212.58	cfs.	ÐST= 231699.2 cu.ft.
34	T=	33.00	min.	Q 100 =	205.31	cfs.	ÐST= 244235.8 cu.ft.
35	T=	34.00	min.	Q 100 =	198.09	cfs.	ÐST= 256337.9 cu.ft.
36	T=	35.00	min.	Q 100 =	190.94	cfs.	ÐST= 268008.9 cu.ft.
37	T=	36.00	min.	Q 100 =	183.86	cfs.	ÐST= 279253.0 cu.ft.
38	T=	37.00	min.	Q 100 =	176.88	cfs.	ÐST= 290075.4 cu.ft.
39	T=	38.00	min.	Q 100 =	170.01	cfs.	ÐST= 300482.0 cu.ft.
40	T=	39.00	min.	Q 100 =	163.25	cfs.	ÐST= 310479.6 cu.ft.
41	T=	40.00	min.	Q 100 =	156.61	cfs.	ÐST= 320075.4 cu.ft.
42	T=	41.00	min.	Q 100 =	150.12	cfs.	ÐST= 329277.3 cu.ft.
43	T=	42.00	min.	Q 100 =	143.76	cfs.	ÐST= 338093.7 cu.ft.
44	T=	43.00	min.	Q 100 =	137.56	cfs.	ÐST= 346533.5 cu.ft.
45	T=	44.00	min.	Q 100 =	131.52	cfs.	ÐST= 354606.0 cu.ft.
46	T=	45.00	min.	Q 100 =	125.64	cfs.	ÐST= 362320.8 cu.ft.
47	T=	46.00	min.	Q 100 =	119.93	cfs.	ÐST= 369687.9 cu.ft.
48	T=	47.00	min.	Q 100 =	114.39	cfs.	ÐST= 376717.4 cu.ft.
49	T=	48.00	min.	Q 100 =	109.02	cfs.	ÐST= 383419.8 cu.ft.
50	T=	49.00	min.	Q 100 =	103.84	cfs.	ÐST= 389805.6 cu.ft.
51	T=	50.00	min.	Q 100 =	98.83	cfs.	ÐST= 395885.5 cu.ft.

52	T= 51.00 min.	Q 100 = 94.00 cfs.	ÕST= 401670.4 cu.ft.
53	T= 52.00 min.	Q 100 = 89.35 cfs.	ÕST= 407170.9 cu.ft.
54	T= 53.00 min.	Q 100 = 84.88 cfs.	ÕST= 412398.0 cu.ft.
55	T= 54.00 min.	Q 100 = 80.60 cfs.	ÕST= 417362.4 cu.ft.
56	T= 55.00 min.	Q 100 = 76.49 cfs.	ÕST= 422074.9 cu.ft.
57	T= 56.00 min.	Q 100 = 72.55 cfs.	ÕST= 426546.1 cu.ft.
58	T= 57.00 min.	Q 100 = 68.80 cfs.	ÕST= 430786.5 cu.ft.
59	T= 58.00 min.	Q 100 = 65.21 cfs.	ÕST= 434806.7 cu.ft.
60	T= 59.00 min.	Q 100 = 61.79 cfs.	ÕST= 438616.7 cu.ft.
61	T= 60.00 min.	Q 100 = 58.54 cfs.	ÕST= 442226.7 cu.ft.
62	T= 61.00 min.	Q 100 = 55.45 cfs.	ÕST= 445646.6 cu.ft.
63	T= 62.00 min.	Q 100 = 52.52 cfs.	ÕST= 448885.9 cu.ft.
64	T= 63.00 min.	Q 100 = 49.75 cfs.	ÕST= 451954.1 cu.ft.
65	T= 64.00 min.	Q 100 = 47.12 cfs.	ÕST= 454860.2 cu.ft.
66	T= 65.00 min.	Q 100 = 44.64 cfs.	ÕST= 457613.2 cu.ft.
67	T= 66.00 min.	Q 100 = 42.30 cfs.	ÕST= 460221.7 cu.ft.
68	T= 67.00 min.	Q 100 = 40.10 cfs.	ÕST= 462693.8 cu.ft.
69	T= 68.00 min.	Q 100 = 38.03 cfs.	ÕST= 465037.7 cu.ft.
70	T= 69.00 min.	Q 100 = 36.08 cfs.	ÕST= 467261.0 cu.ft.
71	T= 70.00 min.	Q 100 = 34.25 cfs.	ÕST= 469371.1 cu.ft.
72	T= 71.00 min.	Q 100 = 32.54 cfs.	ÕST= 471374.9 cu.ft.
73	T= 72.00 min.	Q 100 = 30.94 cfs.	ÕST= 473279.3 cu.ft.
74	T= 73.00 min.	Q 100 = 29.44 cfs.	ÕST= 475090.7 cu.ft.
75	T= 74.00 min.	Q 100 = 28.04 cfs.	ÕST= 476815.1 cu.ft.
76	T= 75.00 min.	Q 100 = 26.73 cfs.	ÕST= 478458.2 cu.ft.
77	T= 76.00 min.	Q 100 = 25.51 cfs.	ÕST= 480025.6 cu.ft.
78	T= 77.00 min.	Q 100 = 24.38 cfs.	ÕST= 481522.2 cu.ft.
79	T= 78.00 min.	Q 100 = 23.32 cfs.	ÕST= 482953.0 cu.ft.
80	T= 79.00 min.	Q 100 = 22.33 cfs.	ÕST= 484322.2 cu.ft.
81	T= 80.00 min.	Q 100 = 21.40 cfs.	ÕST= 485634.1 cu.ft.
82	T= 81.00 min.	Q 100 = 20.54 cfs.	ÕST= 486892.6 cu.ft.
83	T= 82.00 min.	Q 100 = 19.74 cfs.	ÕST= 488101.1 cu.ft.
84	T= 83.00 min.	Q 100 = 18.99 cfs.	ÕST= 489262.9 cu.ft.
85	T= 84.00 min.	Q 100 = 18.28 cfs.	ÕST= 490380.9 cu.ft.
86	T= 85.00 min.	Q 100 = 17.62 cfs.	ÕST= 491458.0 cu.ft.
87	T= 86.00 min.	Q 100 = 17.00 cfs.	ÕST= 492496.6 cu.ft.
88	T= 87.00 min.	Q 100 = 16.41 cfs.	ÕST= 493498.7 cu.ft.
89	T= 88.00 min.	Q 100 = 15.85 cfs.	ÕST= 494466.3 cu.ft.
90	T= 89.00 min.	Q 100 = 15.32 cfs.	ÕST= 495401.2 cu.ft.
91	T= 90.00 min.	Q 100 = 14.81 cfs.	ÕST= 496304.8 cu.ft.
92	T= 91.00 min.	Q 100 = 14.32 cfs.	ÕST= 497178.4 cu.ft.
93	T= 92.00 min.	Q 100 = 13.84 cfs.	ÕST= 498023.2 cu.ft.
94	T= 93.00 min.	Q 100 = 13.38 cfs.	ÕST= 498840.0 cu.ft.
95	T= 94.00 min.	Q 100 = 12.94 cfs.	ÕST= 499629.7 cu.ft.
96	T= 95.00 min.	Q 100 = 12.50 cfs.	ÕST= 500392.7 cu.ft.
97	T= 96.00 min.	Q 100 = 12.06 cfs.	ÕST= 501129.5 cu.ft.
98	T= 97.00 min.	Q 100 = 11.64 cfs.	ÕST= 501840.5 cu.ft.
99	T= 98.00 min.	Q 100 = 11.21 cfs.	ÕST= 502525.9 cu.ft.
100	T= 99.00 min.	Q 100 = 10.79 cfs.	ÕST= 503185.9 cu.ft.
101	T= 100.00 min.	Q 100 = 10.37 cfs.	ÕST= 503820.5 cu.ft.
102	T= 101.00 min.	Q 100 = 9.94 cfs.	ÕST= 504429.8 cu.ft.
103	T= 102.00 min.	Q 100 = 9.52 cfs.	ÕST= 505013.7 cu.ft.
104	T= 103.00 min.	Q 100 = 9.09 cfs.	ÕST= 505572.0 cu.ft.
105	T= 104.00 min.	Q 100 = 8.67 cfs.	ÕST= 506104.8 cu.ft.
106	T= 105.00 min.	Q 100 = 8.24 cfs.	ÕST= 506611.9 cu.ft.
107	T= 106.00 min.	Q 100 = 7.81 cfs.	ÕST= 507093.2 cu.ft.
108	T= 107.00 min.	Q 100 = 7.38 cfs.	ÕST= 507548.7 cu.ft.
109	T= 108.00 min.	Q 100 = 6.94 cfs.	ÕST= 507978.2 cu.ft.
110	T= 109.00 min.	Q 100 = 6.52 cfs.	ÕST= 508382.0 cu.ft.
111	T= 110.00 min.	Q 100 = 6.09 cfs.	ÕST= 508760.0 cu.ft.

112	T=	111.00	min.	Q 100 =	5.66	cfs.	ðST= 509112.5 cu.ft.
113	T=	112.00	min.	Q 100 =	5.24	cfs.	ðST= 509439.6 cu.ft.
114	T=	113.00	min.	Q 100 =	4.83	cfs.	ðST= 509741.9 cu.ft.
115	T=	114.00	min.	Q 100 =	4.43	cfs.	ðST= 510019.6 cu.ft.
116	T=	115.00	min.	Q 100 =	4.04	cfs.	ðST= 510273.6 cu.ft.
117	T=	116.00	min.	Q 100 =	3.66	cfs.	ðST= 510504.4 cu.ft.
118	T=	117.00	min.	Q 100 =	3.30	cfs.	ðST= 510713.1 cu.ft.
119	T=	118.00	min.	Q 100 =	2.96	cfs.	ðST= 510900.7 cu.ft.
120	T=	119.00	min.	Q 100 =	2.64	cfs.	ðST= 511068.6 cu.ft.
121	T=	120.00	min.	Q 100 =	2.34	cfs.	ðST= 511217.9 cu.ft.
122	T=	121.00	min.	Q 100 =	2.07	cfs.	ðST= 511350.4 cu.ft.
123	T=	122.00	min.	Q 100 =	1.84	cfs.	ðST= 511467.7 cu.ft.
124	T=	123.00	min.	Q 100 =	1.64	cfs.	ðST= 511571.8 cu.ft.
125	T=	124.00	min.	Q 100 =	1.47	cfs.	ðST= 511664.9 cu.ft.

Filename: cr_jbb.in

C.I.P. C3* (REFERENCE 6)

Johnson · Brittain & Associates, Inc.
CIVIL ENGINEERS · SURVEYORS

PROJECT THORNYDALE RD.
SUBJECT PIPE (RCP) STA 43+28
DISCHARGE SUMMARY

JOB NO. 3238 SHT. ____ OF ____
CALC. GB DATE 14 Apr 98
CHECKED ____ DATE ____

THE FOLLOWING SUMMARIZES the TOTAL DISCHARGE FOR the CROSS DRAINAGE STRUCTURE @ STA 43+28, 1-42" RCP.

DISCHARGE FOR AREA

$Q_A = 36$ cfs

DISCHARGE FROM Lateral Ditch ON EAST SIDE of THORNYDALE

$Q_{approx} \simeq 2$ cfs

DISCHARGES FROM Catch BASINS CONNECTING to CROSS DRAINAGE STRUCTURE FUTURE CONDITIONS

$Q_{CB5} =$ 2 cfs

$Q_{CB6} =$ 3 cfs

$Q_{CB7} =$ 3 cfs

$Q_{CB8} =$ 3 cfs

$Q_{CB9} =$ 3 cfs

TOTAL DISCHARGE FOR CROSS DRAINAGE STRUCTURE is SUMMATION of ALL DISCHARGES ABOVE

$Q_{TOTAL} = 52$ cfs

Q100 at C.I.P. C3* (REFERENCE 5)

PIMA COUNTY HYDROGRAPH

Project: Cortaro Road
Hydrograph Location: C3*

Job#: 99067-01
Preparer: SP
DATE: 01-08-2001

Qp100 = 52.00 cfs. Tc = 25.0 min. Tp = 27.00 min. delta T = 1.000 min.

1	T=	0.00	min.	Q 100 =	0.00	cfs.	ðST= 0.0 cu.ft.
2	T=	1.00	min.	Q 100 =	0.12	cfs.	ðST= 3.5 cu.ft.
3	T=	2.00	min.	Q 100 =	0.66	cfs.	ðST= 26.9 cu.ft.
4	T=	3.00	min.	Q 100 =	1.54	cfs.	ðST= 92.9 cu.ft.
5	T=	4.00	min.	Q 100 =	2.65	cfs.	ðST= 218.5 cu.ft.
6	T=	5.00	min.	Q 100 =	3.93	cfs.	ðST= 415.9 cu.ft.
7	T=	6.00	min.	Q 100 =	5.32	cfs.	ðST= 693.3 cu.ft.
8	T=	7.00	min.	Q 100 =	6.78	cfs.	ðST= 1056.3 cu.ft.
9	T=	8.00	min.	Q 100 =	8.30	cfs.	ðST= 1508.7 cu.ft.
10	T=	9.00	min.	Q 100 =	9.86	cfs.	ðST= 2053.5 cu.ft.
11	T=	10.00	min.	Q 100 =	11.47	cfs.	ðST= 2693.4 cu.ft.
12	T=	11.00	min.	Q 100 =	13.14	cfs.	ðST= 3431.5 cu.ft.
13	T=	12.00	min.	Q 100 =	14.88	cfs.	ðST= 4271.9 cu.ft.
14	T=	13.00	min.	Q 100 =	16.71	cfs.	ðST= 5219.3 cu.ft.
15	T=	14.00	min.	Q 100 =	18.65	cfs.	ðST= 6280.1 cu.ft.
16	T=	15.00	min.	Q 100 =	20.73	cfs.	ðST= 7461.6 cu.ft.
17	T=	16.00	min.	Q 100 =	22.96	cfs.	ðST= 8772.4 cu.ft.
18	T=	17.00	min.	Q 100 =	25.35	cfs.	ðST= 10221.8 cu.ft.
19	T=	18.00	min.	Q 100 =	27.91	cfs.	ðST= 11819.6 cu.ft.
20	T=	19.00	min.	Q 100 =	30.62	cfs.	ðST= 13575.5 cu.ft.
21	T=	20.00	min.	Q 100 =	33.48	cfs.	ðST= 15498.4 cu.ft.
22	T=	21.00	min.	Q 100 =	36.43	cfs.	ðST= 17595.8 cu.ft.
23	T=	22.00	min.	Q 100 =	39.45	cfs.	ðST= 19872.3 cu.ft.
24	T=	23.00	min.	Q 100 =	42.45	cfs.	ðST= 22329.2 cu.ft.
25	T=	24.00	min.	Q 100 =	45.34	cfs.	ðST= 24963.0 cu.ft.
26	T=	25.00	min.	Q 100 =	48.02	cfs.	ðST= 27763.9 cu.ft.
27	T=	26.00	min.	Q 100 =	50.33	cfs.	ðST= 30714.3 cu.ft.
28	T=	27.00	min.	Q 100 =	52.00	cfs.	ðST= 33784.1 cu.ft.
29	T=	28.00	min.	Q 100 =	50.29	cfs.	ðST= 36852.7 cu.ft.
30	T=	29.00	min.	Q 100 =	48.77	cfs.	ðST= 39824.5 cu.ft.
31	T=	30.00	min.	Q 100 =	47.25	cfs.	ðST= 42705.3 cu.ft.
32	T=	31.00	min.	Q 100 =	45.73	cfs.	ðST= 45494.9 cu.ft.
33	T=	32.00	min.	Q 100 =	44.22	cfs.	ðST= 48193.4 cu.ft.
34	T=	33.00	min.	Q 100 =	42.70	cfs.	ðST= 50801.0 cu.ft.
35	T=	34.00	min.	Q 100 =	41.20	cfs.	ðST= 53318.3 cu.ft.
36	T=	35.00	min.	Q 100 =	39.72	cfs.	ðST= 55745.8 cu.ft.
37	T=	36.00	min.	Q 100 =	38.24	cfs.	ðST= 58084.6 cu.ft.
38	T=	37.00	min.	Q 100 =	36.79	cfs.	ðST= 60335.7 cu.ft.
39	T=	38.00	min.	Q 100 =	35.36	cfs.	ðST= 62500.3 cu.ft.
40	T=	39.00	min.	Q 100 =	33.96	cfs.	ðST= 64579.7 cu.ft.
41	T=	40.00	min.	Q 100 =	32.58	cfs.	ðST= 66575.7 cu.ft.
42	T=	41.00	min.	Q 100 =	31.22	cfs.	ðST= 68489.7 cu.ft.
43	T=	42.00	min.	Q 100 =	29.90	cfs.	ðST= 70323.5 cu.ft.
44	T=	43.00	min.	Q 100 =	28.61	cfs.	ðST= 72079.0 cu.ft.
45	T=	44.00	min.	Q 100 =	27.36	cfs.	ðST= 73758.0 cu.ft.
46	T=	45.00	min.	Q 100 =	26.13	cfs.	ðST= 75362.7 cu.ft.
47	T=	46.00	min.	Q 100 =	24.95	cfs.	ðST= 76895.1 cu.ft.
48	T=	47.00	min.	Q 100 =	23.79	cfs.	ðST= 78357.2 cu.ft.
49	T=	48.00	min.	Q 100 =	22.68	cfs.	ðST= 79751.3 cu.ft.
50	T=	49.00	min.	Q 100 =	21.60	cfs.	ðST= 81079.6 cu.ft.
51	T=	50.00	min.	Q 100 =	20.56	cfs.	ðST= 82344.2 cu.ft.

52	T=	51.00	min.	Q 100 =	19.55	cfs.	ÐST= 83547.4 cu.ft.
53	T=	52.00	min.	Q 100 =	18.59	cfs.	ÐST= 84691.5 cu.ft.
54	T=	53.00	min.	Q 100 =	17.66	cfs.	ÐST= 85778.8 cu.ft.
55	T=	54.00	min.	Q 100 =	16.76	cfs.	ÐST= 86811.4 cu.ft.
56	T=	55.00	min.	Q 100 =	15.91	cfs.	ÐST= 87791.6 cu.ft.
57	T=	56.00	min.	Q 100 =	15.09	cfs.	ÐST= 88721.6 cu.ft.
58	T=	57.00	min.	Q 100 =	14.31	cfs.	ÐST= 89603.6 cu.ft.
59	T=	58.00	min.	Q 100 =	13.56	cfs.	ÐST= 90439.8 cu.ft.
60	T=	59.00	min.	Q 100 =	12.85	cfs.	ÐST= 91232.3 cu.ft.
61	T=	60.00	min.	Q 100 =	12.18	cfs.	ÐST= 91983.2 cu.ft.
62	T=	61.00	min.	Q 100 =	11.53	cfs.	ÐST= 92694.5 cu.ft.
63	T=	62.00	min.	Q 100 =	10.92	cfs.	ÐST= 93368.3 cu.ft.
64	T=	63.00	min.	Q 100 =	10.35	cfs.	ÐST= 94006.4 cu.ft.
65	T=	64.00	min.	Q 100 =	9.80	cfs.	ÐST= 94610.9 cu.ft.
66	T=	65.00	min.	Q 100 =	9.29	cfs.	ÐST= 95183.5 cu.ft.
67	T=	66.00	min.	Q 100 =	8.80	cfs.	ÐST= 95726.1 cu.ft.
68	T=	67.00	min.	Q 100 =	8.34	cfs.	ÐST= 96240.3 cu.ft.
69	T=	68.00	min.	Q 100 =	7.91	cfs.	ÐST= 96727.8 cu.ft.
70	T=	69.00	min.	Q 100 =	7.50	cfs.	ÐST= 97190.3 cu.ft.
71	T=	70.00	min.	Q 100 =	7.12	cfs.	ÐST= 97629.2 cu.ft.
72	T=	71.00	min.	Q 100 =	6.77	cfs.	ÐST= 98046.0 cu.ft.
73	T=	72.00	min.	Q 100 =	6.44	cfs.	ÐST= 98442.1 cu.ft.
74	T=	73.00	min.	Q 100 =	6.12	cfs.	ÐST= 98818.8 cu.ft.
75	T=	74.00	min.	Q 100 =	5.83	cfs.	ÐST= 99177.5 cu.ft.
76	T=	75.00	min.	Q 100 =	5.56	cfs.	ÐST= 99519.3 cu.ft.
77	T=	76.00	min.	Q 100 =	5.31	cfs.	ÐST= 99845.3 cu.ft.
78	T=	77.00	min.	Q 100 =	5.07	cfs.	ÐST= 100156.6 cu.ft.
79	T=	78.00	min.	Q 100 =	4.85	cfs.	ÐST= 100454.2 cu.ft.
80	T=	79.00	min.	Q 100 =	4.64	cfs.	ÐST= 100739.0 cu.ft.
81	T=	80.00	min.	Q 100 =	4.45	cfs.	ÐST= 101011.9 cu.ft.
82	T=	81.00	min.	Q 100 =	4.27	cfs.	ÐST= 101273.6 cu.ft.
83	T=	82.00	min.	Q 100 =	4.11	cfs.	ÐST= 101525.0 cu.ft.
84	T=	83.00	min.	Q 100 =	3.95	cfs.	ÐST= 101766.7 cu.ft.
85	T=	84.00	min.	Q 100 =	3.80	cfs.	ÐST= 101999.2 cu.ft.
86	T=	85.00	min.	Q 100 =	3.67	cfs.	ÐST= 102223.3 cu.ft.
87	T=	86.00	min.	Q 100 =	3.54	cfs.	ÐST= 102439.3 cu.ft.
88	T=	87.00	min.	Q 100 =	3.41	cfs.	ÐST= 102647.7 cu.ft.
89	T=	88.00	min.	Q 100 =	3.30	cfs.	ÐST= 102849.0 cu.ft.
90	T=	89.00	min.	Q 100 =	3.19	cfs.	ÐST= 103043.4 cu.ft.
91	T=	90.00	min.	Q 100 =	3.08	cfs.	ÐST= 103231.4 cu.ft.
92	T=	91.00	min.	Q 100 =	2.98	cfs,	ÐST= 103413.1 cu.ft.
93	T=	92.00	min.	Q 100 =	2.88	cfs.	ÐST= 103588.8 cu.ft.
94	T=	93.00	min.	Q 100 =	2.78	cfs.	ÐST= 103758.7 cu.ft.
95	T=	94.00	min.	Q 100 =	2.69	cfs.	ÐST= 103923.0 cu.ft.
96	T=	95.00	min.	Q 100 =	2.60	cfs.	ÐST= 104081.7 cu.ft.
97	T=	96.00	min.	Q 100 =	2.51	cfs.	ÐST= 104234.9 cu.ft.
98	T=	97.00	min.	Q 100 =	2.42	cfs.	ÐST= 104382.8 cu.ft.
99	T=	98.00	min.	Q 100 =	2.33	cfs.	ÐST= 104525.4 cu.ft.
100	T=	99.00	min.	Q 100 =	2.24	cfs.	ÐST= 104662.6 cu.ft.
101	T=	100.00	min.	Q 100 =	2.16	cfs.	ÐST= 104794.7 cu.ft.
102	T=	101.00	min.	Q 100 =	2.07	cfs.	ÐST= 104921.4 cu.ft.
103	T=	102.00	min.	Q 100 =	1.98	cfs.	ÐST= 105042.8 cu.ft.
104	T=	103.00	min.	Q 100 =	1.89	cfs.	ÐST= 105159.0 cu.ft.
105	T=	104.00	min.	Q 100 =	1.80	cfs.	ÐST= 105269.8 cu.ft.
106	T=	105.00	min.	Q 100 =	1.71	cfs.	ÐST= 105375.3 cu.ft.
107	T=	106.00	min.	Q 100 =	1.62	cfs.	ÐST= 105475.4 cu.ft.
108	T=	107.00	min.	Q 100 =	1.53	cfs.	ÐST= 105570.1 cu.ft.
109	T=	108.00	min.	Q 100 =	1.44	cfs.	ÐST= 105659.5 cu.ft.
110	T=	109.00	min.	Q 100 =	1.36	cfs.	ÐST= 105743.4 cu.ft.
111	T=	110.00	min.	Q 100 =	1.27	cfs.	ÐST= 105822.1 cu.ft.

112	T= 111.00 min.	Q 100 =	1.18 cfs.	ðST= 105895.4 cu.ft.
113	T= 112.00 min.	Q 100 =	1.09 cfs.	ðST= 105963.4 cu.ft.
114	T= 113.00 min.	Q 100 =	1.00 cfs.	ðST= 106026.3 cu.ft.
115	T= 114.00 min.	Q 100 =	0.92 cfs.	ðST= 106084.1 cu.ft.
116	T= 115.00 min.	Q 100 =	0.84 cfs.	ðST= 106136.9 cu.ft.
117	T= 116.00 min.	Q 100 =	0.76 cfs.	ðST= 106184.9 cu.ft.
118	T= 117.00 min.	Q 100 =	0.69 cfs.	ðST= 106228.3 cu.ft.
119	T= 118.00 min.	Q 100 =	0.62 cfs.	ðST= 106267.3 cu.ft.
120	T= 119.00 min.	Q 100 =	0.55 cfs.	ðST= 106302.2 cu.ft.
121	T= 120.00 min.	Q 100 =	0.49 cfs.	ðST= 106333.3 cu.ft.
122	T= 121.00 min.	Q 100 =	0.43 cfs.	ðST= 106360.9 cu.ft.
123	T= 122.00 min.	Q 100 =	0.38 cfs.	ðST= 106385.2 cu.ft.
124	T= 123.00 min.	Q 100 =	0.34 cfs.	ðST= 106406.9 cu.ft.
125	T= 124.00 min.	Q 100 =	0.31 cfs.	ðST= 106426.3 cu.ft.

Filename: cr_jbc3.in

C.P.D+ (REFERENCE 6)

CULVERT @ STA 49+00
THORNYDALE RD.
NEW CONDITIONS

RESULTS

Entrance Type: SQUARE HEADWALL (RCP)
Discharge is 200.00 cfs
 4 X 36 " RCP X 210 FT. LONG
Manning's 'n' 0.012
Inlet Control HW/D 1.33
Inlet Control HW 4.00
Ke 0.50
H 2.17
Critical Depth 2.30
Dc+D/2 2.65
Tailwater 2.50
H0 2.65
L*S0 1.05
Outlet HW 3.77

INLET CONTROL GOVERNS HW= 4.00
Outlet Velocity 8.24 fps

Q100

TAILWATER FROM NEW CONDITIONS HEC-2 (SUBCRITICAL) RUN

INLET INVERT = 70.28

CULVERT HEADWATER = 4.00

NEW WSE = 74.28

PIMA COUNTY HYDROGRAPH

Project: Cortaro Road
Hydrograph Location: D*

Job#: 99067-01
Preparer: SP
DATE: 01-08-2001

Qp100 = 200.00 cfs. Tc = 9.0 min. Tp = 16.60 min. delta T = 1.000 min.

1	T=	0.00	min.	Q 100 =	0.00	cfs.	ÕST= 0.0 cu.ft.
2	T=	1.00	min.	Q 100 =	1.59	cfs.	ÕST= 47.7 cu.ft.
3	T=	2.00	min.	Q 100 =	6.92	cfs.	ÕST= 303.2 cu.ft.
4	T=	3.00	min.	Q 100 =	14.49	cfs.	ÕST= 945.7 cu.ft.
5	T=	4.00	min.	Q 100 =	23.27	cfs.	ÕST= 2078.6 cu.ft.
6	T=	5.00	min.	Q 100 =	32.70	cfs.	ÕST= 3757.8 cu.ft.
7	T=	6.00	min.	Q 100 =	42.60	cfs.	ÕST= 6017.1 cu.ft.
8	T=	7.00	min.	Q 100 =	53.06	cfs.	ÕST= 8887.1 cu.ft.
9	T=	8.00	min.	Q 100 =	64.35	cfs.	ÕST= 12409.4 cu.ft.
10	T=	9.00	min.	Q 100 =	76.78	cfs.	ÕST= 16643.3 cu.ft.
11	T=	10.00	min.	Q 100 =	90.69	cfs.	ÕST= 21667.4 cu.ft.
12	T=	11.00	min.	Q 100 =	106.24	cfs.	ÕST= 27575.3 cu.ft.
13	T=	12.00	min.	Q 100 =	123.40	cfs.	ÕST= 34464.6 cu.ft.
14	T=	13.00	min.	Q 100 =	141.80	cfs.	ÕST= 42420.8 cu.ft.
15	T=	14.00	min.	Q 100 =	160.65	cfs.	ÕST= 51494.3 cu.ft.
16	T=	15.00	min.	Q 100 =	178.62	cfs.	ÕST= 61672.2 cu.ft.
17	T=	16.00	min.	Q 100 =	193.77	cfs.	ÕST= 72843.7 cu.ft.
18	T=	17.00	min.	Q 100 =	195.43	cfs.	ÕST= 84519.6 cu.ft.
19	T=	18.00	min.	Q 100 =	185.97	cfs.	ÕST= 95961.6 cu.ft.
20	T=	19.00	min.	Q 100 =	176.46	cfs.	ÕST= 106834.7 cu.ft.
21	T=	20.00	min.	Q 100 =	166.98	cfs.	ÕST= 117137.9 cu.ft.
22	T=	21.00	min.	Q 100 =	157.57	cfs.	ÕST= 126874.4 cu.ft.
23	T=	22.00	min.	Q 100 =	148.31	cfs.	ÕST= 136051.0 cu.ft.
24	T=	23.00	min.	Q 100 =	139.24	cfs.	ÕST= 144677.6 cu.ft.
25	T=	24.00	min.	Q 100 =	130.40	cfs.	ÕST= 152766.9 cu.ft.
26	T=	25.00	min.	Q 100 =	121.83	cfs.	ÕST= 160334.1 cu.ft.
27	T=	26.00	min.	Q 100 =	113.56	cfs.	ÕST= 167396.0 cu.ft.
28	T=	27.00	min.	Q 100 =	105.62	cfs.	ÕST= 173971.5 cu.ft.
29	T=	28.00	min.	Q 100 =	98.02	cfs.	ÕST= 180080.6 cu.ft.
30	T=	29.00	min.	Q 100 =	90.78	cfs.	ÕST= 185744.5 cu.ft.
31	T=	30.00	min.	Q 100 =	83.91	cfs.	ÕST= 190985.0 cu.ft.
32	T=	31.00	min.	Q 100 =	77.42	cfs.	ÕST= 195824.7 cu.ft.
33	T=	32.00	min.	Q 100 =	71.31	cfs.	ÕST= 200286.4 cu.ft.
34	T=	33.00	min.	Q 100 =	65.58	cfs.	ÕST= 204392.9 cu.ft.
35	T=	34.00	min.	Q 100 =	60.23	cfs.	ÕST= 208167.0 cu.ft.
36	T=	35.00	min.	Q 100 =	55.25	cfs.	ÕST= 211631.2 cu.ft.
37	T=	36.00	min.	Q 100 =	50.64	cfs.	ÕST= 214807.8 cu.ft.
38	T=	37.00	min.	Q 100 =	46.38	cfs.	ÕST= 217718.2 cu.ft.
39	T=	38.00	min.	Q 100 =	42.46	cfs.	ÕST= 220383.4 cu.ft.
40	T=	39.00	min.	Q 100 =	38.87	cfs.	ÕST= 222823.4 cu.ft.
41	T=	40.00	min.	Q 100 =	35.60	cfs.	ÕST= 225057.6 cu.ft.
42	T=	41.00	min.	Q 100 =	32.62	cfs.	ÕST= 227104.2 cu.ft.
43	T=	42.00	min.	Q 100 =	29.92	cfs.	ÕST= 228980.6 cu.ft.
44	T=	43.00	min.	Q 100 =	27.49	cfs.	ÕST= 230703.0 cu.ft.
45	T=	44.00	min.	Q 100 =	25.30	cfs.	ÕST= 232286.5 cu.ft.
46	T=	45.00	min.	Q 100 =	23.33	cfs.	ÕST= 233745.4 cu.ft.
47	T=	46.00	min.	Q 100 =	21.57	cfs.	ÕST= 235092.4 cu.ft.
48	T=	47.00	min.	Q 100 =	20.00	cfs.	ÕST= 236339.3 cu.ft.
49	T=	48.00	min.	Q 100 =	18.59	cfs.	ÕST= 237497.0 cu.ft.
50	T=	49.00	min.	Q 100 =	17.34	cfs.	ÕST= 238575.0 cu.ft.
51	T=	50.00	min.	Q 100 =	16.22	cfs.	ÕST= 239581.8 cu.ft.

52	T=	51.00	min.	Q 100 =	15.22	cfs.	ÐST= 240525.0 cu.ft.
53	T=	52.00	min.	Q 100 =	14.32	cfs.	ÐST= 241411.0 cu.ft.
54	T=	53.00	min.	Q 100 =	13.50	cfs.	ÐST= 242245.4 cu.ft.
55	T=	54.00	min.	Q 100 =	12.75	cfs.	ÐST= 243032.9 cu.ft.
56	T=	55.00	min.	Q 100 =	12.06	cfs.	ÐST= 243777.4 cu.ft.
57	T=	56.00	min.	Q 100 =	11.42	cfs.	ÐST= 244481.9 cu.ft.
58	T=	57.00	min.	Q 100 =	10.81	cfs.	ÐST= 245148.9 cu.ft.
59	T=	58.00	min.	Q 100 =	10.23	cfs.	ÐST= 245780.2 cu.ft.
60	T=	59.00	min.	Q 100 =	9.66	cfs.	ÐST= 246377.0 cu.ft.
61	T=	60.00	min.	Q 100 =	9.11	cfs.	ÐST= 246940.2 cu.ft.
62	T=	61.00	min.	Q 100 =	8.56	cfs.	ÐST= 247470.2 cu.ft.
63	T=	62.00	min.	Q 100 =	8.01	cfs.	ÐST= 247967.2 cu.ft.
64	T=	63.00	min.	Q 100 =	7.45	cfs.	ÐST= 248431.0 cu.ft.
65	T=	64.00	min.	Q 100 =	6.90	cfs.	ÐST= 248861.6 cu.ft.
66	T=	65.00	min.	Q 100 =	6.34	cfs.	ÐST= 249258.8 cu.ft.
67	T=	66.00	min.	Q 100 =	5.78	cfs.	ÐST= 249622.4 cu.ft.
68	T=	67.00	min.	Q 100 =	5.22	cfs.	ÐST= 249952.4 cu.ft.
69	T=	68.00	min.	Q 100 =	4.66	cfs.	ÐST= 250248.9 cu.ft.
70	T=	69.00	min.	Q 100 =	4.12	cfs.	ÐST= 250512.3 cu.ft.
71	T=	70.00	min.	Q 100 =	3.59	cfs.	ÐST= 250743.5 cu.ft.
72	T=	71.00	min.	Q 100 =	3.08	cfs.	ÐST= 250943.6 cu.ft.
73	T=	72.00	min.	Q 100 =	2.61	cfs.	ÐST= 251114.3 cu.ft.
74	T=	73.00	min.	Q 100 =	2.18	cfs.	ÐST= 251257.9 cu.ft.
75	T=	74.00	min.	Q 100 =	1.79	cfs.	ÐST= 251376.9 cu.ft.
76	T=	75.00	min.	Q 100 =	1.47	cfs.	ÐST= 251474.8 cu.ft.
77	T=	76.00	min.	Q 100 =	1.23	cfs.	ÐST= 251555.7 cu.ft.

MMLA
McGovern MacVittie Lodge & Associates, Inc.

PROJECT NAME: CORTARO FARMS ROAD

PROJECT NUMBER: 99067-01 MADE BY: SP DATE: 2/19/01

REFERENCE: _____ CHECKED BY: _____ DATE: _____

HYDROGRAPH LAG TIMES

FOR

CONCENTRATION PT. 2

FOR WATERSHED D* (REFERENCE 5), CROSS SECTION 2-K IS USED TO DETERMINE LAG TIME

$V = 3.13$ fps

Distance to C.P. 2 = 2200 ft

$\therefore$ Lag Time $= \frac{2200 ft}{3.13 fps}\left(\frac{1 min}{60 s}\right) = 12$ min

FOR WATERSHED C3* (REFERENCE 5), CROSS SECTION 2-I IS USED TO DETERMINE LAG TIME

$V = 2.36$ fps

Distance to C.P. 2 = 1740 ft

$\therefore$ Lag Time $= \frac{1740 ft}{2.36 fps}\left(\frac{1 min}{60 s}\right) = 12$ min

FOR WATERSHED B* (REFERENCE 5), CROSS SECTION 2-G IS USED TO DETERMINE LAG TIME

$V = 3.10$ fps

Distance to C.P. 2 = 1440 ft

$\therefore$ Lag Time $= \frac{1440 ft}{3.10 fps}\left(\frac{1 min}{60 s}\right) = 8$ min

100-Year Combined Hydrographs for Concentration Point 2 (Existing)

Time (min)	C.P. 2	C.P. D* (12 min. lag)	C.P. C3* (12 min. lag)	C.P. B* (8 min. lag)	Total (cfs)	
0	0	0	0	0	0	
1	0.86	0	0	0	1	
2	3.92	0	0	0	4	
3	8.41	0	0	0	8	
4	13.75	0	0	0	14	
5	19.55	0	0	0	20	
6	25.66	0	0	0	26	
7	32.02	0	0	0	32	
8	38.73	0	0	0	39	
9	45.92	0	0	0.57	46	
10	53.75	0	0	3.18	57	
11	62.40	0	0	7.39	70	
12	71.96	0	0	12.75	85	
13	82.46	1.59	0.12	18.89	103	
14	93.78	6.92	0.66	25.57	127	
15	105.64	14.49	1.54	32.60	154	
16	117.56	23.27	2.65	39.90	183	
17	128.80	32.70	3.93	47.41	213	
18	138.34	42.60	5.32	55.14	241	
19	140.63	53.06	6.78	63.15	264	
20	134.64	64.35	8.30	71.51	279	
21	128.61	76.78	9.86	80.32	296	
22	122.58	90.69	11.47	89.68	314	
23	116.57	106.24	13.14	99.67	336	
24	110.63	123.40	14.88	110.39	359	
25	104.78	141.80	16.71	121.88	385	
26	99.04	160.65	18.65	134.17	413	
27	93.44	178.62	20.73	147.22	440	
28	87.98	193.77	22.96	160.94	466	
29	82.69	195.43	25.35	175.17	479	
30	77.59	185.97	27.91	189.66	481	
31	72.67	176.46	30.62	204.08	484	
32	67.95	166.98	33.48	218.00	486	
33	63.43	157.57	36.43	230.85	488	
34	59.13	148.31	39.45	241.97	**489**	*
35	55.04	139.24	42.45	250.00	487	
36	51.16	130.40	45.34	241.76	469	
37	47.51	121.83	48.02	234.49	452	
38	44.06	113.56	50.33	227.18	435	
39	40.82	105.62	52.00	219.87	418	
40	37.80	98.02	50.29	212.58	399	
41	34.97	90.78	48.77	205.31	380	
42	32.34	83.91	47.25	198.09	362	
43	29.90	77.42	45.73	190.94	344	
44	27.65	71.31	44.22	183.86	327	
45	25.57	65.58	42.70	176.88	311	

WATERSHED 3

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 3

WATERSHED AREA (A): .50 acres

LENGTH OF WATERCOURSE (Lc): 275. ft

LENGTH TO CENTER OF GRAVITY (Lca): 138. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft 275.

INCREMENTAL CHANGE IN ELEV (Hi) - ft 6.0

MEAN SLOPE (Sc): .0218 ft

BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): NATURAL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.144	.293	.376	.464	.529	.581
Tc (FUNCTION OF i) :	9.95	7.49	6.77	6.23	5.91	5.69
SOLUTION OF Tc (MINUTES):	6	5	5	5	5	5
RAINFL INT. @ Tc (IN/HR):	4.148	5.739	6.669	7.862	8.948	10.018
RUNOFF RATE @ Tc (IN/HR):	.597	1.680	2.510	3.651	4.732	5.818
PEAK DISCHARGE (CFS) :	.30	.85	1.26	1.84	2.39	2.93

+67 cfs

⇓

70 cfs

HYDROLOGIC DATA SHEET

Project Name and Location: CORTARO RIDGE 3124-01-30

Drainage Concentration Point: 8 (ONSITE DEVELOPED)

Watershed Area (A): 12.2 (acres)/~~square miles~~.

Length of Watercourse (L_c): 1770 ft. Length to Center of Gravity (L_{ca}): 885 ft

Incremental Change in Length (L_i) - ft.	Incremental Change in Elevation (H_i) - ft
1770	2370 - 2340.5 = 29.5

Mean Slope (S_c): 0.0166 ft./ft. Watershed Type(s): FOOTHILLS / MOD. URBAN (future)

Basin Factor (n_b): .034 (future) Flood Frequency: 100 yrs

P_{24} (24 hour): _____ in. Areal Value: _____ in.

P_6 (6 hour): _____ in. Areal Value: _____ in.

P_1 (1 hour): 2.87 in. Areal Value: _____ in.

P_2 (2 hour): _____ in. Areal Value: _____ in.

P_3 (3 hour): _____ in. Areal Value: _____ in.

Soil Group(s): 100% B Cover Type(s): DESERT BRUSH

Cover Density (pervious areas): 20% Impervious Cover: 5% (future

CN(s): 83 (curve number) (pervious & impervious areas) CN*(s): 87.5, 99.0 (adjusted curve number)

Runoff to Rainfall Ratio(s), (C): .57 (pervious areas) .95 (impervious areas

Runoff Supply Rate (q): 0.598 i in./hr. (function of i)

Time of Concentration (T_c): 19 $i^{-.4}$ ~~hrs.~~/(mins) (function of i)

Iterative Solution of T_c: 7 ~~hrs.~~/(mins.)

Rainfall Intensity (i) at T_c: 9.040 in./hr.

Runoff Supply Rate (q) at T_c: 5.40 in./hr.

Peak Discharge:

1.008 qA (acres): 67 cfs.

645.33qA (square miles): _____ cfs.

Equation for T_c:

$$T_c = \frac{n_b}{50} \frac{(L_c L_{ca})^{.3}}{(S_c)^{.4}} q^{-.4} \text{ hours.}$$

Note: For impervious areas, CN* = 99 (constant).

FIGURE 3
sheet 10 of 16

WATERSHED 4

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 4

WATERSHED AREA (A): 1.20 acres

LENGTH OF WATERCOURSE (Lc): 350. ft

LENGTH TO CENTER OF GRAVITY (Lca): 175. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft: 350.

INCREMENTAL CHANGE IN ELEV (Hi) - ft: 3.0

MEAN SLOPE (Sc): .0086 ft

BASIN FACTOR (Nb): .0220

WATERSHED TYPE(S): MOD. URBAN

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 50. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.526	.611	.658	.706	.742	.770
Tc (FUNCTION OF i) :	6.25	5.89	5.72	5.56	5.45	5.37
SOLUTION OF Tc (MINUTES):	5	5	5	5	5	5
RAINFL INT. @ Tc (IN/HR):	4.348	5.739	6.669	7.862	8.948	10.018
RUNOFF RATE @ Tc (IN/HR):	2.289	3.509	4.387	5.553	6.636	7.713
PEAK DISCHARGE (CFS) :	2.77	4.24	5.31	6.72	8.03	9.33

WATERSHED 5

CORTARO FARMS RD
WATERSHED 5

HYDROLOGIC DATA SHEET

Project Name and Location: Cortaro Ridge 3124-01-30

Drainage Concentration Point: 11 (ONSITE DEVELOPED) (REF. 3)

Watershed Area (A): 3.1 (acres) ~~square miles~~.

Length of Watercourse (L_c): 435' ft. Length to Center of Gravity (L_{ca}): 217.5 ft

Incremental Change in Length (L_i) - ft.	Incremental Change in Elevation (H_i) - ft
435'	6'

Mean Slope (S_c): .0137 ft./ft. Watershed Type(s): Foothills / Mod Urban (future

Basin Factor (n_b): .022 (future) Flood Frequency: 100 yr

P_{24} (24 hour): ____ in. Areal Value: ____ in

P_6 (6 hour): ____ in. Areal Value: ____ in

P_1 (1 hour): 2.87 in. Areal Value: ____ in

P_2 (2 hour): ____ in. Areal Value: ____ in

P_3 (3 hour): ____ in. Areal Value: ____ in

Soil Group(s): 100% B Cover Type(s): Desert Brush

Cover Density (pervious areas): 20% Impervious Cover: 50% (futur

CN(s): 83 (curve number) (pervious & impervious areas) CN*(s): 87.5, 99.2 (adjusted curve number)

Runoff to Rainfall Ratio(s), (C): .57 (pervious areas) 95 (impervious area

Runoff Supply Rate (q): .764 i in./hr. (function of i)

Time of Concentration (T_c): 5 $i^{-.4}$ ~~hrs.~~/(mins.) (function of i)

Iterative Solution of T_c: 5 ~~hrs.~~/(mins.)

Rainfall Intensity (i) at T_c: 9.987 in./hr.

Runoff Supply Rate (q) at T_c: 7.63 in./hr.

Peak Discharge:

1.008 qA (acres): 24 cfs.

645.33qA (square miles): ____ cfs.

Equation for T_c:

$$T_c = \frac{n_b}{50} \frac{(L_c L_{ca})^{.3}}{(S_c)^{.4}} q^{-.4} \text{ hours.}$$

Note: For impervious areas, CN* = 99 (constant).

FIGURE 3
sheet 16 of 16

WATERSHED 6

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 6

WATERSHED AREA (A): .60 acres

LENGTH OF WATERCOURSE (Lc): 1200. ft

LENGTH TO CENTER OF GRAVITY (Lca): 600. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft INCREMENTAL CHANGE IN ELEV (Hi) - ft

1200. 3.0

MEAN SLOPE (Sc): .0025 ft BASIN FACTOR (Nb): .0220

WATERSHED TYPE(S): MOD. URBAN

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 50. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.526	.611	.658	.706	.742	.770
Tc (FUNCTION OF i) :	21.43	20.19	19.61	19.06	18.69	18.41
SOLUTION OF Tc (MINUTES):	14	11	10	9	8	8
RAINFL INT. @ Tc (IN/HR):	2.961	4.304	5.174	6.416	7.688	8.608
RUNOFF RATE @ Tc (IN/HR):	1.559	2.632	3.404	4.532	5.702	6.627
PEAK DISCHARGE (CFS) :	.94	1.59	2.06	2.74	3.45	4.01

WATERSHED 7

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 7

WATERSHED AREA (A): 1.20 acres

LENGTH OF WATERCOURSE (Lc): 1300. ft

LENGTH TO CENTER OF GRAVITY (Lca): 650. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
1300.	3.0

MEAN SLOPE (Sc): .0023 ft BASIN FACTOR (Nb): .0220

WATERSHED TYPE(S): MOD. URBAN

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

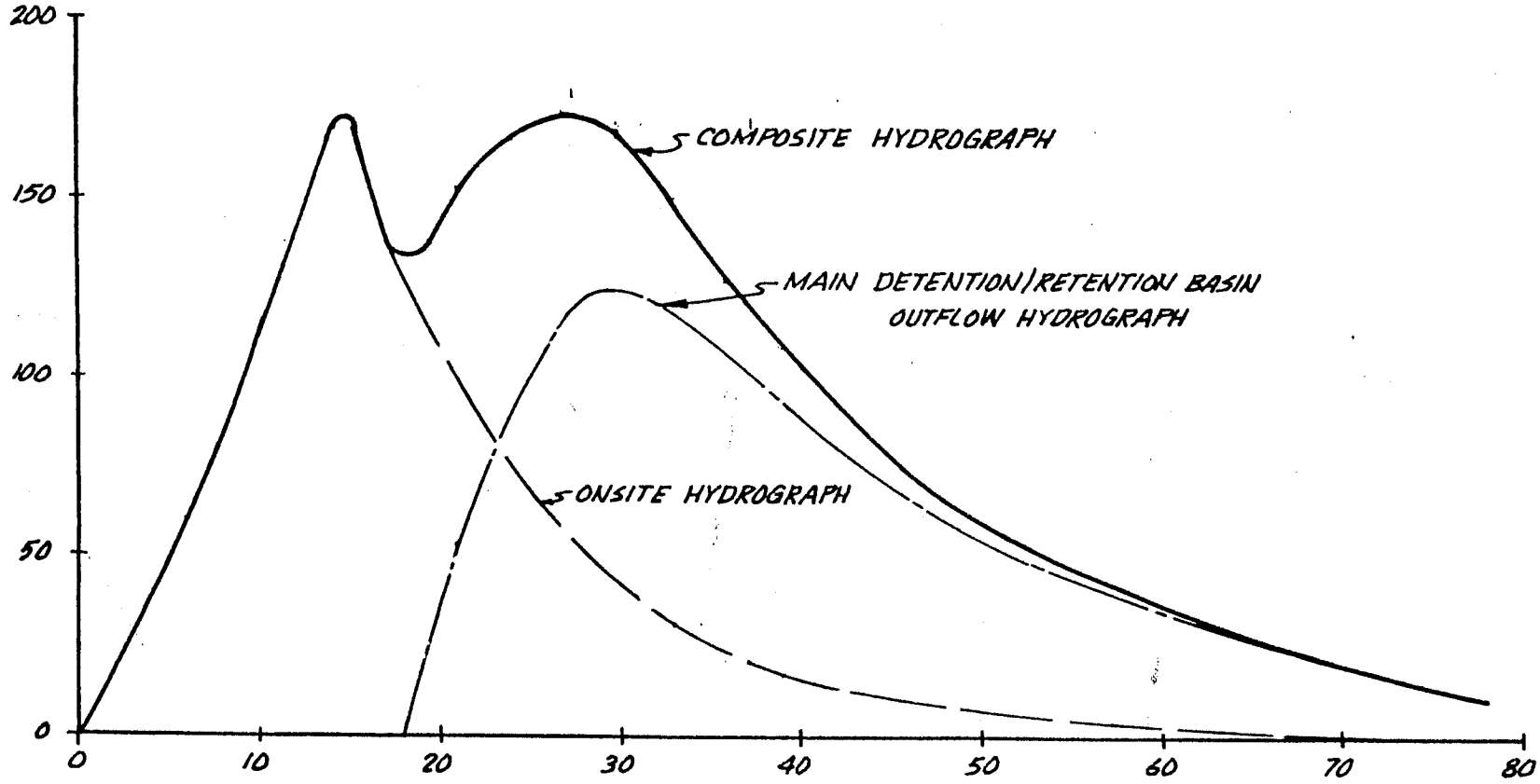
IMPERVIOUS COVER= 50. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.526	.611	.658	.706	.742	.770
Tc (FUNCTION OF i) :	23.22	21.87	21.24	20.64	20.25	19.94
SOLUTION OF Tc (MINUTES):	15	13	11	10	9	9
RAINFL INT. @ Tc (IN/HR):	2.849	4.024	5.002	6.100	7.303	8.176
RUNOFF RATE @ Tc (IN/HR):	1.500	2.460	3.290	4.309	5.416	6.295
PEAK DISCHARGE (CFS) :	1.81	2.98	3.98	5.21	6.55	7.61

WATERSHED 8

INFLOW HYDROGRAPH DETENTIOIN BASIN ADJACENT TO CORTARO FARMS RD.



CORTARO FARMS RD. WATERSHED 8

FIGURE 15

REFERENCE 4 ⇒

CELLA BARR ASSOCIATES
2075 North Sixth Avenue
Tucson, Arizona 85705
(602) 624-7401

JOB No. 03353-01-30

FIGURE 15

SUBJECT: INPUT DATA FOR DETENTION BASIN ADJACENT TO CORTARO FARMS ROAD

```
Total Number of Members       =  1
Number of Inflow Hydrographs  =  1
Number of Reservoirs          =  1
Number of Time Periods        =  27
Time-step in Hours            =  .05


Stage, Discharge & Storage for Reservoir =  1

 0.00        0            0
 0.50        9        4,356
 1.00       18       10,890
 1.50       39       16,988
 2.00       60       23,522
 2.50      105       30,492
 3.00      235       37,897

Inflow Hydrograph for Member  1

Inflow    1       0
Inflow    2      21
Inflow    3      60
Inflow    4      99
Inflow    5     154
Inflow    6     174
Inflow    7     125
Inflow    8     153
Inflow    9     167
Inflow   10     174
Inflow   11     167
Inflow   12     150
Inflow   13     127
Inflow   14     109
Inflow   15      93
Inflow   16      77
Inflow   17      65
Inflow   18      56
Inflow   19      50
Inflow   20      43
Inflow   21      37
Inflow   22      30
Inflow   23      26
Inflow   24      21
Inflow   25      16
Inflow   26      13
Inflow   27      11
```

PREPARED BY DATE CHECKED BY SHEET NO. OF

CELLA BARR ASSOCIATES
2075 North Sixth Avenue, Tucson, Arizona 85705

FIGURE 15

DESIGN NOTES AND COMPUTATIONS

SUBJECT: FLOOD ROUTING FOR DETENTION BASIN ADJACENT TO CORTARO FARMS ROAD

Route Reservoir: 1

T (hrs)	I (cfs)	O (cfs)	V (cf)	H (ft)	
0.00	0.000	0.000	0.000	0.000	
0.05	21.000	3.293	1,593.659	0.183	
0.10	60.000	13.193	7,399.966	0.733	
0.15	99.000	39.061	17,007.092	1.501	
0.20	154.000	89.971	28,164.178	2.333	
0.25	174.000	170.628	34,230.270	2.752	
0.30	125.000	144.750	32,756.234	2.653	
0.35	153.000	137.707	32,355.058	2.626	
0.40	167.000	165.012	33,910.355	2.731	
0.45	174.000	171.734	34,293.262	2.757	← Q100 existing basin
0.50	167.000	170.223	34,207.181	2.751	
0.55	150.000	155.865	33,389.328	2.696	
0.60	127.000	134.596	32,177.848	2.614	
0.65	109.000	114.269	31,019.976	2.536	
0.70	93.000	100.809	29,842.921	2.453	
0.75	77.000	89.189	28,043.061	2.324	
0.80	65.000	75.820	25,972.281	2.176	
0.85	56.000	64.559	24,228.182	2.051	
0.90	50.000	57.596	22,774.163	1.943	
0.95	43.000	52.617	21,224.923	1.824	
1.00	37.000	46.956	19,463.355	1.689	
1.05	30.000	40.918	17,584.734	1.546	
1.10	26.000	34.910	15,800.253	1.403	
1.15	21.000	29.511	14,232.434	1.274	
1.20	16.000	24.300	12,719.467	1.150	
1.25	13.000	19.663	11,372.806	1.040	
1.30	11.000	17.085	10,225.538	0.949	

PREPARED BY DATE CHECKED BY SHEET NO. OF

CELLA BARR ASSOCIATES
2075 North Sixth Avenue, Tucson, Arizona 85705

DETENTION AREA B
OUTLET STRUCTURE

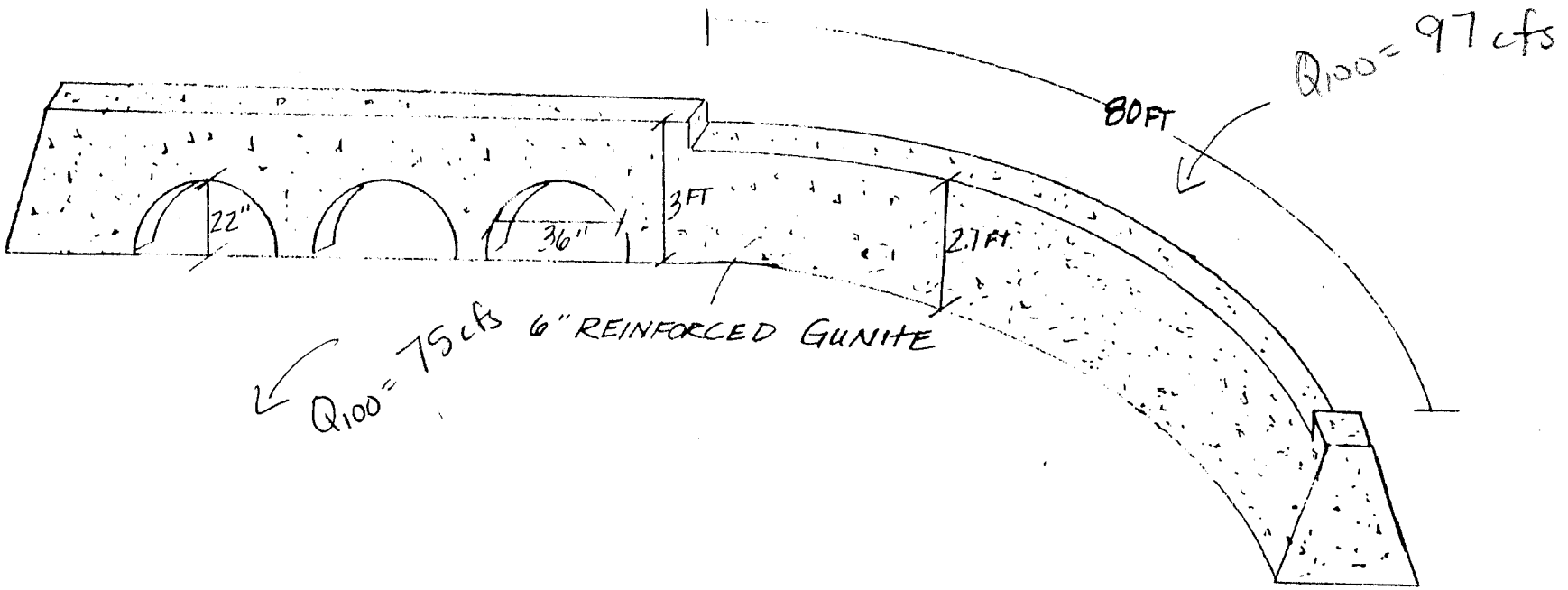


FIGURE 9

(REFERENCE 3)

WATERSHED 8a

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 8a (Portion of W.S. 8 Collecting @ Delta Way)

WATERSHED AREA (A): 2.20 acres

LENGTH OF WATERCOURSE (Lc): 710. ft

LENGTH TO CENTER OF GRAVITY (Lca): 355. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft: 710.

INCREMENTAL CHANGE IN ELEV (Hi) - ft: 3.5

MEAN SLOPE (Sc): .0050 ft

BASIN FACTOR (Nb): .0220

WATERSHED TYPE(S): MOD. URBAN

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 40. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.450	.548	.602	.658	.699	.732
Tc (FUNCTION OF i) :	12.62	11.67	11.24	10.84	10.58	10.39
SOLUTION OF Tc (MINUTES):	7	6	5	5	5	5
RAINFL INT. @ Tc (IN/HR):	3.936	5.475	6.669	7.862	8.948	10.018
RUNOFF RATE @ Tc (IN/HR):	1.771	2.998	4.012	5.173	6.255	7.334
PEAK DISCHARGE (CFS) :	3.93	6.65	8.90	11.47	13.87	16.26

WATERSHED 9

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 9

WATERSHED AREA (A): 1.30 acres

LENGTH OF WATERCOURSE (Lc): 350. ft

LENGTH TO CENTER OF GRAVITY (Lca): 175. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft: 350.

INCREMENTAL CHANGE IN ELEV (Hi) - ft: 6.5

MEAN SLOPE (Sc): .0186 ft

BASIN FACTOR (Nb): .0340

WATERSHED TYPE(S): NATURAL/MOD. URBAN

RAINFALL VALUES

	EVENT 2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 20. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT 2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.297	.420	.489	.561	.614	.656
Tc (FUNCTION OF i) :	8.92	7.76	7.30	6.91	6.67	6.49
SOLUTION OF Tc (MINUTES):	5	5	5	5	5	5
RAINFL INT. @ Tc (IN/HR):	4.348	5.739	6.669	7.862	8.948	10.018
RUNOFF RATE @ Tc (IN/HR):	1.291	2.411	3.261	4.412	5.494	6.576
PEAK DISCHARGE (CFS) :	1.69	3.16	4.27	5.78	7.20	8.62

WATERSHED 10

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 10

WATERSHED AREA (A): .90 acres

LENGTH OF WATERCOURSE (Lc): 370. ft

LENGTH TO CENTER OF GRAVITY (Lca): 185. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft 370.

INCREMENTAL CHANGE IN ELEV (Hi) - ft 7.0

MEAN SLOPE (Sc): .0189 ft

BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): RURAL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 5. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.182	.325	.404	.489	.550	.600
Tc (FUNCTION OF i) :	11.45	9.09	8.32	7.72	7.36	7.11
SOLUTION OF Tc (MINUTES):	7	5	5	5	5	5
RAINFL INT. @ Tc (IN/HR):	3.936	5.739	6.669	7.862	8.948	10.018
RUNOFF RATE @ Tc (IN/HR):	.717	1.863	2.697	3.841	4.923	6.007
PEAK DISCHARGE (CFS) :	.65	1.69	2.45	3.48	4.47	5.45

WATERSHED 11

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 11

WATERSHED AREA (A): 17.50 acres

LENGTH OF WATERCOURSE (Lc): 1660. ft

LENGTH TO CENTER OF GRAVITY (Lca): 830. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft: 1660.

INCREMENTAL CHANGE IN ELEV (Hi) - ft: 30.5

MEAN SLOPE (Sc): .0184 ft

BASIN FACTOR (Nb): .0340

WATERSHED TYPE(S): RURAL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 10. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.220	.356	.433	.513	.571	.619
Tc (FUNCTION OF i) :	25.67	21.18	19.60	18.31	17.54	16.99
SOLUTION OF Tc (MINUTES):	17	12	10	9	8	7
RAINFL INT. @ Tc (IN/HR):	2.699	4.156	5.174	6.416	7.688	9.068
RUNOFF RATE @ Tc (IN/HR):	.595	1.481	2.238	3.290	4.393	5.609
PEAK DISCHARGE (CFS) :	10.	26.	39.	58.	77.	99.

PIMA COUNTY HYDROGRAPH

Project: Cortaro Road
Hydrograph Location: C.P. 11

Job#: 99067-01
Preparer: SP
DATE: 01-08-2001

Qp100 = 99.00 cfs. Tc = 7.0 min. Tp = 15.00 min. delta T = 1.000 min.

1	T=	0.00	min.	Q 100 =	0.00	cfs.	ÕST= 0.0 cu.ft.
2	T=	1.00	min.	Q 100 =	1.00	cfs.	ÕST= 29.9 cu.ft.
3	T=	2.00	min.	Q 100 =	4.15	cfs.	ÕST= 184.4 cu.ft.
4	T=	3.00	min.	Q 100 =	8.52	cfs.	ÕST= 564.5 cu.ft.
5	T=	4.00	min.	Q 100 =	13.48	cfs.	ÕST= 1224.4 cu.ft.
6	T=	5.00	min.	Q 100 =	18.77	cfs.	ÕST= 2192.0 cu.ft.
7	T=	6.00	min.	Q 100 =	24.36	cfs.	ÕST= 3486.2 cu.ft.
8	T=	7.00	min.	Q 100 =	30.39	cfs.	ÕST= 5128.7 cu.ft.
9	T=	8.00	min.	Q 100 =	37.06	cfs.	ÕST= 7152.3 cu.ft.
10	T=	9.00	min.	Q 100 =	44.60	cfs.	ÕST= 9602.1 cu.ft.
11	T=	10.00	min.	Q 100 =	53.13	cfs.	ÕST= 12534.1 cu.ft.
12	T=	11.00	min.	Q 100 =	62.63	cfs.	ÕST= 16006.9 cu.ft.
13	T=	12.00	min.	Q 100 =	72.80	cfs.	ÕST= 20069.9 cu.ft.
14	T=	13.00	min.	Q 100 =	83.06	cfs.	ÕST= 24745.7 cu.ft.
15	T=	14.00	min.	Q 100 =	92.36	cfs.	ÕST= 30008.3 cu.ft.
16	T=	15.00	min.	Q 100 =	99.00	cfs.	ÕST= 35749.1 cu.ft.
17	T=	16.00	min.	Q 100 =	93.43	cfs.	ÕST= 41522.1 cu.ft.
18	T=	17.00	min.	Q 100 =	88.23	cfs.	ÕST= 46972.0 cu.ft.
19	T=	18.00	min.	Q 100 =	83.03	cfs.	ÕST= 52109.7 cu.ft.
20	T=	19.00	min.	Q 100 =	77.88	cfs.	ÕST= 56936.8 cu.ft.
21	T=	20.00	min.	Q 100 =	72.81	cfs.	ÕST= 61457.3 cu.ft.
22	T=	21.00	min.	Q 100 =	67.86	cfs.	ÕST= 65677.6 cu.ft.
23	T=	22.00	min.	Q 100 =	63.06	cfs.	ÕST= 69605.3 cu.ft.
24	T=	23.00	min.	Q 100 =	58.43	cfs.	ÕST= 73250.2 cu.ft.
25	T=	24.00	min.	Q 100 =	53.99	cfs.	ÕST= 76623.0 cu.ft.
26	T=	25.00	min.	Q 100 =	49.75	cfs.	ÕST= 79735.3 cu.ft.
27	T=	26.00	min.	Q 100 =	45.73	cfs.	ÕST= 82599.9 cu.ft.
28	T=	27.00	min.	Q 100 =	41.93	cfs.	ÕST= 85229.8 cu.ft.
29	T=	28.00	min.	Q 100 =	38.36	cfs.	ÕST= 87638.6 cu.ft.
30	T=	29.00	min.	Q 100 =	35.02	cfs.	ÕST= 89840.2 cu.ft.
31	T=	30.00	min.	Q 100 =	31.92	cfs.	ÕST= 91848.4 cu.ft.
32	T=	31.00	min.	Q 100 =	29.04	cfs.	ÕST= 93677.0 cu.ft.
33	T=	32.00	min.	Q 100 =	26.38	cfs.	ÕST= 95339.6 cu.ft.
34	T=	33.00	min.	Q 100 =	23.95	cfs.	ÕST= 96849.5 cu.ft.
35	T=	34.00	min.	Q 100 =	21.72	cfs.	ÕST= 98219.6 cu.ft.
36	T=	35.00	min.	Q 100 =	19.70	cfs.	ÕST= 99462.3 cu.ft.
37	T=	36.00	min.	Q 100 =	17.87	cfs.	ÕST= 100589.4 cu.ft.
38	T=	37.00	min.	Q 100 =	16.22	cfs.	ÕST= 101612.2 cu.ft.
39	T=	38.00	min.	Q 100 =	14.74	cfs.	ÕST= 102541.3 cu.ft.
40	T=	39.00	min.	Q 100 =	13.43	cfs.	ÕST= 103386.4 cu.ft.
41	T=	40.00	min.	Q 100 =	12.25	cfs.	ÕST= 104156.7 cu.ft.
42	T=	41.00	min.	Q 100 =	11.21	cfs.	ÕST= 104860.6 cu.ft.
43	T=	42.00	min.	Q 100 =	10.29	cfs.	ÕST= 105505.7 cu.ft.
44	T=	43.00	min.	Q 100 =	9.48	cfs.	ÕST= 106098.9 cu.ft.
45	T=	44.00	min.	Q 100 =	8.77	cfs.	ÕST= 106646.3 cu.ft.
46	T=	45.00	min.	Q 100 =	8.14	cfs.	ÕST= 107153.3 cu.ft.
47	T=	46.00	min.	Q 100 =	7.58	cfs.	ÕST= 107624.7 cu.ft.
48	T=	47.00	min.	Q 100 =	7.08	cfs.	ÕST= 108064.4 cu.ft.
49	T=	48.00	min.	Q 100 =	6.64	cfs.	ÕST= 108475.9 cu.ft.
50	T=	49.00	min.	Q 100 =	6.23	cfs.	ÕST= 108862.0 cu.ft.
51	T=	50.00	min.	Q 100 =	5.86	cfs.	ÕST= 109224.8 cu.ft.

52	T=	51.00	min.	Q 100 =	5.52	cfs.	ðST= 109566.3 cu.ft.
53	T=	52.00	min.	Q 100 =	5.19	cfs.	ðST= 109887.6 cu.ft.
54	T=	53.00	min.	Q 100 =	4.88	cfs.	ðST= 110189.9 cu.ft.
55	T=	54.00	min.	Q 100 =	4.57	cfs.	ðST= 110473.5 cu.ft.
56	T=	55.00	min.	Q 100 =	4.27	cfs.	ðST= 110738.9 cu.ft.
57	T=	56.00	min.	Q 100 =	3.97	cfs.	ðST= 110986.2 cu.ft.
58	T=	57.00	min.	Q 100 =	3.67	cfs.	ðST= 111215.4 cu.ft.
59	T=	58.00	min.	Q 100 =	3.36	cfs.	ðST= 111426.4 cu.ft.
60	T=	59.00	min.	Q 100 =	3.06	cfs.	ðST= 111619.0 cu.ft.
61	T=	60.00	min.	Q 100 =	2.75	cfs.	ðST= 111793.3 cu.ft.
62	T=	61.00	min.	Q 100 =	2.44	cfs.	ðST= 111949.1 cu.ft.
63	T=	62.00	min.	Q 100 =	2.14	cfs.	ðST= 112086.7 cu.ft.
64	T=	63.00	min.	Q 100 =	1.85	cfs.	ðST= 112206.4 cu.ft.
65	T=	64.00	min.	Q 100 =	1.57	cfs.	ðST= 112308.9 cu.ft.
66	T=	65.00	min.	Q 100 =	1.31	cfs.	ðST= 112395.1 cu.ft.
67	T=	66.00	min.	Q 100 =	1.07	cfs.	ðST= 112466.3 cu.ft.
68	T=	67.00	min.	Q 100 =	0.86	cfs.	ðST= 112524.2 cu.ft.
69	T=	68.00	min.	Q 100 =	0.69	cfs.	ðST= 112570.9 cu.ft.
70	T=	69.00	min.	Q 100 =	0.57	cfs.	ðST= 112608.8 cu.ft.

Filename: cr11.in

(REFERENCE 3)

HYDROLOGIC DATA SHEET

Project Name and Location: CORTARO RIDGE 3124-01-30

Drainage Concentration Point: 9 (ONSITE DEVELOPED)

Watershed Area (A): 18 acres/square miles.

Length of Watercourse (L_c): 2629 ft. Length to Center of Gravity (L_{ca}): 13145 f

Incremental Change in Length (L_i) - ft.	Incremental Change in Elevation (H_i) - f
1800	20
264	5
565	9

Mean Slope (S_c): .0125 ft./ft. Watershed Type(s): Foothills/MOD. URBAN (future

Basin Factor (n_b): .033 (future) Flood Frequency: 100 yr

P_{24} (24 hour): _____ in. Areal Value: _____ in

P_6 (6 hour): _____ in. Areal Value: _____ in

P_1 (1 hour): 2.87 in. Areal Value: _____ in

P_2 (2 hour): _____ in. Areal Value: _____ in

P_3 (3 hour): _____ in. Areal Value: _____ in

Soil Group(s): 100% B Cover Type(s): DESERT BRUSH

Cover Density (pervious areas): 20% Impervious Cover: 7% (futur

CN(s): 83 (curve number) (pervious & impervious areas) CN*(s): 87.5, 99.0 (adjusted curve number)

Runoff to Rainfall Ratio(s), (C): .57 (pervious areas) .95 (impervious area

Runoff Supply Rate (q): .605 i in./hr. (function of i)

Time of Concentration (T_c): 27 $i^{-.6}$ hrs./mins. (function of i)

Iterative Solution of T_c: 12 hrs./mins.

Rainfall Intensity (i) at T_c: 7.232 in./hr.

Runoff Supply Rate (q) at T_c: 4.38 in./hr.

Peak Discharge:

1.008 qA (acres): 79 cfs. -5 CFS (CAPACITY OF SWALE) = 74 CFS

645.33qA (square miles): _____ cfs.

Equation for T_c:

$$T_c = \frac{n_b}{50} \frac{(L_c L_{ca})^{.3}}{(S_c)^{.4}} q^{-.4} \text{ hours.}$$

Note: For impervious areas, CN* = 99 (constant).

FIGURE 3
sheet 12 of 16

PIMA COUNTY HYDROGRAPH

Project: Cortaro Road
Hydrograph Location: 9* (Cortaro Ridge I)

Job#: 99067-01
Preparer: SP
DATE: 01-09-2001

Qp100 = 74.00 cfs. Tc = 12.0 min. Tp = 18.70 min. delta T = 1.000 min.

1	T=	0.00	min.	Q 100 =	0.00	cfs.	ÕST= 0.0 cu.ft.
2	T=	1.00	min.	Q 100 =	0.44	cfs.	ÕST= 13.3 cu.ft.
3	T=	2.00	min.	Q 100 =	2.03	cfs.	ÕST= 87.4 cu.ft.
4	T=	3.00	min.	Q 100 =	4.35	cfs.	ÕST= 278.9 cu.ft.
5	T=	4.00	min.	Q 100 =	7.11	cfs.	ÕST= 622.9 cu.ft.
6	T=	5.00	min.	Q 100 =	10.12	cfs.	ÕST= 1139.8 cu.ft.
7	T=	6.00	min.	Q 100 =	13.28	cfs.	ÕST= 1841.7 cu.ft.
8	T=	7.00	min.	Q 100 =	16.57	cfs.	ÕST= 2737.1 cu.ft.
9	T=	8.00	min.	Q 100 =	20.04	cfs.	ÕST= 3835.5 cu.ft.
10	T=	9.00	min.	Q 100 =	23.76	cfs.	ÕST= 5149.6 cu.ft.
11	T=	10.00	min.	Q 100 =	27.82	cfs.	ÕST= 6696.9 cu.ft.
12	T=	11.00	min.	Q 100 =	32.29	cfs.	ÕST= 8500.1 cu.ft.
13	T=	12.00	min.	Q 100 =	37.24	cfs.	ÕST= 10586.0 cu.ft.
14	T=	13.00	min.	Q 100 =	42.67	cfs.	ÕST= 12983.3 cu.ft.
15	T=	14.00	min.	Q 100 =	48.53	cfs.	ÕST= 15719.3 cu.ft.
16	T=	15.00	min.	Q 100 =	54.67	cfs.	ÕST= 18815.2 cu.ft.
17	T=	16.00	min.	Q 100 =	60.84	cfs.	ÕST= 22280.3 cu.ft.
18	T=	17.00	min.	Q 100 =	66.65	cfs.	ÕST= 26105.0 cu.ft.
19	T=	18.00	min.	Q 100 =	71.59	cfs.	ÕST= 30252.3 cu.ft.
20	T=	19.00	min.	Q 100 =	72.77	cfs.	ÕST= 34583.3 cu.ft.
21	T=	20.00	min.	Q 100 =	69.67	cfs.	ÕST= 38856.7 cu.ft.
22	T=	21.00	min.	Q 100 =	66.55	cfs.	ÕST= 42943.4 cu.ft.
23	T=	22.00	min.	Q 100 =	63.43	cfs.	ÕST= 46842.9 cu.ft.
24	T=	23.00	min.	Q 100 =	60.33	cfs.	ÕST= 50555.6 cu.ft.
25	T=	24.00	min.	Q 100 =	57.25	cfs.	ÕST= 54082.9 cu.ft.
26	T=	25.00	min.	Q 100 =	54.22	cfs.	ÕST= 57427.1 cu.ft.
27	T=	26.00	min.	Q 100 =	51.25	cfs.	ÕST= 60591.5 cu.ft.
28	T=	27.00	min.	Q 100 =	48.35	cfs.	ÕST= 63579.7 cu.ft.
29	T=	28.00	min.	Q 100 =	45.53	cfs.	ÕST= 66396.1 cu.ft.
30	T=	29.00	min.	Q 100 =	42.79	cfs.	ÕST= 69045.8 cu.ft.
31	T=	30.00	min.	Q 100 =	40.15	cfs.	ÕST= 71534.1 cu.ft.
32	T=	31.00	min.	Q 100 =	37.60	cfs.	ÕST= 73866.7 cu.ft.
33	T=	32.00	min.	Q 100 =	35.16	cfs.	ÕST= 76049.6 cu.ft.
34	T=	33.00	min.	Q 100 =	32.83	cfs.	ÕST= 78089.3 cu.ft.
35	T=	34.00	min.	Q 100 =	30.60	cfs.	ÕST= 79992.0 cu.ft.
36	T=	35.00	min.	Q 100 =	28.48	cfs.	ÕST= 81764.4 cu.ft.
37	T=	36.00	min.	Q 100 =	26.48	cfs.	ÕST= 83413.2 cu.ft.
38	T=	37.00	min.	Q 100 =	24.58	cfs.	ÕST= 84945.0 cu.ft.
39	T=	38.00	min.	Q 100 =	22.80	cfs.	ÕST= 86366.5 cu.ft.
40	T=	39.00	min.	Q 100 =	21.13	cfs.	ÕST= 87684.2 cu.ft.
41	T=	40.00	min.	Q 100 =	19.56	cfs.	ÕST= 88904.7 cu.ft.
42	T=	41.00	min.	Q 100 =	18.10	cfs.	ÕST= 90034.4 cu.ft.
43	T=	42.00	min.	Q 100 =	16.74	cfs.	ÕST= 91079.4 cu.ft.
44	T=	43.00	min.	Q 100 =	15.48	cfs.	ÕST= 92045.7 cu.ft.
45	T=	44.00	min.	Q 100 =	14.31	cfs.	ÕST= 92939.2 cu.ft.
46	T=	45.00	min.	Q 100 =	13.23	cfs.	ÕST= 93765.5 cu.ft.
47	T=	46.00	min.	Q 100 =	12.25	cfs.	ÕST= 94529.9 cu.ft.
48	T=	47.00	min.	Q 100 =	11.34	cfs.	ÕST= 95237.4 cu.ft.
49	T=	48.00	min.	Q 100 =	10.51	cfs.	ÕST= 95892.9 cu.ft.
50	T=	49.00	min.	Q 100 =	9.76	cfs.	ÕST= 96501.0 cu.ft.
51	T=	50.00	min.	Q 100 =	9.07	cfs.	ÕST= 97065.8 cu.ft.

52	T=	51.00	min.	Q 100 =	8.45	cfs.	ðST=	97591.3 cu.ft.
53	T=	52.00	min.	Q 100 =	7.88	cfs.	ðST=	98081.2 cu.ft.
54	T=	53.00	min.	Q 100 =	7.37	cfs.	ðST=	98538.9 cu.ft.
55	T=	54.00	min.	Q 100 =	6.91	cfs.	ðST=	98967.4 cu.ft.
56	T=	55.00	min.	Q 100 =	6.49	cfs.	ðST=	99369.5 cu.ft.
57	T=	56.00	min.	Q 100 =	6.12	cfs.	ðST=	99747.9 cu.ft.
58	T=	57.00	min.	Q 100 =	5.77	cfs.	ðST=	100104.6 cu.ft.
59	T=	58.00	min.	Q 100 =	5.46	cfs.	ðST=	100441.7 cu.ft.
60	T=	59.00	min.	Q 100 =	5.18	cfs.	ðST=	100761.1 cu.ft.
61	T=	60.00	min.	Q 100 =	4.92	cfs.	ðST=	101064.0 cu.ft.
62	T=	61.00	min.	Q 100 =	4.68	cfs.	ðST=	101352.0 cu.ft.
63	T=	62.00	min.	Q 100 =	4.45	cfs.	ðST=	101626.0 cu.ft.
64	T=	63.00	min.	Q 100 =	4.24	cfs.	ðST=	101886.9 cu.ft.
65	T=	64.00	min.	Q 100 =	4.04	cfs.	ðST=	102135.5 cu.ft.
66	T=	65.00	min.	Q 100 =	3.85	cfs.	ðST=	102372.2 cu.ft.
67	T=	66.00	min.	Q 100 =	3.66	cfs.	ðST=	102597.5 cu.ft.
68	T=	67.00	min.	Q 100 =	3.48	cfs.	ðST=	102811.7 cu.ft.
69	T=	68.00	min.	Q 100 =	3.30	cfs.	ðST=	103014.9 cu.ft.
70	T=	69.00	min.	Q 100 =	3.12	cfs.	ðST=	103207.2 cu.ft.
71	T=	70.00	min.	Q 100 =	2.93	cfs.	ðST=	103388.7 cu.ft.
72	T=	71.00	min.	Q 100 =	2.75	cfs.	ðST=	103559.4 cu.ft.
73	T=	72.00	min.	Q 100 =	2.57	cfs.	ðST=	103719.0 cu.ft.
74	T=	73.00	min.	Q 100 =	2.39	cfs.	ðST=	103867.8 cu.ft.
75	T=	74.00	min.	Q 100 =	2.20	cfs.	ðST=	104005.5 cu.ft.
76	T=	75.00	min.	Q 100 =	2.02	cfs.	ðST=	104132.1 cu.ft.
77	T=	76.00	min.	Q 100 =	1.84	cfs.	ðST=	104247.7 cu.ft.
78	T=	77.00	min.	Q 100 =	1.65	cfs.	ðST=	104352.4 cu.ft.
79	T=	78.00	min.	Q 100 =	1.48	cfs.	ðST=	104446.2 cu.ft.
80	T=	79.00	min.	Q 100 =	1.30	cfs.	ðST=	104529.6 cu.ft.
81	T=	80.00	min.	Q 100 =	1.14	cfs.	ðST=	104602.8 cu.ft.
82	T=	81.00	min.	Q 100 =	0.98	cfs.	ðST=	104666.4 cu.ft.
83	T=	82.00	min.	Q 100 =	0.84	cfs.	ðST=	104720.9 cu.ft.
84	T=	83.00	min.	Q 100 =	0.71	cfs.	ðST=	104767.2 cu.ft.
85	T=	84.00	min.	Q 100 =	0.59	cfs.	ðST=	104806.2 cu.ft.
86	T=	85.00	min.	Q 100 =	0.50	cfs.	ðST=	104839.0 cu.ft.
87	T=	86.00	min.	Q 100 =	0.43	cfs.	ðST=	104866.9 cu.ft.

Filename: cr_crI9.in

(REFERENCE 3)

HYDROLOGIC DATA SHEET

Project Name and Location: CORTARO RIDGE - 03124-01-30

Drainage Concentration Point: 10 (ONSITE DEVELOPED)

Watershed Area (A): 2.5 (acres/~~square miles~~).

Length of Watercourse (L_c): 400' ft. Length to Center of Gravity (L_{ca}): 200' ft

Incremental Change in Length (L_i) - ft.	Incremental Change in Elevation (H_i) - ft
400'	6'

Mean Slope (S_c): .0150 ft./ft. Watershed Type(s): MOD. URBAN (future

Basin Factor (n_b): .022 (future) Flood Frequency: 100 yrs

P_{24} (24 hour): ____ in. Areal Value: ____ in.

P_6 (6 hour): ____ in. Areal Value: ____ in.

P_1 (1 hour): 2.87 in. Areal Value: ____ in.

P_2 (2 hour): ____ in. Areal Value: ____ in.

P_3 (3 hour): ____ in. Areal Value: ____ in.

Soil Group(s): 100% B Cover Type(s): DESERT BRUSH

Cover Density (pervious areas): 20% Impervious Cover: 50% (futur

CN(s): 83 (curve number) (pervious & impervious areas) CN*(s): 87.5, 99.0 (adjusted curve number)

Runoff to Rainfall Ratio(s), (C): .57 (pervious areas) .95 (impervious area

Runoff Supply Rate (q): .764 i in./hr. (function of i)

Time of Concentration (T_c): 5 $i^{-.4}$ ~~hrs./~~mins. (function of i)

Iterative Solution of T_c: 5 ~~hrs./~~mins.

Rainfall Intensity (i) at T_c: 9.987 in./hr.

Runoff Supply Rate (q) at T_c: 7.63 in./hr.

Peak Discharge:

1.008 qA (acres): 19 cfs.

645.33qA (square miles): ____ cfs.

Equation for T_c:

$$T_c = \frac{n_b}{50} \frac{(L_c L_{ca})^{.3}}{(S_c)^{.4}} q^{-.4} \text{ hours.}$$

Note: For impervious areas, $CN^* = 99$ (constant).

FIGURE 3
sheet 4 of 16

PIMA COUNTY HYDROGRAPH

Project: Cortaro Road
Hydrograph Location: 10* (Cortaro Ridge I)

Job#: 99067-01
Preparer: SP
DATE: 01-08-2001

Qp100 = 19.00 cfs. Tc = 5.0 min. Tp = 13.60 min. delta T = 1.000 min.

1	T=	0.00	min.	Q 100 =	0.00	cfs.	ΔST= 0.0 cu.ft.
2	T=	1.00	min.	Q 100 =	0.24	cfs.	ΔST= 7.1 cu.ft.
3	T=	2.00	min.	Q 100 =	0.96	cfs.	ΔST= 42.9 cu.ft.
4	T=	3.00	min.	Q 100 =	1.92	cfs.	ΔST= 129.2 cu.ft.
5	T=	4.00	min.	Q 100 =	3.00	cfs.	ΔST= 276.8 cu.ft.
6	T=	5.00	min.	Q 100 =	4.15	cfs.	ΔST= 491.2 cu.ft.
7	T=	6.00	min.	Q 100 =	5.38	cfs.	ΔST= 776.9 cu.ft.
8	T=	7.00	min.	Q 100 =	6.74	cfs.	ΔST= 1140.4 cu.ft.
9	T=	8.00	min.	Q 100 =	8.29	cfs.	ΔST= 1591.4 cu.ft.
10	T=	9.00	min.	Q 100 =	10.07	cfs.	ΔST= 2142.2 cu.ft.
11	T=	10.00	min.	Q 100 =	12.08	cfs.	ΔST= 2806.6 cu.ft.
12	T=	11.00	min.	Q 100 =	14.24	cfs.	ΔST= 3595.9 cu.ft.
13	T=	12.00	min.	Q 100 =	16.39	cfs.	ΔST= 4514.5 cu.ft.
14	T=	13.00	min.	Q 100 =	18.24	cfs.	ΔST= 5553.3 cu.ft.
15	T=	14.00	min.	Q 100 =	18.49	cfs.	ΔST= 6655.2 cu.ft.
16	T=	15.00	min.	Q 100 =	17.39	cfs.	ΔST= 7731.4 cu.ft.
17	T=	16.00	min.	Q 100 =	16.29	cfs.	ΔST= 8741.7 cu.ft.
18	T=	17.00	min.	Q 100 =	15.19	cfs.	ΔST= 9686.0 cu.ft.
19	T=	18.00	min.	Q 100 =	14.12	cfs.	ΔST= 10565.2 cu.ft.
20	T=	19.00	min.	Q 100 =	13.07	cfs.	ΔST= 11380.7 cu.ft.
21	T=	20.00	min.	Q 100 =	12.05	cfs.	ΔST= 12134.1 cu.ft.
22	T=	21.00	min.	Q 100 =	11.07	cfs.	ΔST= 12827.8 cu.ft.
23	T=	22.00	min.	Q 100 =	10.14	cfs.	ΔST= 13464.3 cu.ft.
24	T=	23.00	min.	Q 100 =	9.26	cfs.	ΔST= 14046.4 cu.ft.
25	T=	24.00	min.	Q 100 =	8.43	cfs.	ΔST= 14577.1 cu.ft.
26	T=	25.00	min.	Q 100 =	7.65	cfs.	ΔST= 15059.4 cu.ft.
27	T=	26.00	min.	Q 100 =	6.92	cfs.	ΔST= 15496.6 cu.ft.
28	T=	27.00	min.	Q 100 =	6.25	cfs.	ΔST= 15891.9 cu.ft.
29	T=	28.00	min.	Q 100 =	5.64	cfs.	ΔST= 16248.6 cu.ft.
30	T=	29.00	min.	Q 100 =	5.07	cfs.	ΔST= 16569.7 cu.ft.
31	T=	30.00	min.	Q 100 =	4.56	cfs.	ΔST= 16858.6 cu.ft.
32	T=	31.00	min.	Q 100 =	4.09	cfs.	ΔST= 17118.0 cu.ft.
33	T=	32.00	min.	Q 100 =	3.67	cfs.	ΔST= 17351.0 cu.ft.
34	T=	33.00	min.	Q 100 =	3.30	cfs.	ΔST= 17560.2 cu.ft.
35	T=	34.00	min.	Q 100 =	2.97	cfs.	ΔST= 17748.2 cu.ft.
36	T=	35.00	min.	Q 100 =	2.67	cfs.	ΔST= 17917.5 cu.ft.
37	T=	36.00	min.	Q 100 =	2.41	cfs.	ΔST= 18070.1 cu.ft.
38	T=	37.00	min.	Q 100 =	2.19	cfs.	ΔST= 18208.2 cu.ft.
39	T=	38.00	min.	Q 100 =	1.99	cfs.	ΔST= 18333.6 cu.ft.
40	T=	39.00	min.	Q 100 =	1.82	cfs.	ΔST= 18447.8 cu.ft.
41	T=	40.00	min.	Q 100 =	1.67	cfs.	ΔST= 18552.3 cu.ft.
42	T=	41.00	min.	Q 100 =	1.54	cfs.	ΔST= 18648.5 cu.ft.
43	T=	42.00	min.	Q 100 =	1.42	cfs.	ΔST= 18737.2 cu.ft.
44	T=	43.00	min.	Q 100 =	1.32	cfs.	ΔST= 18819.5 cu.ft.
45	T=	44.00	min.	Q 100 =	1.23	cfs.	ΔST= 18896.1 cu.ft.
46	T=	45.00	min.	Q 100 =	1.15	cfs.	ΔST= 18967.6 cu.ft.
47	T=	46.00	min.	Q 100 =	1.08	cfs.	ΔST= 19034.4 cu.ft.
48	T=	47.00	min.	Q 100 =	1.01	cfs.	ΔST= 19096.9 cu.ft.
49	T=	48.00	min.	Q 100 =	0.94	cfs.	ΔST= 19155.3 cu.ft.
50	T=	49.00	min.	Q 100 =	0.88	cfs.	ΔST= 19209.8 cu.ft.
51	T=	50.00	min.	Q 100 =	0.81	cfs.	ΔST= 19260.4 cu.ft.

52	T=	51.00	min.	Q 100 =	0.75	cfs.	ðST= 19307.1 cu.ft.
53	T=	52.00	min.	Q 100 =	0.68	cfs.	ðST= 19350.1 cu.ft.
54	T=	53.00	min.	Q 100 =	0.62	cfs.	ðST= 19389.1 cu.ft.
55	T=	54.00	min.	Q 100 =	0.55	cfs.	ðST= 19424.3 cu.ft.
56	T=	55.00	min.	Q 100 =	0.49	cfs.	ðST= 19455.6 cu.ft.
57	T=	56.00	min.	Q 100 =	0.42	cfs.	ðST= 19483.0 cu.ft.
58	T=	57.00	min.	Q 100 =	0.36	cfs.	ðST= 19506.6 cu.ft.
59	T=	58.00	min.	Q 100 =	0.30	cfs.	ðST= 19526.5 cu.ft.
60	T=	59.00	min.	Q 100 =	0.25	cfs.	ðST= 19543.0 cu.ft.
61	T=	60.00	min.	Q 100 =	0.20	cfs.	ðST= 19556.4 cu.ft.
62	T=	61.00	min.	Q 100 =	0.16	cfs.	ðST= 19567.0 cu.ft.
63	T=	62.00	min.	Q 100 =	0.12	cfs.	ðST= 19575.3 cu.ft.

Filename: cr_crI10.in

MMLA
McGovern MacVittie Lodge & Associates, Inc.

PROJECT NAME: CORTARO FARMS ROAD

PROJECT NUMBER: 99067-01 MADE BY: SP DATE: 2/19/01

REFERENCE: _____ CHECKED BY: _____ DATE: _____

HYDROGRAPH LAG TIMES FOR CONCENTRATION PT. 11

FOR CORTARO RIDGE WATERSHED 9 (REFERENCE 2), SEE ATTACHED HYDRAULIC CALCULATION SHEET

$V = 1.97$ fps

Distance to C.P. 11 = 1450 ft

$\therefore$ Lag Time = $\frac{1450 \text{ ft}}{1.97 \text{ fps}} \left(\frac{1 \text{ min}}{60 \text{ s}}\right) = 12 \text{ min}$

FOR CORTARO RIDGE WATERSHED 10 (REFERENCE 2), SEE ATTACHED HYDRAULIC CALCULATION ~~SHEET~~

$V = 1.10$ fps

Distance to C.P. 11 = 1200 ft

$\therefore$ Lag Time = $\frac{1200 \text{ ft}}{1.10 \text{ fps}} \left(\frac{1 \text{ min}}{60 \text{ s}}\right) = 18 \text{ min}$

Cortaro Road
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_rout.fm2
Worksheet	C.P. 9* Routing Channel
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data				
Channel Slope	0.017000 ft/ft			
Elevation range: 2,338.00 ft to 2,340.00 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,340.00	100.00	410.00	0.034
165.00	2,338.00			
325.00	2,338.00			
410.00	2,339.00			
Discharge	74.00 cfs			

Results		
Wtd. Mannings Coefficient	0.034	
Water Surface Elevation	2,338.22	ft
Flow Area	37.63	ft²
Wetted Perimeter	185.59	ft
Top Width	185.59	ft
Height	0.22	ft
Critical Depth	2,338.18	ft
Critical Slope	0.030240	ft/ft
Velocity	1.97	ft/s
Velocity Head	0.06	ft
Specific Energy	2,338.28	ft
Froude Number	0.77	
Flow is subcritical.		

Cortaro Road
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_rout.fm2
Worksheet	C.P. 10* Routing Channel
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data				
Channel Slope	0.011000 ft/ft			
Elevation range: 2,338.00 ft to 2,340.00 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,339.00	100.00	375.00	0.034
130.00	2,338.00			
265.00	2,338.00			
375.00	2,340.00			
Discharge	19.00 cfs			

Results		
Wtd. Mannings Coefficient	0.034	
Water Surface Elevation	2,338.12	ft
Flow Area	17.20	ft^2
Wetted Perimeter	145.43	ft
Top Width	145.43	ft
Height	0.12	ft
Critical Depth	2,338.08	ft
Critical Slope	0.038738	ft/ft
Velocity	1.10	ft/s
Velocity Head	0.02	ft
Specific Energy	2,338.14	ft
Froude Number	0.57	
Flow is subcritical.		

100-Year Combined Hydrographs for Concentration Point 11 (Existing)

Time (min)	C.P. 11	C.P. 9* (12 min. lag)	C.P. 10* (18 min. lag)	Total (cfs)
0	0	0	0	0
1	1.00	0	0	1
2	4.15	0	0	4
3	8.52	0	0	9
4	13.48	0	0	13
5	18.77	0	0	19
6	24.36	0	0	24
7	30.39	0	0	30
8	37.06	0	0	37
9	44.60	0	0	45
10	53.13	0	0	53
11	62.63	0	0	63
12	72.80	0	0	73
13	83.06	0.44	0	83
14	92.36	2.03	0	94
15	99.00	4.35	0	103
16	93.43	7.11	0	101
17	88.23	10.12	0	98
18	83.03	13.28	0	96
19	77.88	16.57	0.24	95
20	72.81	20.04	0.96	94
21	67.86	23.76	1.92	94
22	63.06	27.82	3.00	94
23	58.43	32.29	4.15	95
24	53.99	37.24	5.38	97
25	49.75	42.67	6.74	99
26	45.73	48.53	8.29	103
27	41.93	54.67	10.07	107
28	38.36	60.84	12.08	111
29	35.02	66.65	14.24	116
30	31.92	71.59	16.39	**120**
31	29.04	72.77	18.24	120
32	26.38	69.67	18.49	115
33	23.95	66.55	17.39	108
34	21.72	63.43	16.29	101
35	19.70	60.33	15.19	95
36	17.87	57.25	14.12	89
37	16.22	54.22	13.07	84
38	14.74	51.25	12.05	78
39	13.43	48.35	11.07	73
40	12.25	45.53	10.14	68
41	11.21	42.79	9.26	63
42	10.29	40.15	8.43	59
43	9.48	37.60	7.65	55
44	8.77	35.16	6.92	51
45	8.14	32.83	6.25	47

100-Year Combined Hydrographs for Concentration Point 11 (Existing)

Time (min)	C.P. 11	C.P. 9* (12 min. lag)	C.P. 10* (18 min. lag)	Total (cfs)
46	7.58	30.60	5.64	44
47	7.08	28.48	5.07	41
48	6.64	26.48	4.56	38
49	6.23	24.58	4.09	35
50	5.86	22.80	3.67	32
51	5.52	21.13	3.30	30
52	5.19	19.56	2.97	28
53	4.88	18.10	2.67	26
54	4.57	16.74	2.41	24
55	4.27	15.48	2.19	22
56	3.97	14.31	1.99	20
57	3.67	13.23	1.82	19
58	3.36	12.25	1.67	17
59	3.06	11.34	1.54	16
60	2.75	10.51	1.42	15
61	2.44	9.76	1.32	14
62	2.14	9.07	1.23	12
63	1.85	8.45	1.15	11
64	1.57	7.88	1.08	11
65	1.31	7.37	1.01	10
66	1.07	6.91	0.94	9
67	0.86	6.49	0.88	8
68	0.69	6.12	0.81	8
69	0.57	5.77	0.75	7

WATERSHED 12

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 12

WATERSHED AREA (A): 4.70 acres

LENGTH OF WATERCOURSE (Lc): 1080. ft

LENGTH TO CENTER OF GRAVITY (Lca): 540. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
1080.	22.0

MEAN SLOPE (Sc): .0204 ft BASIN FACTOR (Nb): .0340

WATERSHED TYPE(S): RURAL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 10. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.220	.356	.433	.513	.571	.619
Tc (FUNCTION OF i) :	19.03	15.70	14.53	13.58	13.00	12.60
SOLUTION OF Tc (MINUTES):	12	8	7	6	6	5
RAINFL INT. @ Tc (IN/HR):	3.149	4.931	6.037	7.501	8.537	10.018
RUNOFF RATE @ Tc (IN/HR):	.694	1.757	2.611	3.846	4.878	6.197
PEAK DISCHARGE (CFS) :	3.29	8.33	12.37	18.22	23.11	29.36

WATERSHED 13

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 13

WATERSHED AREA (A): 5.40 acres

LENGTH OF WATERCOURSE (Lc): 1250. ft

LENGTH TO CENTER OF GRAVITY (Lca): 625. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
1250.	23.0

MEAN SLOPE (Sc): .0184 ft BASIN FACTOR (Nb): .0340

WATERSHED TYPE(S): RURAL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 10. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.220	.356	.433	.513	.571	.619
Tc (FUNCTION OF i) :	21.64	17.86	16.52	15.44	14.78	14.32
SOLUTION OF Tc (MINUTES):	14	10	8	7	6	6
RAINFL INT. @ Tc (IN/HR):	2.961	4.453	5.730	7.117	8.537	9.558
RUNOFF RATE @ Tc (IN/HR):	.653	1.587	2.479	3.649	4.878	5.912
PEAK DISCHARGE (CFS) :	3.55	8.64	13.49	19.86	26.55	32.18

WATERSHED 14

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 14

WATERSHED AREA (A): 1.10 acres

LENGTH OF WATERCOURSE (Lc): 540. ft

LENGTH TO CENTER OF GRAVITY (Lca): 270. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
540.	11.0

MEAN SLOPE (Sc): .0204 ft BASIN FACTOR (Nb): .0340

WATERSHED TYPE(S): RURAL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 10. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.220	.356	.433	.513	.571	.619
Tc (FUNCTION OF i) :	12.56	10.36	9.59	8.96	8.58	8.31
SOLUTION OF Tc (MINUTES):	7	5	5	5	5	5
RAINFL INT. @ Tc (IN/HR):	3.936	5.739	6.669	7.862	8.948	10.018
RUNOFF RATE @ Tc (IN/HR):	.867	2.045	2.885	4.032	5.113	6.197
PEAK DISCHARGE (CFS) :	.96	2.27	3.20	4.47	5.67	6.87

WATERSHED 15

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 15

WATERSHED AREA (A): 1.00 acres

LENGTH OF WATERCOURSE (Lc): 450. ft

LENGTH TO CENTER OF GRAVITY (Lca): 225. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
450.	10.0

MEAN SLOPE (Sc): .0222 ft BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): NATURAL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.144	.293	.376	.464	.529	.581
Tc (FUNCTION OF i) :	13.27	9.99	9.04	8.31	7.89	7.60
SOLUTION OF Tc (MINUTES):	8	5	5	5	5	5
RAINFL INT. @ Tc (IN/HR):	3.736	5.739	6.669	7.862	8.948	10.018
RUNOFF RATE @ Tc (IN/HR):	.537	1.680	2.510	3.651	4.732	5.818
PEAK DISCHARGE (CFS) :	.54	1.69	2.53	3.68	4.77	5.86

WATERSHED 16

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 16

WATERSHED AREA (A): 1.00 acres

LENGTH OF WATERCOURSE (Lc): 430. ft

LENGTH TO CENTER OF GRAVITY (Lca): 215. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
430.	12.0

MEAN SLOPE (Sc): .0279 ft BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): NATURAL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

40. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %
60. % C, CN= 88, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.212	.369	.452	.537	.597	.644
Tc (FUNCTION OF i) :	10.09	8.09	7.46	6.96	6.67	6.47
SOLUTION OF Tc (MINUTES):	6	5	5	5	5	5
RAINFL INT. @ Tc (IN/HR):	4.148	5.739	6.669	7.862	8.948	10.018
RUNOFF RATE @ Tc (IN/HR):	.881	2.119	3.016	4.220	5.342	6.457
PEAK DISCHARGE (CFS) :	.89	2.14	3.04	4.25	5.38	6.51

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 16 (Watersheds 14-16)

WATERSHED AREA (A): 3.10 acres

LENGTH OF WATERCOURSE (Lc): 960. ft

LENGTH TO CENTER OF GRAVITY (Lca): 480. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
540.	11.0
420.	8.0

MEAN SLOPE (Sc): .0198 ft BASIN FACTOR (Nb): .0320

WATERSHED TYPE(S): NATURAL/RURAL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

81. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %
19. % C, CN= 88, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 4. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.195	.341	.422	.506	.567	.615
Tc (FUNCTION OF i) :	17.73	14.18	13.03	12.12	11.58	11.20
SOLUTION OF Tc (MINUTES):	11	7	6	5	5	5
RAINFL INT. @ Tc (IN/HR):	3.261	5.195	6.362	7.862	8.948	10.018
RUNOFF RATE @ Tc (IN/HR):	.637	1.774	2.684	3.976	5.070	6.164
PEAK DISCHARGE (CFS) :	1.99	5.54	8.39	12.42	15.84	19.26

WATERSHED 17

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 17

WATERSHED AREA (A): 38.20 acres

LENGTH OF WATERCOURSE (Lc): 3830. ft

LENGTH TO CENTER OF GRAVITY (Lca): 1915. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
560.	8.0
3270.	63.0

MEAN SLOPE (Sc): .0184 ft BASIN FACTOR (Nb): .0320

WATERSHED TYPE(S): RURAL/SCHOOL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

84. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %
16. % C, CN= 88, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 8. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.222	.362	.440	.521	.580	.627
Tc (FUNCTION OF i) :	39.78	32.69	30.25	28.28	27.09	26.26
SOLUTION OF Tc (MINUTES):	31	21	17	15	13	12
RAINFL INT. @ Tc (IN/HR):	1.924	3.183	4.139	5.151	6.274	7.255
RUNOFF RATE @ Tc (IN/HR):	.427	1.154	1.821	2.683	3.636	4.546
PEAK DISCHARGE (CFS) :	16.	44.	70.	103.	140.	175.

WATERSHED 18

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 18 (Watersheds 17 & 18)

WATERSHED AREA (A): 71.20 acres

LENGTH OF WATERCOURSE (Lc): 4090. ft

LENGTH TO CENTER OF GRAVITY (Lca): 2045. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
560.	8.0
3270.	63.0
260.	6.0

MEAN SLOPE (Sc): .0186 ft BASIN FACTOR (Nb): .0320

WATERSHED TYPE(S): RURAL/SCHOOL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

80. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %
20. % C, CN= 88, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 7. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.219	.361	.439	.521	.580	.627
Tc (FUNCTION OF i) :	41.39	33.87	31.32	29.26	28.03	27.16
SOLUTION OF Tc (MINUTES):	32	21	18	15	14	12
RAINFL INT. @ Tc (IN/HR):	1.887	3.183	4.024	5.151	6.094	7.255
RUNOFF RATE @ Tc (IN/HR):	.413	1.149	1.768	2.682	3.533	4.549
PEAK DISCHARGE (CFS) :	30.	82.	127.	192.	254.	326.

WATERSHED 19

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 19

WATERSHED AREA (A): 1.40 acres

LENGTH OF WATERCOURSE (Lc): 380. ft

LENGTH TO CENTER OF GRAVITY (Lca): 190. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
380.	12.0

MEAN SLOPE (Sc): .0316 ft BASIN FACTOR (Nb): .0250

WATERSHED TYPE(S): RURAL/SCHOOL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % C, CN= 88, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.258	.420	.503	.585	.642	.687
Tc (FUNCTION OF i) :	5.89	4.85	4.51	4.25	4.09	3.98
SOLUTION OF Tc (MINUTES):	5	5	5	5	5	5
RAINFL INT. @ Tc (IN/HR):	4.348	5.739	6.669	7.862	8.948	10.018
RUNOFF RATE @ Tc (IN/HR):	1.122	2.411	3.353	4.599	5.748	6.883
PEAK DISCHARGE (CFS) :	1.58	3.40	4.73	6.49	8.11	9.71

WATERSHED 20

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 20

WATERSHED AREA (A): 2.30 acres

LENGTH OF WATERCOURSE (Lc): 560. ft

LENGTH TO CENTER OF GRAVITY (Lca): 280. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
560.	25.5

MEAN SLOPE (Sc): .0455 ft BASIN FACTOR (Nb): .0250

WATERSHED TYPE(S): RURAL/SCHOOL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % C, CN= 88, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.258	.420	.503	.585	.642	.687
Tc (FUNCTION OF i) :	6.42	5.28	4.92	4.63	4.46	4.34
SOLUTION OF Tc (MINUTES):	5	5	5	5	5	5
RAINFL INT. @ Tc (IN/HR):	4.348	5.739	6.669	7.862	8.948	10.018
RUNOFF RATE @ Tc (IN/HR):	1.122	2.411	3.353	4.599	5.748	6.883
PEAK DISCHARGE (CFS) :	2.60	5.59	7.77	10.66	13.33	15.96

WATERSHED 21

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 21

WATERSHED AREA (A): 3.60 acres

LENGTH OF WATERCOURSE (Lc): 760. ft

LENGTH TO CENTER OF GRAVITY (Lca): 380. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
590.	23.0
170.	3.5

MEAN SLOPE (Sc): .0332 ft BASIN FACTOR (Nb): .0250

WATERSHED TYPE(S): NATURAL/MOD. URBAN

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % C, CN= 88, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 5. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.291	.446	.525	.603	.658	.701
Tc (FUNCTION OF i) :	8.35	7.04	6.59	6.24	6.02	5.87
SOLUTION OF Tc (MINUTES):	5	5	5	5	5	5
RAINFL INT. @ Tc (IN/HR):	4.348	5.739	6.669	7.862	8.948	10.018
RUNOFF RATE @ Tc (IN/HR):	1.264	2.558	3.499	4.742	5.887	7.019
PEAK DISCHARGE (CFS) :	4.59	9.28	12.70	17.21	21.36	25.47

WATERSHED 22

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 22

WATERSHED AREA (A): .20 acres

LENGTH OF WATERCOURSE (Lc): 100. ft

LENGTH TO CENTER OF GRAVITY (Lca): 50. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
100.	8.0

MEAN SLOPE (Sc): .0800 ft BASIN FACTOR (Nb): .0400

WATERSHED TYPE(S): NATURAL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

100. % C, CN= 88, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.258	.420	.503	.585	.642	.687
Tc (FUNCTION OF i) :	2.92	2.40	2.23	2.10	2.03	1.97
SOLUTION OF Tc (MINUTES):	5	5	5	5	5	5
RAINFL INT. @ Tc (IN/HR):	4.348	5.739	6.669	7.862	8.948	10.018
RUNOFF RATE @ Tc (IN/HR):	1.122	2.411	3.353	4.599	5.748	6.883
PEAK DISCHARGE (CFS) :	.23	.49	.68	.93	1.16	1.39

WATERSHED 23

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 23

WATERSHED AREA (A): 145.60 acres

LENGTH OF WATERCOURSE (Lc): 4800. ft

LENGTH TO CENTER OF GRAVITY (Lca): 2400. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
2750.	52.5
2050.	45.0

MEAN SLOPE (Sc): .0202 ft BASIN FACTOR (Nb): .0290

WATERSHED TYPE(S): RURAL/MOD. URBAN

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

2. % A,	CN= 68,	COVER TYPE= DESERT BRUSH ,	COVER DENSITY= 25 %
37. % B,	CN= 82,	COVER TYPE= DESERT BRUSH ,	COVER DENSITY= 25 %
61. % C,	CN= 88,	COVER TYPE= DESERT BRUSH ,	COVER DENSITY= 25 %

IMPERVIOUS COVER= 5. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.241	.388	.467	.547	.605	.650
Tc (FUNCTION OF i) :	38.45	31.77	29.51	27.69	26.60	25.84
SOLUTION OF Tc (MINUTES):	29	20	17	14	13	12
RAINFL INT. @ Tc (IN/HR):	2.012	3.282	4.139	5.354	6.274	7.255
RUNOFF RATE @ Tc (IN/HR):	.484	1.273	1.932	2.929	3.794	4.718
PEAK DISCHARGE (CFS) :	71.	187.	283.	430.	557.	692.

PIMA COUNTY HYDROGRAPH

Project: Cortaro Road
Hydrograph Location: C.P. 23

Job#: 99067-01
Preparer: SP
DATE: 01-08-2001

Qp100 = 692.00 cfs. Tc = 12.0 min. Tp = 18.70 min. delta T = 1.000 min.

1	T= 0.00 min.	Q 100 = 0.00 cfs.	ðST= 0.0 cu.ft.
2	T= 1.00 min.	Q 100 = 4.14 cfs.	ðST= 124.2 cu.ft.
3	T= 2.00 min.	Q 100 = 18.97 cfs.	ðST= 817.6 cu.ft.
4	T= 3.00 min.	Q 100 = 40.71 cfs.	ðST= 2608.2 cu.ft.
5	T= 4.00 min.	Q 100 = 66.52 cfs.	ðST= 5825.1 cu.ft.
6	T= 5.00 min.	Q 100 = 94.62 cfs.	ðST= 10659.0 cu.ft.
7	T= 6.00 min.	Q 100 = 124.15 cfs.	ðST= 17222.0 cu.ft.
8	T= 7.00 min.	Q 100 = 154.97 cfs.	ðST= 25595.5 cu.ft.
9	T= 8.00 min.	Q 100 = 187.42 cfs.	ðST= 35867.1 cu.ft.
10	T= 9.00 min.	Q 100 = 222.20 cfs.	ðST= 48155.6 cu.ft.
11	T= 10.00 min.	Q 100 = 260.12 cfs.	ðST= 62625.2 cu.ft.
12	T= 11.00 min.	Q 100 = 301.96 cfs.	ðST= 79487.7 cu.ft.
13	T= 12.00 min.	Q 100 = 348.23 cfs.	ðST= 98993.4 cu.ft.
14	T= 13.00 min.	Q 100 = 399.03 cfs.	ðST= 121411.2 cu.ft.
15	T= 14.00 min.	Q 100 = 453.81 cfs.	ðST= 146996.3 cu.ft.
16	T= 15.00 min.	Q 100 = 511.22 cfs.	ðST= 175947.1 cu.ft.
17	T= 16.00 min.	Q 100 = 568.90 cfs.	ðST= 208350.8 cu.ft.
18	T= 17.00 min.	Q 100 = 623.30 cfs.	ðST= 244116.9 cu.ft.
19	T= 18.00 min.	Q 100 = 669.47 cfs.	ðST= 282900.1 cu.ft.
20	T= 19.00 min.	Q 100 = 680.53 cfs.	ðST= 323400.3 cu.ft.
21	T= 20.00 min.	Q 100 = 651.54 cfs.	ðST= 363362.4 cu.ft.
22	T= 21.00 min.	Q 100 = 622.35 cfs.	ðST= 401579.2 cu.ft.
23	T= 22.00 min.	Q 100 = 593.16 cfs.	ðST= 438044.7 cu.ft.
24	T= 23.00 min.	Q 100 = 564.12 cfs.	ðST= 472763.2 cu.ft.
25	T= 24.00 min.	Q 100 = 535.38 cfs.	ðST= 505748.1 cu.ft.
26	T= 25.00 min.	Q 100 = 507.06 cfs.	ðST= 537021.4 cu.ft.
27	T= 26.00 min.	Q 100 = 479.29 cfs.	ðST= 566612.1 cu.ft.
28	T= 27.00 min.	Q 100 = 452.16 cfs.	ðST= 594555.7 cu.ft.
29	T= 28.00 min.	Q 100 = 425.76 cfs.	ðST= 620893.5 cu.ft.
30	T= 29.00 min.	Q 100 = 400.17 cfs.	ðST= 645671.6 cu.ft.
31	T= 30.00 min.	Q 100 = 375.45 cfs.	ðST= 668940.3 cu.ft.
32	T= 31.00 min.	Q 100 = 351.65 cfs.	ðST= 690753.1 cu.ft.
33	T= 32.00 min.	Q 100 = 328.81 cfs.	ðST= 711166.8 cu.ft.
34	T= 33.00 min.	Q 100 = 306.96 cfs.	ðST= 730240.0 cu.ft.
35	T= 34.00 min.	Q 100 = 286.14 cfs.	ðST= 748033.1 cu.ft.
36	T= 35.00 min.	Q 100 = 266.35 cfs.	ðST= 764607.8 cu.ft.
37	T= 36.00 min.	Q 100 = 247.60 cfs.	ðST= 780026.0 cu.ft.
38	T= 37.00 min.	Q 100 = 229.88 cfs.	ðST= 794350.4 cu.ft.
39	T= 38.00 min.	Q 100 = 213.21 cfs.	ðST= 807643.1 cu.ft.
40	T= 39.00 min.	Q 100 = 197.55 cfs.	ðST= 819965.8 cu.ft.
41	T= 40.00 min.	Q 100 = 182.90 cfs.	ðST= 831379.3 cu.ft.
42	T= 41.00 min.	Q 100 = 169.23 cfs.	ðST= 841942.9 cu.ft.
43	T= 42.00 min.	Q 100 = 156.51 cfs.	ðST= 851714.9 cu.ft.
44	T= 43.00 min.	Q 100 = 144.71 cfs.	ðST= 860751.6 cu.ft.
45	T= 44.00 min.	Q 100 = 133.81 cfs.	ðST= 869107.1 cu.ft.
46	T= 45.00 min.	Q 100 = 123.75 cfs.	ðST= 876833.9 cu.ft.
47	T= 46.00 min.	Q 100 = 114.51 cfs.	ðST= 883981.7 cu.ft.
48	T= 47.00 min.	Q 100 = 106.04 cfs.	ðST= 890598.2 cu.ft.
49	T= 48.00 min.	Q 100 = 98.30 cfs.	ðST= 896728.2 cu.ft.
50	T= 49.00 min.	Q 100 = 91.24 cfs.	ðST= 902414.2 cu.ft.
51	T= 50.00 min.	Q 100 = 84.82 cfs.	ðST= 907695.9 cu.ft.

52	T=	51.00	min.	Q 100 =	78.99	cfs.	ÐST= 912610.3 cu.ft.
53	T=	52.00	min.	Q 100 =	73.72	cfs.	ÐST= 917191.6 cu.ft.
54	T=	53.00	min.	Q 100 =	68.94	cfs.	ÐST= 921471.2 cu.ft.
55	T=	54.00	min.	Q 100 =	64.63	cfs.	ÐST= 925478.4 cu.ft.
56	T=	55.00	min.	Q 100 =	60.73	cfs.	ÐST= 929239.1 cu.ft.
57	T=	56.00	min.	Q 100 =	57.20	cfs.	ÐST= 932776.9 cu.ft.
58	T=	57.00	min.	Q 100 =	54.00	cfs.	ÐST= 936112.8 cu.ft.
59	T=	58.00	min.	Q 100 =	51.09	cfs.	ÐST= 939265.7 cu.ft.
60	T=	59.00	min.	Q 100 =	48.44	cfs.	ÐST= 942251.8 cu.ft.
61	T=	60.00	min.	Q 100 =	46.01	cfs.	ÐST= 945085.1 cu.ft.
62	T=	61.00	min.	Q 100 =	43.75	cfs.	ÐST= 947777.9 cu.ft.
63	T=	62.00	min.	Q 100 =	41.66	cfs.	ÐST= 950340.2 cu.ft.
64	T=	63.00	min.	Q 100 =	39.68	cfs.	ÐST= 952780.2 cu.ft.
65	T=	64.00	min.	Q 100 =	37.80	cfs.	ÐST= 955104.6 cu.ft.
66	T=	65.00	min.	Q 100 =	35.99	cfs.	ÐST= 957318.2 cu.ft.
67	T=	66.00	min.	Q 100 =	34.24	cfs.	ÐST= 959425.2 cu.ft.
68	T=	67.00	min.	Q 100 =	32.52	cfs.	ÐST= 961428.0 cu.ft.
69	T=	68.00	min.	Q 100 =	30.82	cfs.	ÐST= 963328.2 cu.ft.
70	T=	69.00	min.	Q 100 =	29.13	cfs.	ÐST= 965126.9 cu.ft.
71	T=	70.00	min.	Q 100 =	27.44	cfs.	ÐST= 966824.1 cu.ft.
72	T=	71.00	min.	Q 100 =	25.74	cfs.	ÐST= 968419.6 cu.ft.
73	T=	72.00	min.	Q 100 =	24.04	cfs.	ÐST= 969912.9 cu.ft.
74	T=	73.00	min.	Q 100 =	22.32	cfs.	ÐST= 971303.6 cu.ft.
75	T=	74.00	min.	Q 100 =	20.60	cfs.	ÐST= 972591.2 cu.ft.
76	T=	75.00	min.	Q 100 =	18.87	cfs.	ÐST= 973775.4 cu.ft.
77	T=	76.00	min.	Q 100 =	17.16	cfs.	ÐST= 974856.6 cu.ft.
78	T=	77.00	min.	Q 100 =	15.46	cfs.	ÐST= 975835.4 cu.ft.
79	T=	78.00	min.	Q 100 =	13.80	cfs.	ÐST= 976713.2 cu.ft.
80	T=	79.00	min.	Q 100 =	12.18	cfs.	ÐST= 977492.8 cu.ft.
81	T=	80.00	min.	Q 100 =	10.64	cfs.	ÐST= 978177.4 cu.ft.
82	T=	81.00	min.	Q 100 =	9.18	cfs.	ÐST= 978771.9 cu.ft.
83	T=	82.00	min.	Q 100 =	7.83	cfs.	ÐST= 979282.2 cu.ft.
84	T=	83.00	min.	Q 100 =	6.60	cfs.	ÐST= 979715.2 cu.ft.
85	T=	84.00	min.	Q 100 =	5.55	cfs.	ÐST= 980079.7 cu.ft.
86	T=	85.00	min.	Q 100 =	4.67	cfs.	ÐST= 980386.1 cu.ft.
87	T=	86.00	min.	Q 100 =	4.01	cfs.	ÐST= 980646.5 cu.ft.

Filename: cr23.in

WATERSHED 24

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 24

WATERSHED AREA (A): 14.90 acres

LENGTH OF WATERCOURSE (Lc): 1320. ft

LENGTH TO CENTER OF GRAVITY (Lca): 660. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
1320.	35.0

MEAN SLOPE (Sc): .0265 ft BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): NATURAL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

24. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %
76. % C, CN= 88, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.227	.385	.468	.552	.611	.657
Tc (FUNCTION OF i) :	19.65	15.91	14.72	13.78	13.23	12.85
SOLUTION OF Tc (MINUTES):	13	9	7	6	6	5
RAINFL INT. @ Tc (IN/HR):	3.049	4.684	6.037	7.501	8.537	10.018
RUNOFF RATE @ Tc (IN/HR):	.693	1.805	2.825	4.137	5.214	6.585
PEAK DISCHARGE (CFS) :	10.	27.	42.	62.	78.	99.

PIMA COUNTY HYDROGRAPH

Project: Cortaro Road
Hydrograph Location: C.P. 24

Job#: 99067-01
Preparer: SP
DATE: 01-08-2001

Qp100 = 99.00 cfs. Tc = 5.0 min. Tp = 13.60 min. delta T = 1.000 min.

1	T=	0.00	min.	Q 100 =	0.00	cfs.	ðST= 0.0 cu.ft.
2	T=	1.00	min.	Q 100 =	1.24	cfs.	ðST= 37.2 cu.ft.
3	T=	2.00	min.	Q 100 =	4.98	cfs.	ðST= 223.7 cu.ft.
4	T=	3.00	min.	Q 100 =	10.00	cfs.	ðST= 673.2 cu.ft.
5	T=	4.00	min.	Q 100 =	15.63	cfs.	ðST= 1442.2 cu.ft.
6	T=	5.00	min.	Q 100 =	21.61	cfs.	ðST= 2559.2 cu.ft.
7	T=	6.00	min.	Q 100 =	28.02	cfs.	ðST= 4048.1 cu.ft.
8	T=	7.00	min.	Q 100 =	35.12	cfs.	ðST= 5942.3 cu.ft.
9	T=	8.00	min.	Q 100 =	43.20	cfs.	ðST= 8291.8 cu.ft.
10	T=	9.00	min.	Q 100 =	52.47	cfs.	ðST= 11161.9 cu.ft.
11	T=	10.00	min.	Q 100 =	62.92	cfs.	ðST= 14623.6 cu.ft.
12	T=	11.00	min.	Q 100 =	74.17	cfs.	ðST= 18736.4 cu.ft.
13	T=	12.00	min.	Q 100 =	85.38	cfs.	ðST= 23523.0 cu.ft.
14	T=	13.00	min.	Q 100 =	95.05	cfs.	ðST= 28935.7 cu.ft.
15	T=	14.00	min.	Q 100 =	96.33	cfs.	ðST= 34676.9 cu.ft.
16	T=	15.00	min.	Q 100 =	90.60	cfs.	ðST= 40284.8 cu.ft.
17	T=	16.00	min.	Q 100 =	84.86	cfs.	ðST= 45548.7 cu.ft.
18	T=	17.00	min.	Q 100 =	79.16	cfs.	ðST= 50469.2 cu.ft.
19	T=	18.00	min.	Q 100 =	73.55	cfs.	ðST= 55050.4 cu.ft.
20	T=	19.00	min.	Q 100 =	68.08	cfs.	ðST= 59299.2 cu.ft.
21	T=	20.00	min.	Q 100 =	62.79	cfs.	ðST= 63225.1 cu.ft.
22	T=	21.00	min.	Q 100 =	57.70	cfs.	ðST= 66839.7 cu.ft.
23	T=	22.00	min.	Q 100 =	52.85	cfs.	ðST= 70156.3 cu.ft.
24	T=	23.00	min.	Q 100 =	48.25	cfs.	ðST= 73189.2 cu.ft.
25	T=	24.00	min.	Q 100 =	43.92	cfs.	ðST= 75954.2 cu.ft.
26	T=	25.00	min.	Q 100 =	39.86	cfs.	ðST= 78467.3 cu.ft.
27	T=	26.00	min.	Q 100 =	36.08	cfs.	ðST= 80745.4 cu.ft.
28	T=	27.00	min.	Q 100 =	32.58	cfs.	ðST= 82805.2 cu.ft.
29	T=	28.00	min.	Q 100 =	29.36	cfs.	ðST= 84663.6 cu.ft.
30	T=	29.00	min.	Q 100 =	26.42	cfs.	ðST= 86337.1 cu.ft.
31	T=	30.00	min.	Q 100 =	23.74	cfs.	ðST= 87842.0 cu.ft.
32	T=	31.00	min.	Q 100 =	21.32	cfs.	ðST= 89193.9 cu.ft.
33	T=	32.00	min.	Q 100 =	19.14	cfs.	ðST= 90407.8 cu.ft.
34	T=	33.00	min.	Q 100 =	17.20	cfs.	ðST= 91497.9 cu.ft.
35	T=	34.00	min.	Q 100 =	15.46	cfs.	ðST= 92477.7 cu.ft.
36	T=	35.00	min.	Q 100 =	13.93	cfs.	ðST= 93359.5 cu.ft.
37	T=	36.00	min.	Q 100 =	12.58	cfs.	ðST= 94154.9 cu.ft.
38	T=	37.00	min.	Q 100 =	11.40	cfs.	ðST= 94874.4 cu.ft.
39	T=	38.00	min.	Q 100 =	10.37	cfs.	ðST= 95527.5 cu.ft.
40	T=	39.00	min.	Q 100 =	9.47	cfs.	ðST= 96122.7 cu.ft.
41	T=	40.00	min.	Q 100 =	8.69	cfs.	ðST= 96667.5 cu.ft.
42	T=	41.00	min.	Q 100 =	8.01	cfs.	ðST= 97168.3 cu.ft.
43	T=	42.00	min.	Q 100 =	7.41	cfs.	ðST= 97630.8 cu.ft.
44	T=	43.00	min.	Q 100 =	6.88	cfs.	ðST= 98059.6 cu.ft.
45	T=	44.00	min.	Q 100 =	6.42	cfs.	ðST= 98458.7 cu.ft.
46	T=	45.00	min.	Q 100 =	6.00	cfs.	ðST= 98831.1 cu.ft.
47	T=	46.00	min.	Q 100 =	5.61	cfs.	ðST= 99179.2 cu.ft.
48	T=	47.00	min.	Q 100 =	5.24	cfs.	ðST= 99504.8 cu.ft.
49	T=	48.00	min.	Q 100 =	4.90	cfs.	ðST= 99809.1 cu.ft.
50	T=	49.00	min.	Q 100 =	4.56	cfs.	ðST= 100092.9 cu.ft.
51	T=	50.00	min.	Q 100 =	4.23	cfs.	ðST= 100356.6 cu.ft.

52	T=	51.00	min.	Q 100 =	3.90	cfs.	ðST= 100600.3 cu.ft.
53	T=	52.00	min.	Q 100 =	3.56	cfs.	ðST= 100824.0 cu.ft.
54	T=	53.00	min.	Q 100 =	3.22	cfs.	ðST= 101027.6 cu.ft.
55	T=	54.00	min.	Q 100 =	2.89	cfs.	ðST= 101210.8 cu.ft.
56	T=	55.00	min.	Q 100 =	2.55	cfs.	ðST= 101373.8 cu.ft.
57	T=	56.00	min.	Q 100 =	2.21	cfs.	ðST= 101516.6 cu.ft.
58	T=	57.00	min.	Q 100 =	1.89	cfs.	ðST= 101639.6 cu.ft.
59	T=	58.00	min.	Q 100 =	1.58	cfs.	ðST= 101743.4 cu.ft.
60	T=	59.00	min.	Q 100 =	1.29	cfs.	ðST= 101829.4 cu.ft.
61	T=	60.00	min.	Q 100 =	1.03	cfs.	ðST= 101898.9 cu.ft.
62	T=	61.00	min.	Q 100 =	0.81	cfs.	ðST= 101954.2 cu.ft.
63	T=	62.00	min.	Q 100 =	0.64	cfs.	ðST= 101997.7 cu.ft.

Filename: cr24.in

MMLA
McGovern MacVittie Lodge & Associates, Inc.

PROJECT NAME: CORTARO FARMS ROAD

PROJECT NUMBER: 99067-01 MADE BY: SP DATE: 2/19/01

REFERENCE: _____ CHECKED BY: _____ DATE: _____

HYDROGRAPH LAG TIME

FOR

CONCENTRATION PT. 24

FOR WATERSHED 23, CROSS SECTION 24-D IS USED TO DETERMINE LAG TIME

$V = 5.21$ fps

Distance to C.P. 24 = 930 ft

$\therefore$ Lag Time $= \frac{930\ ft}{5.21\ fps}\left(\frac{1\ min}{60\ s}\right) = 3\ min$

100-Year Combined Hydrographs for Concentration Point 24 (Existing)

Time (min)	C.P. 24	C.P. 23 (1/2 Q_{100}, 3 min. lag)	Total (cfs)
0	0	0	0
1	1.24	0	1
2	4.98	0	5
3	10.00	0	10
4	15.63	2.07	18
5	21.61	9.49	31
6	28.02	20.36	48
7	35.12	33.26	68
8	43.20	47.31	91
9	52.47	62.08	115
10	62.92	77.48	140
11	74.17	93.71	168
12	85.38	111.10	196
13	95.05	130.06	225
14	96.33	150.98	247
15	90.60	174.12	265
16	84.86	199.51	284
17	79.16	226.90	306
18	73.55	255.61	329
19	68.08	284.45	353
20	62.79	311.65	374
21	57.70	334.74	392
22	52.85	340.27	**393**
23	48.25	325.77	374
24	43.92	311.18	355
25	39.86	296.58	336
26	36.08	282.06	318
27	32.58	267.69	300
28	29.36	253.53	283
29	26.42	239.65	266
30	23.74	226.08	250
31	21.32	212.88	234
32	19.14	200.09	219
33	17.20	187.72	205
34	15.46	175.82	191
35	13.93	164.40	178
36	12.58	153.48	166
37	11.40	143.07	154
38	10.37	133.17	144
39	9.47	123.80	133
40	8.69	114.94	124
41	8.01	106.60	115
42	7.41	98.78	106
43	6.88	91.45	98
44	6.42	84.61	91
45	6.00	78.25	84

100-Year Combined Hydrographs for Concentration Point 24 (Existing)

Time (min)	C.P. 24	C.P. 23 (1/2 Q_{100}, 3 min. lag)	Total (cfs)
46	5.61	72.36	78
47	5.24	66.90	72
48	4.90	61.88	67
49	4.56	57.26	62
50	4.23	53.02	57
51	3.90	49.15	53
52	3.56	45.62	49
53	3.22	42.41	46
54	2.89	39.50	42
55	2.55	36.86	39
56	2.21	34.47	37
57	1.89	32.31	34
58	1.58	30.36	32
59	1.29	28.60	30
60	1.03	27.00	28
61	0.81	25.55	26
62	0.64	24.22	25

WATERSHED 25

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 25

WATERSHED AREA (A): 32.20 acres

LENGTH OF WATERCOURSE (Lc): 2330. ft

LENGTH TO CENTER OF GRAVITY (Lca): 1165. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
2330.	55.0

MEAN SLOPE (Sc): .0236 ft BASIN FACTOR (Nb): .0340

WATERSHED TYPE(S): RURAL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

14. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %
86. % C, CN= 88, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 10. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.307	.453	.528	.604	.657	.699
Tc (FUNCTION OF i) :	24.93	21.34	20.07	19.02	18.39	17.94
SOLUTION OF Tc (MINUTES):	17	12	11	9	8	8
RAINFL INT. @ Tc (IN/HR):	2.699	4.156	5.002	6.416	7.688	8.608
RUNOFF RATE @ Tc (IN/HR):	.829	1.882	2.642	3.874	5.051	6.014
PEAK DISCHARGE (CFS) :	27.	61.	86.	126.	164.	195.

PIMA COUNTY HYDROGRAPH

Project: Cortaro Road
Hydrograph Location: C.P. 25

Job#: 99067-01
Preparer: SP
DATE: 01-08-2001

Qp100 = 195.00 cfs. Tc = 8.0 min. Tp = 15.80 min. delta T = 1.000 min.

1	T= 0.00 min.	Q 100 = 0.00 cfs.	ΔST= 0.0	cu.ft.
2	T= 1.00 min.	Q 100 = 1.74 cfs.	ΔST= 52.2	cu.ft.
3	T= 2.00 min.	Q 100 = 7.42 cfs.	ΔST= 327.0	cu.ft.
4	T= 3.00 min.	Q 100 = 15.37 cfs.	ΔST= 1010.8	cu.ft.
5	T= 4.00 min.	Q 100 = 24.51 cfs.	ΔST= 2207.3	cu.ft.
6	T= 5.00 min.	Q 100 = 34.29 cfs.	ΔST= 3971.2	cu.ft.
7	T= 6.00 min.	Q 100 = 44.57 cfs.	ΔST= 6337.0	cu.ft.
8	T= 7.00 min.	Q 100 = 55.53 cfs.	ΔST= 9339.9	cu.ft.
9	T= 8.00 min.	Q 100 = 67.49 cfs.	ΔST= 13030.6	cu.ft.
10	T= 9.00 min.	Q 100 = 80.85 cfs.	ΔST= 17480.9	cu.ft.
11	T= 10.00 min.	Q 100 = 95.89 cfs.	ΔST= 22783.2	cu.ft.
12	T= 11.00 min.	Q 100 = 112.73 cfs.	ΔST= 29041.8	cu.ft.
13	T= 12.00 min.	Q 100 = 131.11 cfs.	ΔST= 36357.0	cu.ft.
14	T= 13.00 min.	Q 100 = 150.37 cfs.	ΔST= 44801.6	cu.ft.
15	T= 14.00 min.	Q 100 = 169.24 cfs.	ΔST= 54389.8	cu.ft.
16	T= 15.00 min.	Q 100 = 185.75 cfs.	ΔST= 65039.3	cu.ft.
17	T= 16.00 min.	Q 100 = 192.28 cfs.	ΔST= 76380.2	cu.ft.
18	T= 17.00 min.	Q 100 = 182.61 cfs.	ΔST= 87627.1	cu.ft.
19	T= 18.00 min.	Q 100 = 172.87 cfs.	ΔST= 98291.6	cu.ft.
20	T= 19.00 min.	Q 100 = 163.15 cfs.	ΔST= 108372.4	cu.ft.
21	T= 20.00 min.	Q 100 = 153.52 cfs.	ΔST= 117872.5	cu.ft.
22	T= 21.00 min.	Q 100 = 144.04 cfs.	ΔST= 126799.2	cu.ft.
23	T= 22.00 min.	Q 100 = 134.77 cfs.	ΔST= 135163.4	cu.ft.
24	T= 23.00 min.	Q 100 = 125.75 cfs.	ΔST= 142978.9	cu.ft.
25	T= 24.00 min.	Q 100 = 117.03 cfs.	ΔST= 150262.2	cu.ft.
26	T= 25.00 min.	Q 100 = 108.63 cfs.	ΔST= 157032.1	cu.ft.
27	T= 26.00 min.	Q 100 = 100.60 cfs.	ΔST= 163309.0	cu.ft.
28	T= 27.00 min.	Q 100 = 92.93 cfs.	ΔST= 169114.9	cu.ft.
29	T= 28.00 min.	Q 100 = 85.67 cfs.	ΔST= 174472.9	cu.ft.
30	T= 29.00 min.	Q 100 = 78.80 cfs.	ΔST= 179406.9	cu.ft.
31	T= 30.00 min.	Q 100 = 72.34 cfs.	ΔST= 183941.1	cu.ft.
32	T= 31.00 min.	Q 100 = 66.30 cfs.	ΔST= 188100.3	cu.ft.
33	T= 32.00 min.	Q 100 = 60.66 cfs.	ΔST= 191908.9	cu.ft.
34	T= 33.00 min.	Q 100 = 55.43 cfs.	ΔST= 195391.4	cu.ft.
35	T= 34.00 min.	Q 100 = 50.59 cfs.	ΔST= 198571.8	cu.ft.
36	T= 35.00 min.	Q 100 = 46.13 cfs.	ΔST= 201473.5	cu.ft.
37	T= 36.00 min.	Q 100 = 42.05 cfs.	ΔST= 204119.1	cu.ft.
38	T= 37.00 min.	Q 100 = 38.33 cfs.	ΔST= 206530.4	cu.ft.
39	T= 38.00 min.	Q 100 = 34.94 cfs.	ΔST= 208728.5	cu.ft.
40	T= 39.00 min.	Q 100 = 31.88 cfs.	ΔST= 210733.0	cu.ft.
41	T= 40.00 min.	Q 100 = 29.11 cfs.	ΔST= 212562.6	cu.ft.
42	T= 41.00 min.	Q 100 = 26.63 cfs.	ΔST= 214235.0	cu.ft.
43	T= 42.00 min.	Q 100 = 24.41 cfs.	ΔST= 215766.2	cu.ft.
44	T= 43.00 min.	Q 100 = 22.43 cfs.	ΔST= 217171.3	cu.ft.
45	T= 44.00 min.	Q 100 = 20.67 cfs.	ΔST= 218464.1	cu.ft.
46	T= 45.00 min.	Q 100 = 19.10 cfs.	ΔST= 219657.1	cu.ft.
47	T= 46.00 min.	Q 100 = 17.71 cfs.	ΔST= 220761.4	cu.ft.
48	T= 47.00 min.	Q 100 = 16.48 cfs.	ΔST= 221787.1	cu.ft.
49	T= 48.00 min.	Q 100 = 15.38 cfs.	ΔST= 222742.9	cu.ft.
50	T= 49.00 min.	Q 100 = 14.40 cfs.	ΔST= 223636.4	cu.ft.
51	T= 50.00 min.	Q 100 = 13.52 cfs.	ΔST= 224474.2	cu.ft.

52	T=	51.00	min.	Q 100 =	12.73	cfs.	ðST= 225261.9 cu.ft.
53	T=	52.00	min.	Q 100 =	12.00	cfs.	ðST= 226003.9 cu.ft.
54	T=	53.00	min.	Q 100 =	11.33	cfs.	ðST= 226703.8 cu.ft.
55	T=	54.00	min.	Q 100 =	10.70	cfs.	ðST= 227364.6 cu.ft.
56	T=	55.00	min.	Q 100 =	10.09	cfs.	ðST= 227988.4 cu.ft.
57	T=	56.00	min.	Q 100 =	9.51	cfs.	ðST= 228576.6 cu.ft.
58	T=	57.00	min.	Q 100 =	8.94	cfs.	ðST= 229130.2 cu.ft.
59	T=	58.00	min.	Q 100 =	8.38	cfs.	ðST= 229649.8 cu.ft.
60	T=	59.00	min.	Q 100 =	7.81	cfs.	ðST= 230135.6 cu.ft.
61	T=	60.00	min.	Q 100 =	7.25	cfs.	ðST= 230587.4 cu.ft.
62	T=	61.00	min.	Q 100 =	6.68	cfs.	ðST= 231005.3 cu.ft.
63	T=	62.00	min.	Q 100 =	6.11	cfs.	ðST= 231388.8 cu.ft.
64	T=	63.00	min.	Q 100 =	5.53	cfs.	ðST= 231737.9 cu.ft.
65	T=	64.00	min.	Q 100 =	4.96	cfs.	ðST= 232052.5 cu.ft.
66	T=	65.00	min.	Q 100 =	4.39	cfs.	ðST= 232333.0 cu.ft.
67	T=	66.00	min.	Q 100 =	3.84	cfs.	ðST= 232579.8 cu.ft.
68	T=	67.00	min.	Q 100 =	3.30	cfs.	ðST= 232794.0 cu.ft.
69	T=	68.00	min.	Q 100 =	2.80	cfs.	ðST= 232977.1 cu.ft.
70	T=	69.00	min.	Q 100 =	2.33	cfs.	ðST= 233130.8 cu.ft.
71	T=	70.00	min.	Q 100 =	1.91	cfs.	ðST= 233257.9 cu.ft.
72	T=	71.00	min.	Q 100 =	1.55	cfs.	ðST= 233361.7 cu.ft.
73	T=	72.00	min.	Q 100 =	1.27	cfs.	ðST= 233446.3 cu.ft.

Filename: cr25.in

MMLA
McGovern MacVittie Lodge & Associates, Inc.

PROJECT NAME: CURTARO FARMS ROAD

PROJECT NUMBER: 99067-01 MADE BY: SP DATE: 2/19/01

REFERENCE: _____ CHECKED BY: _____ DATE: _____

HYDROGRAPH LAG TIME FOR CONCENTRATION PT. 25

FOR WATERSHED 23, CROSS SECTION 25-H IS USED TO DETERMINE LAG TIME

$V = 4.11$ fps

Distance to C.P. 25 = 1900 ft

$\therefore$ Lag Time $= \frac{1900\text{ ft}}{4.11\text{ fps}}\left(\frac{1\text{ min}}{60\text{ s}}\right) = 8\text{ min}$

100-Year Combined Hydrographs for Concentration Point 25 (Existing)

Time (min)	C.P. 25	C.P. 23 (1/2 Q_{100}, 8 min. lag)	Total (cfs)
0	0	0	0
1	1.74	0	2
2	7.42	0	7
3	15.37	0	15
4	24.51	0	25
5	34.29	0	34
6	44.57	0	45
7	55.53	0	56
8	67.49	0	67
9	80.85	2.07	83
10	95.89	9.49	105
11	112.73	20.36	133
12	131.11	33.26	164
13	150.37	47.31	198
14	169.24	62.08	231
15	185.75	77.48	263
16	192.28	93.71	286
17	182.61	111.10	294
18	172.87	130.06	303
19	163.15	150.98	314
20	153.52	174.12	328
21	144.04	199.51	344
22	134.77	226.90	362
23	125.75	255.61	381
24	117.03	284.45	401
25	108.63	311.65	420
26	100.60	334.74	**435**
27	92.93	340.27	433
28	85.67	325.77	411
29	78.80	311.18	390
30	72.34	296.58	369
31	66.30	282.06	348
32	60.66	267.69	328
33	55.43	253.53	309
34	50.59	239.65	290
35	46.13	226.08	272
36	42.05	212.88	255
37	38.33	200.09	238
38	34.94	187.72	223
39	31.88	175.82	208
40	29.11	164.40	194
41	26.63	153.48	180
42	24.41	143.07	167
43	22.43	133.17	156
44	20.67	123.80	144
45	19.10	114.94	134

100-Year Combined Hydrographs for Concentration Point 25 (Existing)

Time (min)	C.P. 25	C.P. 23 (1/2 Q_{100}, 8 min. lag)	Total (cfs)
46	17.71	106.60	124
47	16.48	98.78	115
48	15.38	91.45	107
49	14.40	84.61	99
50	13.52	78.25	92
51	12.73	72.36	85
52	12.00	66.90	79
53	11.33	61.88	73
54	10.70	57.26	68
55	10.09	53.02	63
56	9.51	49.15	59
57	8.94	45.62	55
58	8.38	42.41	51
59	7.81	39.50	47
60	7.25	36.86	44
61	6.68	34.47	41
62	6.11	32.31	38
63	5.53	30.36	36
64	4.96	28.60	34
65	4.39	27.00	31
66	3.84	25.55	29
67	3.30	24.22	28

WATERSHED 26

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 26

WATERSHED AREA (A): 2.70 acres

LENGTH OF WATERCOURSE (Lc): 580. ft

LENGTH TO CENTER OF GRAVITY (Lca): 290. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft 580.

INCREMENTAL CHANGE IN ELEV (Hi) - ft 38.5

MEAN SLOPE (Sc): .0664 ft

BASIN FACTOR (Nb): .0400

WATERSHED TYPE(S): RURAL

RAINFALL VALUES

	EVENT 2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

30. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %
70. % C, CN= 88, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 5. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT 2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.254	.404	.483	.563	.620	.665
Tc (FUNCTION OF i) :	9.08	7.54	7.02	6.60	6.35	6.18
SOLUTION OF Tc (MINUTES):	5	5	5	5	5	5
RAINFL INT. @ Tc (IN/HR):	4.348	5.739	6.669	7.862	8.948	10.018
RUNOFF RATE @ Tc (IN/HR):	1.105	2.320	3.223	4.430	5.552	6.666
PEAK DISCHARGE (CFS) :	3.01	6.31	8.77	12.06	15.11	18.14

WATERSHED 27

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 27

WATERSHED AREA (A): 17.90 acres

LENGTH OF WATERCOURSE (Lc): 2240. ft

LENGTH TO CENTER OF GRAVITY (Lca): 1120. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
2240.	93.0

MEAN SLOPE (Sc): .0415 ft BASIN FACTOR (Nb): .0340

WATERSHED TYPE(S): RURAL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

6. % A,	CN= 68,	COVER TYPE= DESERT BRUSH ,	COVER DENSITY= 25 %
45. % B,	CN= 82,	COVER TYPE= DESERT BRUSH ,	COVER DENSITY= 25 %
49. % C,	CN= 88,	COVER TYPE= DESERT BRUSH ,	COVER DENSITY= 25 %

IMPERVIOUS COVER= 20. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.330	.453	.520	.590	.640	.680
Tc (FUNCTION OF i) :	18.87	16.62	15.73	14.96	14.48	14.14
SOLUTION OF Tc (MINUTES):	12	9	8	7	6	6
RAINFL INT. @ Tc (IN/HR):	3.149	4.684	5.730	7.117	8.537	9.558
RUNOFF RATE @ Tc (IN/HR):	1.039	2.123	2.981	4.195	5.460	6.495
PEAK DISCHARGE (CFS) :	19.	38.	54.	76.	99.	117.

WATERSHED 28

CORTARO FARMS
WATERSHED 28

(VISTA OESTE ESTATES - REF 11)

PIMA COUNTY HYDROGRAPH

WASH/SITE:.....
AT:.....
RETURN PERIOD:.....100 YEAR
DATE:.....25 JULY 1994
BY:.....TAB
PEAK Q = 57 CFS.
Tc = 5 min.
TL = 13.31 min.
&T = 1.331 min.

T=	0.00	min.	Q=	0.00	cfs.	V=	0.0	cu. ft.
T=	1.33	min.	Q=	1.36	cfs.	V=	63.7	cu. ft.
T=	2.66	min.	Q=	4.90	cfs.	V=	313.9	cu. ft.
T=	3.99	min.	Q=	9.26	cfs.	V=	879.4	cu. ft.
T=	5.32	min.	Q=	14.02	cfs.	V=	1809.1	cu. ft.
T=	6.65	min.	Q=	19.35	cfs.	V=	3141.7	cu. ft.
T=	7.99	min.	Q=	25.67	cfs.	V=	4939.3	cu. ft.
T=	9.32	min.	Q=	33.24	cfs.	V=	7291.6	cu. ft.
T=	10.65	min.	Q=	41.90	cfs.	V=	10291.9	cu. ft.
T=	11.98	min.	Q=	50.59	cfs.	V=	13984.8	cu. ft.
T=	13.31	min.	Q=	57.11	cfs.	V=	18285.3	cu. ft.
T=	14.64	min.	Q=	52.31	cfs.	V=	22654.5	cu. ft.
T=	15.97	min.	Q=	47.82	cfs.	V=	26652.8	cu. ft.
T=	17.30	min.	Q=	43.39	cfs.	V=	30294.9	cu. ft.
T=	18.63	min.	Q=	39.09	cfs.	V=	33588.4	cu. ft.
T=	19.97	min.	Q=	34.98	cfs.	V=	36546.2	cu. ft.
T=	21.30	min.	Q=	31.11	cfs.	V=	39185.0	cu. ft.
T=	22.63	min.	Q=	27.49	cfs.	V=	41524.8	cu. ft.
T=	23.96	min.	Q=	24.16	cfs.	V=	43587.2	cu. ft.
T=	25.29	min.	Q=	21.13	cfs.	V=	45395.6	cu. ft.
T=	26.62	min.	Q=	18.39	cfs.	V=	46973.6	cu. ft.
T=	27.95	min.	Q=	15.95	cfs.	V=	48345.1	cu. ft.
T=	29.28	min.	Q=	13.80	cfs.	V=	49533.2	cu. ft.
T=	30.61	min.	Q=	11.92	cfs.	V=	50560.4	cu. ft.
T=	31.94	min.	Q=	10.30	cfs.	V=	51447.8	cu. ft.
T=	33.27	min.	Q=	8.91	cfs.	V=	52215.0	cu. ft.
T=	34.61	min.	Q=	7.74	cfs.	V=	52880.0	cu. ft.
T=	35.94	min.	Q=	6.75	cfs.	V=	53458.6	cu. ft.
T=	37.27	min.	Q=	5.93	cfs.	V=	53965.2	cu. ft.
T=	38.60	min.	Q=	5.25	cfs.	V=	54411.8	cu. ft.
T=	39.93	min.	Q=	4.69	cfs.	V=	54808.7	cu. ft.
T=	41.26	min.	Q=	4.22	cfs.	V=	55164.4	cu. ft.
T=	42.59	min.	Q=	3.82	cfs.	V=	55485.6	cu. ft.
T=	43.92	min.	Q=	3.48	cfs.	V=	55777.4	cu. ft.
T=	45.25	min.	Q=	3.18	cfs.	V=	56043.5	cu. ft.
T=	46.59	min.	Q=	2.90	cfs.	V=	56286.4	cu. ft.
T=	47.92	min.	Q=	2.64	cfs.	V=	56507.6	cu. ft.
T=	49.25	min.	Q=	2.38	cfs.	V=	56707.8	cu. ft.
T=	50.58	min.	Q=	2.12	cfs.	V=	56887.1	cu. ft.
T=	51.91	min.	Q=	1.85	cfs.	V=	57045.5	cu. ft.
T=	53.24	min.	Q=	1.59	cfs.	V=	57182.8	cu. ft.
T=	54.57	min.	Q=	1.32	cfs.	V=	57299.0	cu. ft.

T=	57.23	min.	Q=	0.83	cfs.	V=	57470.2	cu. ft.
T=	58.56	min.	Q=	0.62	cfs.	V=	57528.0	cu. ft.
T=	59.90	min.	Q=	0.45	cfs.	V=	57570.5	cu. ft.
T=	61.23	min.	Q=	0.33	cfs.	V=	57601.5	cu. ft.

INFLOW HYDROGRAPH MEMBER 1

100 YEAR
BASIN 1
TWIN 90 DEGREE V-NOTCH WEIRS

0.00
1.36
4.90
9.26
14.02
19.35
25.67
33.24
41.90
50.59
57.11
52.31
47.82
43.39
39.09
34.98
31.11
27.49
24.16
21.13
18.39
15.95
13.80
11.92
10.30
8.91
7.74
6.75
5.93
5.25
4.69
4.22
3.82
3.48
3.18
2.90
2.64
2.38
2.12
1.85
1.59
1.32
1.07
0.83
0.62
0.45
0.33
0.00
0.00

ROUTE RESERVOIR

100 YEAR
BASIN 1
TWIN 90 DEGREE V-NOTCH WEIRS

T (hrs)	I (cfs)	O (cfs)	V (cf)	H (ft)
0.000	0.000	0.00	0.00	69.700
0.017	1.365	0.00	41.03	69.704
0.033	4.901	0.00	229.37	69.722
0.050	9.261	0.00	655.05	69.763
0.067	14.021	0.00	1354.87	69.830
0.084	19.354	0.00	2358.01	69.926
0.100	25.665	0.00	3711.11	70.055
0.117	33.243	0.01	5481.64	70.225
0.134	41.895	0.01	7739.93	70.441
0.150	50.591	0.01	10519.54	70.708
0.167	57.108	0.01	13756.28	71.018
0.184	52.314	0.02	17044.61	71.332
0.200	47.821	0.02	20053.58	71.621
0.217	43.390	0.77	22771.66	71.819
0.234	39.092	1.72	25176.06	71.969
0.251	34.982	2.56	27274.00	72.101
0.267	31.105	3.28	29085.22	72.214
0.284	27.491	3.89	30631.19	72.311
0.301	24.161	4.41	31934.44	72.393
0.317	21.127	4.84	33017.91	72.461
0.334	18.392	5.19	33904.46	72.517
0.351	15.954	5.47	34616.42	72.561
0.367	13.802	5.69	35175.22	72.596
0.384	11.923	5.86	35601.13	72.623
0.401	10.301	5.99	35912.99	72.643
0.418	8.913	6.07	36128.08	72.656
0.434	7.739	6.13	36261.99	72.664
0.451	6.753	6.15	36328.57	72.669
0.468	5.932	* 6.16	36339.92	72.669
0.484	5.252	6.14	36306.43	72.667
0.501	4.689	6.12	36236.77	72.663
0.518	4.220	6.08	36138.10	72.657
0.534	3.824	6.03	36016.06	72.649
0.551	3.483	5.97	35875.04	72.640
0.568	3.180	5.91	35718.21	72.630
0.585	2.902	5.84	35547.81	72.620
0.601	2.637	5.77	35365.30	72.608
0.618	2.376	5.69	35171.47	72.596
0.635	2.115	5.61	34966.71	72.583
0.651	1.852	5.53	34751.20	72.570
0.668	1.586	5.44	34525.06	72.556
0.685	1.323	5.34	34288.53	72.541
0.701	1.069	5.24	34042.20	72.525
0.718	0.829	5.14	33787.02	72.509

Q_{100} OUT

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0.768	0.329	4.83	32986.76	72.459
0.785	0.000	4.72	32709.87	72.442
0.802	0.000	4.60	32429.74	72.424
0.818	0.000	4.50	32156.21	72.407
0.835	0.000	4.39	31889.13	72.390
0.852	0.000	4.29	31628.35	72.374
0.868	0.000	4.18	31373.72	72.358
0.885	0.000	4.09	31125.10	72.342
0.902	0.000	3.99	30882.33	72.327
0.919	0.000	3.90	30645.30	72.312
0.935	0.000	3.80	30413.85	72.298
0.952	0.000	3.71	30187.87	72.284
0.969	0.000	3.63	29967.21	72.270
0.985	0.000	3.54	29751.76	72.256

WATERSHED 29

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 29

WATERSHED AREA (A): 74.20 acres

LENGTH OF WATERCOURSE (Lc): 3580. ft

LENGTH TO CENTER OF GRAVITY (Lca): 1790. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
3580.	115.0

MEAN SLOPE (Sc): .0321 ft BASIN FACTOR (Nb): .0340

WATERSHED TYPE(S): RURAL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

21. % A, CN= 68, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %
10. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %
69. % C, CN= 88, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 5. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.228	.363	.438	.515	.571	.617
Tc (FUNCTION OF i) :	32.11	26.66	24.75	23.19	22.24	21.57
SOLUTION OF Tc (MINUTES):	23	16	14	12	10	9
RAINFL INT. @ Tc (IN/HR):	2.299	3.661	4.542	5.693	6.943	8.176
RUNOFF RATE @ Tc (IN/HR):	.525	1.330	1.987	2.932	3.967	5.042
PEAK DISCHARGE (CFS) :	39.	99.	149.	219.	297.	377.

+ ½ Q_{100} @ C.P. 28 (= 3 cfs)

∴ Q_{100} = 380 c

PROJECT NAME AND LOCATION: CORTARO ROAD (I-10 TO THORNYDALE)

DRAINAGE CONCENTRATION POINT: 29 (Watersheds 27 & 29)

WATERSHED AREA (A): 92.10 acres

LENGTH OF WATERCOURSE (Lc): 3580. ft

LENGTH TO CENTER OF GRAVITY (Lca): 1790. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
3580.	115.0

MEAN SLOPE (Sc): .0321 ft BASIN FACTOR (Nb): .0340

WATERSHED TYPE(S): RURAL

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.65	1.92	2.26	2.57	2.88
P 2	1.38	1.84	2.14	2.53	2.88	3.23
P 3	1.47	1.96	2.29	2.71	3.09	3.47
P 6	1.64	2.20	2.57	3.05	3.48	3.91
P24	2.01	2.70	3.17	3.76	4.31	4.84

SOIL GROUPS

18. % A, CN= 68, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %
17. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %
65. % C, CN= 88, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 10. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.263	.393	.465	.539	.593	.637
Tc (FUNCTION OF i) :	30.35	25.83	24.16	22.76	21.91	21.30
SOLUTION OF Tc (MINUTES):	22	15	13	11	10	9
RAINFL INT. @ Tc (IN/HR):	2.362	3.760	4.676	5.897	6.943	8.176
RUNOFF RATE @ Tc (IN/HR):	.621	1.478	2.173	3.179	4.119	5.206
PEAK DISCHARGE (CFS) :	58.	137.	202.	295.	382.	483.

$+ \frac{1}{2} Q_{100}$ @ C.P. 28 (= 3 cfs)

$\therefore Q_{100} = 486$ cfs

WATERSHED 30

CONTRIBUTES TO CORTARO FARMS W.S. 30

PROJECT NAME AND LOCATION: CORTARO FARMS (REFERENCE 2)

DRAINAGE CONCENTRATION POINT: DESIGN D

WATERSHED AREA (A): 1.30 acres

LENGTH OF WATERCOURSE (Lc): 250. ft

LENGTH TO CENTER OF GRAVITY (Lca): 125. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft 250.

INCREMENTAL CHANGE IN ELEV (Hi) - f 2.0

MEAN SLOPE (Sc): .0080 ft

BASIN FACTOR (Nb): .0220

WATERSHED TYPE(S): HIGH URBAN

RAINFALL VALUES

	EVENT 2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.61	1.84	2.15	2.42	2.69
P 2	1.39	1.79	2.06	2.41	2.73	3.04
P 3	1.48	1.92	2.21	2.59	2.93	3.27
P 6	1.65	2.15	2.49	2.92	3.31	3.70
P24	2.03	2.68	3.12	3.68	4.20	4.70

SOIL GROUPS

100. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 65. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT 2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.642	.701	.733	.768	.793	.814
Tc (FUNCTION OF i) :	4.85	4.68	4.60	4.52	4.46	4.41
SOLUTION OF Tc (MINUTES):	5	5	5	5	5	5
RAINFL INT. @ Tc (IN/HR):	4.358	5.588	6.410	7.466	8.426	9.372
RUNOFF RATE @ Tc (IN/HR):	2.797	3.915	4.700	5.731	6.685	7.632
PEAK DISCHARGE (CFS) :	3.67	5.13	6.16	7.51	8.76	10.00

APPENDIX C

CONTRIBUTES TO CORTARO FARMS W.S. 30

PROJECT NAME AND LOCATION: CORTARO FARMS (REFERENCE 2)

DRAINAGE CONCENTRATION POINT: DESIGN L

WATERSHED AREA (A): .50 acres

LENGTH OF WATERCOURSE (Lc): 220. ft

LENGTH TO CENTER OF GRAVITY (Lca): 110. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft 220.

INCREMENTAL CHANGE IN ELEV (Hi) - f: 2.7

MEAN SLOPE (Sc): .0123 ft BASIN FACTOR (Nb): .0220

WATERSHED TYPE(S): HIGH URBAN

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.61	1.84	2.15	2.42	2.69
P 2	1.39	1.79	2.06	2.41	2.73	3.04
P 3	1.48	1.92	2.21	2.59	2.93	3.27
P 6	1.65	2.15	2.49	2.92	3.31	3.70
P24	2.03	2.68	3.12	3.68	4.20	4.70

SOIL GROUPS

100. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 65. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.642	.701	.733	.768	.793	.814
Tc (FUNCTION OF i) :	3.79	3.66	3.59	3.52	3.48	3.44
SOLUTION OF Tc (MINUTES):	5	5	5	5	5	5
RAINFL INT. @ Tc (IN/HR):	4.358	5.588	6.410	7.466	8.426	9.372
RUNOFF RATE @ Tc (IN/HR):	2.797	3.915	4.700	5.731	6.685	7.632
PEAK DISCHARGE (CFS) :	1.41	1.97	2.37	2.89	3.37	3.85

WATERSHED 31

CORTARO FARMS WATERSHED 31

(REFERENCE 2)

PROJECT NAME AND LOCATION: CORTARO FARMS

DRAINAGE CONCENTRATION POINT: DESIGN A2

WATERSHED AREA (A): 3.70 acres

LENGTH OF WATERCOURSE (Lc): 1432. ft

LENGTH TO CENTER OF GRAVITY (Lca): 716. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft	INCREMENTAL CHANGE IN ELEV (Hi) - ft
1432.	35.0

MEAN SLOPE (Sc): .0244 ft BASIN FACTOR (Nb): .0220

WATERSHED TYPE(S): HIGH URBAN

RAINFALL VALUES

	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
P 1	1.25	1.61	1.84	2.15	2.42	2.69
P 2	1.39	1.79	2.06	2.41	2.73	3.04
P 3	1.48	1.92	2.21	2.59	2.93	3.27
P 6	1.65	2.15	2.49	2.92	3.31	3.70
P24	2.03	2.68	3.12	3.68	4.20	4.70

SOIL GROUPS

100. % B, CN= 83, COVER TYPE= DESERT BRUSH , COVER DENSITY= 20 %

IMPERVIOUS COVER= 65. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

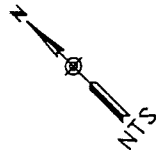
	EVENT					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
RUNOFF SUPPLY RATE (q/i):	.642	.701	.733	.768	.793	.814
Tc (FUNCTION OF i) :	8.84	8.54	8.39	8.23	8.12	8.04
SOLUTION OF Tc (MINUTES):	5	5	5	5	5	5
RAINFL INT. @ Tc (IN/HR):	4.358	5.588	6.410	7.466	8.426	9.372
RUNOFF RATE @ Tc (IN/HR):	2.797	3.915	4.700	5.731	6.685	7.632
PEAK DISCHARGE (CFS) :	10.	15.	18.	21.	25.	28.

APPENDIX C

11 OF 29

CONCENTRATION POINT 32

CORTARO ROAD UNDERPASS
BETWEEN CULVERTS #6 & #7



C.P. 32

740cfs

740cfs

U.P.R.R.

CORTARO FARMS ROAD

46cfs

FRONTAGE ROAD

178cfs

WESTBOUND I-10

EASTBOUND I-10

224cfs

ARROYO ENGINEERING, INC.

(REFERENCE 1)

MMLA
McGovern MacVittie Lodge & Associates, Inc.

PROJECT NAME: CORTARO FARMS RD ENGINEER: SP DATE: 5/1/02

PROJECT NUMBER: 99067-01 CHECKED BY: _____ DATE: _____

SUBJECT: DISCHARGE CALCULATIONS REFERENCE: _____

CONCENTRATION POINT 32

DISCHARGES FOR LESSER STORM EVENTS

	2-Year	10-Year	25-Year	50-Year
Ratio*	0.20	0.45	0.65	0.85
Q (cfs)	148	333	481	629

* Moderately Urban Watershed Development

DEVELOPED CONDITIONS

MMLA
McGovern MacVittie Lodge & Associates, Inc.

PROJECT NAME: Cortaro Farms Road ENGINEER: SP DATE: 5/1/02

PROJECT NUMBER: 99067-01 CHECKED BY: DATE:

SUBJECT: Sub Watershed Calcs REFERENCE:

WATERSHED 31 - DEVELOPED CONDITIONS

FOR WATERSHED 31: D.A. = 3.7 ac
Q_{10} = 18 cfs
Q_{100} = 28 cfs

C.P. 31a (@ Cortaro Crossing Drive)

D.A. = 0.64 ac

$Q_{10} = (0.64/3.7)(18) = 3.1$ cfs

$Q_{100} = (0.64/3.7)(28) = 4.8$ cfs

C.P. 31b (@ Red Rock Ridge Drive)

D.A. = 1.29 ac

$Q_{10} = (1.29/3.7)(18) = 6.3$ cfs

$Q_{100} = (1.29/3.7)(28) = 9.8$ cfs

C.P. 31c

D.A. = 0.22 ac

$Q_{10} = (0.22/3.7)(18) = 1.1$ cfs

$Q_{100} = (0.22/3.7)(28) = 1.7$ cfs

C.P. 31d

D.A. = 0.20 ac

$Q_{10} = (0.20/3.7)(18) = 1.0$ cfs

$Q_{100} = (0.20/3.7)(28) = 1.5$ cfs

100-YEAR FLOODPLAIN CALCULATIONS

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Worksheet	Cross Section 2-A2 (Existing)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.014000	ft/ft
Discharge	489.00	cfs

Options	
Current Roughness Method	mproved Lotter's Method
Open Channel Weighting Method	mproved Lotter's Method
Closed Channel Weighting Metho	Horton's Method

Results		
Mannings Coefficient	0.035	
Water Surface Elevation	2,341.31	ft
Elevation Range	2,339.00 to 2,342.00	
Flow Area	120.1	ft²
Wetted Perimeter	164.67	ft
Top Width	164.31	ft
Actual Depth	2.31	ft
Critical Elevation	2,341.21	ft
Critical Slope	0.020396	ft/ft
Velocity	4.07	ft/s
Velocity Head	0.26	ft
Specific Energy	2,341.57	ft
Froude Number	0.84	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
1+00	3+32	0.035

Natural Channel Points

Station (ft)	Elevation (ft)
1+00	2,342.00
1+40	2,341.00
1+79	2,340.00
1+81	2,339.00
1+86	2,340.00
2+74	2,341.00
3+32	2,342.00

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McGovern, MacVittie Lodge & Associates
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	untitled.fm2
Worksheet	Cross Section 2-A
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data				
Channel Slope	0.020000 ft/ft			
Elevation range: 2,340.00 ft to 2,342.00 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,342.00	100.00	158.00	0.035
140.00	2,340.00	158.00	290.00	0.028
158.00	2,340.00			
290.00	2,342.00			
Discharge	489.00 cfs			

Results		
Wtd. Mannings Coefficient	0.030	
Water Surface Elevation	2,341.24	ft
Flow Area	89.01	ft²
Wetted Perimeter	125.08	ft
Top Width	125.04	ft
Height	1.24	ft
Critical Depth	2,341.33	ft
Critical Slope	0.014859	ft/ft
Velocity	5.49	ft/s
Velocity Head	0.47	ft
Specific Energy	2,341.71	ft
Froude Number	1.15	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	untitled.fm2
Worksheet	Cross Section 2-B
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data				
Channel Slope	0.015000 ft/ft			
Elevation range: 2,344.00 ft to 2,346.00 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,345.40	100.00	155.00	0.035
155.00	2,344.00	155.00	400.00	0.028
400.00	2,344.00	400.00	470.00	0.035
470.00	2,346.00			
Discharge	489.00 cfs			

Results		
Wtd. Mannings Coefficient	0.029	
Water Surface Elevation	2,344.49	ft
Flow Area	130.19	ft^2
Wetted Perimeter	281.74	ft
Top Width	281.72	ft
Height	0.49	ft
Critical Depth	2,344.49	ft
Critical Slope	0.015877	ft/ft
Velocity	3.76	ft/s
Velocity Head	0.22	ft
Specific Energy	2,344.71	ft
Froude Number	0.97	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 2-C
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.015000	ft/ft
Elevation range: 2,348.00 ft to 2,350.00 ft.		
Discharge	489.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,350.00	100.00	515.00	0.035
250.00	2,348.00			
430.00	2,348.00			
515.00	2,349.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,348.63	ft
Flow Area	145.74	ft²
Wetted Perimeter	281.14	ft
Top Width	281.13	ft
Height	0.63	ft
Critical Depth	2,348.56	ft
Critical Slope	0.023000	ft/ft
Velocity	3.36	ft/s
Velocity Head	0.17	ft
Specific Energy	2,348.81	ft
Froude Number	0.82	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 2-D
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.015000	ft/ft
Elevation range: 2,352.00 ft to 2,354.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,354.00	100.00	490.00	0.035
145.00	2,352.00			
420.00	2,352.00			
490.00	2,353.20			

Discharge	489.00	cfs

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,352.52	ft
Flow Area	152.86	ft²
Wetted Perimeter	316.78	ft
Top Width	316.76	ft
Height	0.52	ft
Critical Depth	2,352.45	ft
Critical Slope	0.023748	ft/ft
Velocity	3.20	ft/s
Velocity Head	0.16	ft
Specific Energy	2,352.68	ft
Froude Number	0.81	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 2-E
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.015000	ft/ft
Elevation range: 2,356.00 ft to 2,358.00 ft.		
Discharge	489.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,358.00	100.00	590.00	0.035
170.00	2,356.00			
450.00	2,356.00			
590.00	2,357.30			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,356.50	ft
Flow Area	159.45	ft²
Wetted Perimeter	352.01	ft
Top Width	352.00	ft
Height	0.50	ft
Critical Depth	2,356.44	ft
Critical Slope	0.024255	ft/ft
Velocity	3.07	ft/s
Velocity Head	0.15	ft
Specific Energy	2,356.65	ft
Froude Number	0.80	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 2-F
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.015000	ft/ft
Elevation range: 2,360.00 ft to 2,361.40 ft.		
Discharge	252.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,361.00	100.00	450.00	0.035
135.00	2,360.00			
315.00	2,360.00			
450.00	2,361.40			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,360.44	ft
Flow Area	91.54	ft²
Wetted Perimeter	237.63	ft
Top Width	237.62	ft
Height	0.44	ft
Critical Depth	2,360.38	ft
Critical Slope	0.025708	ft/ft
Velocity	2.75	ft/s
Velocity Head	0.12	ft
Specific Energy	2,360.56	ft
Froude Number	0.78	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 2-G
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.013000	ft/ft
Elevation range: 2,362.00 ft to 2,364.00 ft.		
Discharge	250.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,364.00	100.00	480.00	0.035
250.00	2,363.00			
345.00	2,362.00			
380.00	2,362.00			
480.00	2,364.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,362.84	ft
Flow Area	80.53	ft²
Wetted Perimeter	156.79	ft
Top Width	156.77	ft
Height	0.84	ft
Critical Depth	2,362.74	ft
Critical Slope	0.023144	ft/ft
Velocity	3.10	ft/s
Velocity Head	0.15	ft
Specific Energy	2,362.99	ft
Froude Number	0.76	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 2-H
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.015000	ft/ft
Elevation range: 2,364.00 ft to 2,365.70 ft.		
Discharge	200.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,365.00	100.00	320.00	0.035
145.00	2,364.00			
195.00	2,364.00			
320.00	2,365.70			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,364.69	ft
Flow Area	63.00	ft²
Wetted Perimeter	132.05	ft
Top Width	132.04	ft
Height	0.69	ft
Critical Depth	2,364.62	ft
Critical Slope	0.023575	ft/ft
Velocity	3.17	ft/s
Velocity Head	0.16	ft
Specific Energy	2,364.85	ft
Froude Number	0.81	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 2-I
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.014000	ft/ft
Elevation range: 2,366.00 ft to 2,368.00 ft.		
Discharge	52.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,368.00	100.00	315.00	0.035
190.00	2,366.00			
210.00	2,366.00			
315.00	2,368.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,366.50	ft
Flow Area	22.05	ft²
Wetted Perimeter	68.57	ft
Top Width	68.56	ft
Height	0.50	ft
Critical Depth	2,366.42	ft
Critical Slope	0.027245	ft/ft
Velocity	2.36	ft/s
Velocity Head	0.09	ft
Specific Energy	2,366.58	ft
Froude Number	0.73	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 2-J
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.015000	ft/ft
Elevation range: 2,370.00 ft to 2,372.00 ft.		
Discharge	200.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,372.00	100.00	355.00	0.035
160.00	2,370.00			
195.00	2,370.00			
355.00	2,371.40			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,370.73	ft
Flow Area	64.68	ft^2
Wetted Perimeter	141.05	ft
Top Width	141.03	ft
Height	0.73	ft
Critical Depth	2,370.66	ft
Critical Slope	0.023866	ft/ft
Velocity	3.09	ft/s
Velocity Head	0.15	ft
Specific Energy	2,370.88	ft
Froude Number	0.80	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 2-K
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.012000	ft/ft
Elevation range: 2,374.00 ft to 2,376.00 ft.		
Discharge	200.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,375.00	100.00	275.00	0.035
145.00	2,374.00			
160.00	2,374.00			
275.00	2,376.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,374.98	ft
Flow Area	63.82	ft²
Wetted Perimeter	115.38	ft
Top Width	115.36	ft
Height	0.98	ft
Critical Depth	2,374.86	ft
Critical Slope	0.022643	ft/ft
Velocity	3.13	ft/s
Velocity Head	0.15	ft
Specific Energy	2,375.13	ft
Froude Number	0.74	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 11-A
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.017000	ft/ft
Elevation range: 2,322.00 ft to 2,323.70 ft.		
Discharge	120.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,323.70	100.00	425.00	0.035
200.00	2,322.00			
335.00	2,322.00			
425.00	2,323.70			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,322.32	ft
Flow Area	49.54	ft²
Wetted Perimeter	171.18	ft
Top Width	171.17	ft
Height	0.32	ft
Critical Depth	2,322.28	ft
Critical Slope	0.028221	ft/ft
Velocity	2.42	ft/s
Velocity Head	0.09	ft
Specific Energy	2,322.41	ft
Froude Number	0.79	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 11-B
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.017000	ft/ft
Elevation range: 2,326.00 ft to 2,328.00 ft.		
Discharge	120.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,328.00	100.00	355.00	0.035
140.00	2,326.00			
290.00	2,326.00			
355.00	2,328.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,326.31	ft
Flow Area	48.97	ft²
Wetted Perimeter	166.27	ft
Top Width	166.26	ft
Height	0.31	ft
Critical Depth	2,326.27	ft
Critical Slope	0.028141	ft/ft
Velocity	2.45	ft/s
Velocity Head	0.09	ft
Specific Energy	2,326.40	ft
Froude Number	0.80	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 17-A
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.019000	ft/ft
Elevation range: 2,296.00 ft to 2,298.00 ft.		
Discharge	175.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,298.00	100.00	275.00	0.035
120.00	2,296.00			
250.00	2,296.00			
275.00	2,298.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,296.41	ft
Flow Area	55.34	ft²
Wetted Perimeter	139.29	ft
Top Width	139.25	ft
Height	0.41	ft
Critical Depth	2,296.38	ft
Critical Slope	0.024930	ft/ft
Velocity	3.16	ft/s
Velocity Head	0.16	ft
Specific Energy	2,296.57	ft
Froude Number	0.88	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 17-B
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.019000	ft/ft
Elevation range: 2,302.00 ft to 2,304.00 ft.		
Discharge	175.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,303.80	100.00	270.00	0.035
130.00	2,302.00			
240.00	2,302.00			
270.00	2,304.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,302.45	ft
Flow Area	52.88	ft^2
Wetted Perimeter	124.32	ft
Top Width	124.29	ft
Height	0.45	ft
Critical Depth	2,302.42	ft
Critical Slope	0.024292	ft/ft
Velocity	3.31	ft/s
Velocity Head	0.17	ft
Specific Energy	2,302.62	ft
Froude Number	0.89	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 17-C
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.019000	ft/ft
Elevation range: 2,308.00 ft to 2,310.00 ft.		
Discharge	175.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,310.00	100.00	340.00	0.035
160.00	2,308.00			
300.00	2,308.00			
340.00	2,310.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,308.39	ft
Flow Area	58.42	ft²
Wetted Perimeter	159.52	ft
Top Width	159.51	ft
Height	0.39	ft
Critical Depth	2,308.36	ft
Critical Slope	0.025658	ft/ft
Velocity	3.00	ft/s
Velocity Head	0.14	ft
Specific Energy	2,308.53	ft
Froude Number	0.87	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 17-D
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.019000	ft/ft
Elevation range: 2,314.00 ft to 2,316.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,316.00	100.00	360.00	0.035
155.00	2,314.00			
325.00	2,314.00			
360.00	2,316.00			

Discharge	138.00	cfs

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,314.30	ft
Flow Area	53.60	ft²
Wetted Perimeter	183.65	ft
Top Width	183.64	ft
Height	0.30	ft
Critical Depth	2,314.27	ft
Critical Slope	0.027923	ft/ft
Velocity	2.57	ft/s
Velocity Head	0.10	ft
Specific Energy	2,314.41	ft
Froude Number	0.84	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 17-E
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.019000	ft/ft
Elevation range: 2,320.00 ft to 2,322.00 ft.		
Discharge	138.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,322.00	100.00	265.00	0.035
120.00	2,320.00			
240.00	2,320.00			
265.00	2,322.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,320.37	ft
Flow Area	46.46	ft^2
Wetted Perimeter	128.45	ft
Top Width	128.42	ft
Height	0.37	ft
Critical Depth	2,320.34	ft
Critical Slope	0.025809	ft/ft
Velocity	2.97	ft/s
Velocity Head	0.14	ft
Specific Energy	2,320.51	ft
Froude Number	0.87	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 17-F
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.019000	ft/ft
Elevation range: 2,326.00 ft to 2,330.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,330.00	100.00	430.00	0.035
190.00	2,328.00			
245.00	2,326.00			
320.00	2,326.00			
340.00	2,328.00			
430.00	2,329.00			

Discharge	138.00	cfs

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,326.49	ft
Flow Area	40.87	ft^2
Wetted Perimeter	93.25	ft
Top Width	93.22	ft
Height	0.49	ft
Critical Depth	2,326.45	ft
Critical Slope	0.024001	ft/ft
Velocity	3.38	ft/s
Velocity Head	0.18	ft
Specific Energy	2,326.66	ft
Froude Number	0.90	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 17-G
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data				
Channel Slope	0.019000 ft/ft			
Elevation range: 2,330.00 ft to 2,332.00 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,332.00	100.00	310.00	0.035
170.00	2,330.00			
275.00	2,330.00			
310.00	2,332.00			
Discharge	100.00 cfs			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,330.33	ft
Flow Area	37.56	ft^2
Wetted Perimeter	122.36	ft
Top Width	122.35	ft
Height	0.33	ft
Critical Depth	2,330.30	ft
Critical Slope	0.027368	ft/ft
Velocity	2.66	ft/s
Velocity Head	0.11	ft
Specific Energy	2,330.44	ft
Froude Number	0.85	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 18-A
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.024000	ft/ft
Elevation range: 2,274.00 ft to 2,280.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,280.00	100.00	365.00	0.035
115.00	2,276.00			
130.00	2,274.00			
295.00	2,274.00			
330.00	2,276.00			
365.00	2,280.00			

Discharge	336.00	cfs

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,274.49	ft
Flow Area	84.04	ft²
Wetted Perimeter	177.32	ft
Top Width	177.28	ft
Height	0.49	ft
Critical Depth	2,274.50	ft
Critical Slope	0.022787	ft/ft
Velocity	4.00	ft/s
Velocity Head	0.25	ft
Specific Energy	2,274.74	ft
Froude Number	1.02	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 18-B
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.023000	ft/ft
Elevation range: 2,284.00 ft to 2,290.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,290.00	100.00	580.00	0.035
125.00	2,288.00			
215.00	2,286.00			
250.00	2,284.00			
400.00	2,284.00			
485.00	2,286.00			
580.00	2,288.00			

Discharge	336.00	cfs

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,284.52	ft
Flow Area	85.85	ft²
Wetted Perimeter	181.13	ft
Top Width	181.11	ft
Height	0.52	ft
Critical Depth	2,284.52	ft
Critical Slope	0.022888	ft/ft
Velocity	3.91	ft/s
Velocity Head	0.24	ft
Specific Energy	2,284.76	ft
Froude Number	1.00	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 18-C
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.023000	ft/ft
Elevation range: 2,288.00 ft to 2,292.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,292.00	100.00	390.00	0.035
165.00	2,290.00			
250.00	2,288.00			
310.00	2,288.00			
370.00	2,290.00			
390.00	2,292.00			

Discharge	326.00	cfs

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,288.80	ft
Flow Area	71.00	ft²
Wetted Perimeter	117.90	ft
Top Width	117.88	ft
Height	0.80	ft
Critical Depth	2,288.82	ft
Critical Slope	0.021001	ft/ft
Velocity	4.59	ft/s
Velocity Head	0.33	ft
Specific Energy	2,289.13	ft
Froude Number	1.04	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 24-A
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.029000	ft/ft
Elevation range: 2,224.00 ft to 2,228.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,228.00	100.00	480.00	0.035
120.00	2,226.00			
135.00	2,224.00			
460.00	2,224.00			
470.00	2,226.00			
480.00	2,228.00			

Discharge	393.00	cfs

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,224.34	ft
Flow Area	111.74	ft²
Wetted Perimeter	329.33	ft
Top Width	329.27	ft
Height	0.34	ft
Critical Depth	2,224.36	ft
Critical Slope	0.025247	ft/ft
Velocity	3.52	ft/s
Velocity Head	0.19	ft
Specific Energy	2,224.53	ft
Froude Number	1.06	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 24-B
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.024000	ft/ft
Elevation range: 2,230.00 ft to 2,234.00 ft.		
Discharge	393.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,234.00	100.00	225.00	0.035
115.00	2,232.00	225.00	530.00	0.025
160.00	2,230.00	530.00	545.00	0.035
225.00	2,230.00			
530.00	2,232.00			
545.00	2,234.00			

Results		
Wtd. Mannings Coefficient	0.030	
Water Surface Elevation	2,230.68	ft
Flow Area	84.64	ft²
Wetted Perimeter	184.00	ft
Top Width	183.98	ft
Height	0.68	ft
Critical Depth	2,230.75	ft
Critical Slope	0.015827	ft/ft
Velocity	4.64	ft/s
Velocity Head	0.34	ft
Specific Energy	2,231.01	ft
Froude Number	1.21	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 24-C
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.027000	ft/ft
Elevation range: 2,236.00 ft to 2,240.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,239.00	100.00	410.00	0.035
165.00	2,238.00			
245.00	2,236.00			
360.00	2,236.00			
390.00	2,238.00			
410.00	2,240.00			

Discharge	393.00	cfs

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,236.63	ft
Flow Area	83.27	ft²
Wetted Perimeter	149.64	ft
Top Width	149.62	ft
Height	0.63	ft
Critical Depth	2,236.67	ft
Critical Slope	0.021265	ft/ft
Velocity	4.72	ft/s
Velocity Head	0.35	ft
Specific Energy	2,236.98	ft
Froude Number	1.12	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 24-D
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.027000	ft/ft
Elevation range: 2,244.00 ft to 2,248.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,248.00	100.00	250.00	0.035
110.00	2,246.00			
135.00	2,244.00			
225.00	2,244.00			
250.00	2,248.00			

Discharge	346.00	cfs

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,244.69	ft
Flow Area	66.44	ft²
Wetted Perimeter	103.00	ft
Top Width	102.91	ft
Height	0.69	ft
Critical Depth	2,244.75	ft
Critical Slope	0.020125	ft/ft
Velocity	5.21	ft/s
Velocity Head	0.42	ft
Specific Energy	2,245.11	ft
Froude Number	1.14	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 24-E
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.031000	ft/ft
Elevation range: 2,250.00 ft to 2,254.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,254.00	100.00	235.00	0.035
115.00	2,252.00			
135.00	2,250.00			
200.00	2,250.00			
215.00	2,252.00			
235.00	2,254.00			

Discharge	346.00	cfs

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,250.80	ft
Flow Area	57.33	ft^2
Wetted Perimeter	79.03	ft
Top Width	78.94	ft
Height	0.80	ft
Critical Depth	2,250.92	ft
Critical Slope	0.019049	ft/ft
Velocity	6.03	ft/s
Velocity Head	0.57	ft
Specific Energy	2,251.36	ft
Froude Number	1.25	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 25-A
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.030000	ft/ft
Elevation range: 2,199.00 ft to 2,202.00 ft.		
Discharge	435.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,202.00	100.00	480.00	0.035
190.00	2,200.00			
360.00	2,200.00			
435.00	2,199.00			
460.00	2,199.00			
470.00	2,200.00			
480.00	2,202.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,200.15	ft
Flow Area	111.39	ft²
Wetted Perimeter	287.80	ft
Top Width	287.73	ft
Height	1.15	ft
Critical Depth	2,200.18	ft
Critical Slope	0.023982	ft/ft
Velocity	3.91	ft/s
Velocity Head	0.24	ft
Specific Energy	2,200.39	ft
Froude Number	1.11	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 25-B
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.050000	ft/ft
Elevation range: 2,206.00 ft to 2,210.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,210.00	100.00	340.00	0.035
230.00	2,208.00			
305.00	2,206.00			
325.00	2,206.00			
340.00	2,210.00			

Discharge	435.00	cfs

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,207.21	ft
Flow Area	54.29	ft²
Wetted Perimeter	70.03	ft
Top Width	69.85	ft
Height	1.21	ft
Critical Depth	2,207.53	ft
Critical Slope	0.018234	ft/ft
Velocity	8.01	ft/s
Velocity Head	1.00	ft
Specific Energy	2,208.21	ft
Froude Number	1.60	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 25-C
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.021000	ft/ft
Elevation range: 2,214.00 ft to 2,218.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,218.00	100.00	535.00	0.035
205.00	2,216.00			
370.00	2,214.00			
485.00	2,214.00			
520.00	2,216.00			
535.00	2,218.00			

Discharge	435.00	cfs

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,214.69	ft
Flow Area	103.73	ft^2
Wetted Perimeter	184.34	ft
Top Width	184.31	ft
Height	0.69	ft
Critical Depth	2,214.69	ft
Critical Slope	0.021678	ft/ft
Velocity	4.19	ft/s
Velocity Head	0.27	ft
Specific Energy	2,214.97	ft
Froude Number	0.99	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 25-D
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.024000	ft/ft
Elevation range: 2,222.00 ft to 2,226.00 ft.		
Discharge	435.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,225.00	100.00	540.00	0.035
120.00	2,224.00			
200.00	2,222.00			
505.00	2,222.00			
520.00	2,224.00			
540.00	2,226.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,222.40	ft
Flow Area	124.86	ft²
Wetted Perimeter	323.89	ft
Top Width	323.86	ft
Height	0.40	ft
Critical Depth	2,222.39	ft
Critical Slope	0.024585	ft/ft
Velocity	3.48	ft/s
Velocity Head	0.19	ft
Specific Energy	2,222.59	ft
Froude Number	0.99	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 25-E
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.032000	ft/ft
Elevation range: 2,228.00 ft to 2,232.00 ft.		
Discharge	435.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,232.00	100.00	510.00	0.035
125.00	2,230.00			
150.00	2,228.00			
485.00	2,228.00			
495.00	2,230.00			
510.00	2,232.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,228.35	ft
Flow Area	116.94	ft²
Wetted Perimeter	341.10	ft
Top Width	341.05	ft
Height	0.35	ft
Critical Depth	2,228.37	ft
Critical Slope	0.024883	ft/ft
Velocity	3.72	ft/s
Velocity Head	0.22	ft
Specific Energy	2,228.56	ft
Froude Number	1.12	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 25-F
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data				
Channel Slope	0.024000 ft/ft			
Elevation range: 2,234.00 ft to 2,240.00 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,238.00	100.00	190.00	0.035
115.00	2,236.00	190.00	520.00	0.030
190.00	2,234.00	520.00	565.00	0.035
520.00	2,234.00			
565.00	2,240.00			
Discharge	435.00 cfs			

Results		
Wtd. Mannings Coefficient	0.030	
Water Surface Elevation	2,234.35	ft
Flow Area	117.38	ft²
Wetted Perimeter	345.66	ft
Top Width	345.64	ft
Height	0.35	ft
Critical Depth	2,234.37	ft
Critical Slope	0.018654	ft/ft
Velocity	3.71	ft/s
Velocity Head	0.21	ft
Specific Energy	2,234.56	ft
Froude Number	1.12	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 25-G
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.024000	ft/ft
Elevation range: 2,240.00 ft to 2,244.00 ft.		
Discharge	346.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
90.00	2,244.00	90.00	150.00	0.025
100.00	2,242.00	150.00	400.00	0.030
150.00	2,240.00	400.00	450.00	0.035
400.00	2,240.00			
450.00	2,244.00			

Results		
Wtd. Mannings Coefficient	0.030	
Water Surface Elevation	2,240.36	ft
Flow Area	91.21	ft²
Wetted Perimeter	263.35	ft
Top Width	263.33	ft
Height	0.36	ft
Critical Depth	2,240.39	ft
Critical Slope	0.018075	ft/ft
Velocity	3.79	ft/s
Velocity Head	0.22	ft
Specific Energy	2,240.58	ft
Froude Number	1.14	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 25-H
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.024000	ft/ft
Elevation range: 2,248.00 ft to 2,252.00 ft.		
Discharge	346.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,252.00	100.00	350.00	0.035
110.00	2,250.00			
130.00	2,248.00			
290.00	2,248.00			
340.00	2,250.00			
350.00	2,252.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,248.51	ft
Flow Area	85.62	ft²
Wetted Perimeter	177.78	ft
Top Width	177.75	ft
Height	0.51	ft
Critical Depth	2,248.52	ft
Critical Slope	0.022653	ft/ft
Velocity	4.04	ft/s
Velocity Head	0.25	ft
Specific Energy	2,248.76	ft
Froude Number	1.03	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 25-I
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.031000	ft/ft
Elevation range: 2,256.00 ft to 2,260.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,260.00	100.00	495.00	0.035
105.00	2,258.00			
108.00	2,256.00			
310.00	2,256.00			
405.00	2,258.00			
495.00	2,260.00			

Discharge	346.00	cfs

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,256.41	ft
Flow Area	86.69	ft²
Wetted Perimeter	222.16	ft
Top Width	222.03	ft
Height	0.41	ft
Critical Depth	2,256.44	ft
Critical Slope	0.023846	ft/ft
Velocity	3.99	ft/s
Velocity Head	0.25	ft
Specific Energy	2,256.66	ft
Froude Number	1.13	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 27-A
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.023000	ft/ft
Elevation range: 2,164.00 ft to 2,166.00 ft.		
Discharge	117.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,165.00	100.00	180.00	0.035
120.00	2,164.00			
145.00	2,164.00			
180.00	2,166.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,164.72	ft
Flow Area	27.67	ft²
Wetted Perimeter	52.00	ft
Top Width	51.97	ft
Height	0.72	ft
Critical Depth	2,164.73	ft
Critical Slope	0.021971	ft/ft
Velocity	4.23	ft/s
Velocity Head	0.28	ft
Specific Energy	2,165.00	ft
Froude Number	1.02	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 27-B
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.042000	ft/ft
Elevation range: 2,170.00 ft to 2,172.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,172.00	100.00	365.00	0.035
225.00	2,170.00			
280.00	2,170.00			
365.00	2,172.00			

Discharge	100.00	cfs

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,170.36	ft
Flow Area	26.49	ft^2
Wetted Perimeter	92.68	ft
Top Width	92.67	ft
Height	0.36	ft
Critical Depth	2,170.41	ft
Critical Slope	0.026131	ft/ft
Velocity	3.78	ft/s
Velocity Head	0.22	ft
Specific Energy	2,170.58	ft
Froude Number	1.24	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 29-A
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data				
Channel Slope	0.002000 ft/ft			
Elevation range: 2,160.20 ft to 2,167.80 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,162.30	100.00	255.00	0.033
140.00	2,162.00	255.00	290.00	0.025
185.00	2,160.40	290.00	390.00	0.030
235.00	2,162.00			
255.00	2,162.00			
270.00	2,160.20			
290.00	2,162.00			
300.00	2,160.30			
310.00	2,162.00			
330.00	2,160.90			
370.00	2,161.10			
390.00	2,167.80			
Discharge	486.00	cfs		

Results		
Wtd. Mannings Coefficient	0.029	
Water Surface Elevation	2,162.23	ft
Flow Area	232.92	ft^2
Wetted Perimeter	264.31	ft
Top Width	263.57	ft
Height	2.03	ft
Critical Depth	2,161.65	ft
Critical Slope	0.015228	ft/ft
Velocity	2.09	ft/s
Velocity Head	0.07	ft
Specific Energy	2,162.29	ft
Froude Number	0.39	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 29-B
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data				
Channel Slope	0.003000 ft/ft			
Elevation range: 2,160.80 ft to 2,168.40 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,162.70	100.00	300.00	0.033
160.00	2,162.00	300.00	325.00	0.025
195.00	2,160.80	325.00	420.00	0.030
230.00	2,162.00			
265.00	2,162.00			
285.00	2,160.80			
300.00	2,162.00			
312.00	2,162.80			
325.00	2,162.00			
355.00	2,161.40			
390.00	2,161.70			
420.00	2,168.40			
Discharge	486.00	cfs		

Results		
Wtd. Mannings Coefficient	0.031	
Water Surface Elevation	2,162.54	ft
Flow Area	217.52	ft^2
Wetted Perimeter	272.38	ft
Top Width	272.12	ft
Height	1.74	ft
Critical Depth	2,162.14	ft
Critical Slope	0.018215	ft/ft
Velocity	2.23	ft/s
Velocity Head	0.08	ft
Specific Energy	2,162.62	ft
Froude Number	0.44	
Flow is subcritical.		
Flow is divided.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 29-C
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data				
Channel Slope	0.004000 ft/ft			
Elevation range: 2,161.30 ft to 2,169.10 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,163.20	100.00	275.00	0.033
155.00	2,162.00	275.00	308.00	0.025
180.00	2,161.30	308.00	390.00	0.030
215.00	2,162.00			
250.00	2,162.00			
265.00	2,161.40			
275.00	2,162.00			
290.00	2,163.20			
308.00	2,162.00			
325.00	2,161.90			
350.00	2,162.00			
370.00	2,162.00			
390.00	2,169.10			
Discharge	486.00	cfs		

Results		
Wtd. Mannings Coefficient	0.031	
Water Surface Elevation	2,162.76	ft
Flow Area	189.83	ft²
Wetted Perimeter	239.77	ft
Top Width	239.53	ft
Height	1.46	ft
Critical Depth	2,162.43	ft
Critical Slope	0.017773	ft/ft
Velocity	2.56	ft/s
Velocity Head	0.10	ft
Specific Energy	2,162.86	ft
Froude Number	0.51	
Flow is subcritical.		
Flow is divided.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 29-D
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data				
Channel Slope	0.004000 ft/ft			
Elevation range: 2,162.00 ft to 2,170.00 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,163.60	100.00	276.00	0.033
185.00	2,162.00	276.00	300.00	0.025
265.00	2,162.00	300.00	385.00	0.030
276.00	2,162.70			
288.00	2,162.70			
300.00	2,162.80			
365.00	2,163.30			
385.00	2,170.00			
Discharge	486.00	cfs		

Results		
Wtd. Mannings Coefficient	0.029	
Water Surface Elevation	2,163.27	ft
Flow Area	182.94	ft²
Wetted Perimeter	244.31	ft
Top Width	244.27	ft
Height	1.27	ft
Critical Depth	2,162.93	ft
Critical Slope	0.015199	ft/ft
Velocity	2.66	ft/s
Velocity Head	0.11	ft
Specific Energy	2,163.38	ft
Froude Number	0.54	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 29-E
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.019000	ft/ft
Discharge	380.00	cfs

Elevation range: 2,163.00 ft to 2,166.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,166.00	100.00	120.00	0.030
120.00	2,164.00	120.00	200.00	0.025
125.00	2,163.00			
130.00	2,164.00			
150.00	2,164.40			
180.00	2,163.80			
200.00	2,165.10			

Results		
Wtd. Mannings Coefficient	0.026	
Water Surface Elevation	2,164.83	ft
Flow Area	59.69	ft²
Wetted Perimeter	84.52	ft
Top Width	84.23	ft
Height	1.83	ft
Critical Depth	2,164.99	ft
Critical Slope	0.010189	ft/ft
Velocity	6.37	ft/s
Velocity Head	0.63	ft
Specific Energy	2,165.46	ft
Froude Number	1.33	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 29-F
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.021000	ft/ft
Discharge	380.00	cfs

Elevation range: 2,170.30 ft to 2,174.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,174.00	100.00	280.00	0.035
195.00	2,172.00	280.00	360.00	0.025
255.00	2,172.00			
280.00	2,171.30			
285.00	2,170.30			
290.00	2,171.30			
310.00	2,171.70			
340.00	2,171.10			
360.00	2,172.30			

Results		
Wtd. Mannings Coefficient	0.031	
Water Surface Elevation	2,172.18	ft
Flow Area	85.93	ft²
Wetted Perimeter	172.02	ft
Top Width	171.77	ft
Height	1.88	ft
Critical Depth	2,172.22	ft
Critical Slope	0.016990	ft/ft
Velocity	4.42	ft/s
Velocity Head	0.30	ft
Specific Energy	2,172.49	ft
Froude Number	1.10	

Flow is supercritical.

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 29-G (Roadway Capacity)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Channel Slope	0.015000	ft/ft
Water Surface Elevation	2,176.60	ft

Elevation range: 2,175.20 ft to 2,178.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,178.00	100.00	195.00	0.035
195.00	2,176.20	195.00	225.00	0.025
200.00	2,175.20			
205.00	2,176.20			
225.00	2,176.60			

Results		
Wtd. Mannings Coefficient	0.029	
Discharge	51.62	cfs
Flow Area	17.22	ft²
Wetted Perimeter	51.32	ft
Top Width	51.11	ft
Height	1.40	ft
Critical Depth	2,176.57	ft
Critical Slope	0.018185	ft/ft
Velocity	3.00	ft/s
Velocity Head	0.14	ft
Specific Energy	2,176.74	ft
Froude Number	0.91	
Flow is subcritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 29-G w/Cor. Ranch Channel
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.015000	ft/ft
Elevation range: 2,172.80 ft to 2,178.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,178.00	100.00	195.00	0.035
195.00	2,176.20	195.00	303.00	0.025
200.00	2,175.20			
205.00	2,176.20			
225.00	2,176.60			
255.00	2,176.00			
275.00	2,176.10			
285.00	2,172.80			
290.00	2,172.80			
303.00	2,177.10			

Discharge	140.00	cfs

Results		
Wtd. Mannings Coefficient	0.025	
Water Surface Elevation	2,174.54	ft
Flow Area	17.92	ft²
Wetted Perimeter	16.12	ft
Top Width	15.55	ft
Height	1.74	ft
Critical Depth	2,174.78	ft
Critical Slope	0.008805	ft/ft
Velocity	7.81	ft/s
Velocity Head	0.95	ft
Specific Energy	2,175.49	ft
Froude Number	1.28	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 29-H
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.029000	ft/ft
Elevation range: 2,190.00 ft to 2,194.00 ft.		
Discharge	192.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,194.00	100.00	545.00	0.035
120.00	2,192.00			
245.00	2,192.00			
285.00	2,190.00			
505.00	2,190.00			
545.00	2,194.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,190.28	ft
Flow Area	62.81	ft²
Wetted Perimeter	228.42	ft
Top Width	228.40	ft
Height	0.28	ft
Critical Depth	2,190.29	ft
Critical Slope	0.027289	ft/ft
Velocity	3.06	ft/s
Velocity Head	0.15	ft
Specific Energy	2,190.43	ft
Froude Number	1.03	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 29-I
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.029000	ft/ft
Elevation range: 2,204.00 ft to 2,210.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,210.00	100.00	325.00	0.035
115.00	2,206.00			
125.00	2,204.00			
295.00	2,204.00			
310.00	2,206.00			
325.00	2,210.00			

Discharge	192.00	cfs

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,204.33	ft
Flow Area	56.35	ft²
Wetted Perimeter	174.15	ft
Top Width	174.09	ft
Height	0.33	ft
Critical Depth	2,204.34	ft
Critical Slope	0.025701	ft/ft
Velocity	3.41	ft/s
Velocity Head	0.18	ft
Specific Energy	2,204.51	ft
Froude Number	1.06	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 29-J
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.029000	ft/ft
Elevation range: 2,214.00 ft to 2,220.00 ft.		
Discharge	192.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,220.00	100.00	315.00	0.035
115.00	2,216.00			
125.00	2,214.00			
285.00	2,214.00			
300.00	2,216.00			
310.00	2,218.00			
315.00	2,220.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,214.34	ft
Flow Area	55.05	ft²
Wetted Perimeter	164.30	ft
Top Width	164.24	ft
Height	0.34	ft
Critical Depth	2,214.35	ft
Critical Slope	0.025373	ft/ft
Velocity	3.49	ft/s
Velocity Head	0.19	ft
Specific Energy	2,214.53	ft
Froude Number	1.06	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 29-K
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.029000	ft/ft
Elevation range: 2,224.00 ft to 2,226.00 ft.		
Discharge	100.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,226.00	100.00	270.00	0.035
110.00	2,224.00			
250.00	2,224.00			
270.00	2,226.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,224.25	ft
Flow Area	35.28	ft²
Wetted Perimeter	143.77	ft
Top Width	143.73	ft
Height	0.25	ft
Critical Depth	2,224.25	ft
Critical Slope	0.028464	ft/ft
Velocity	2.83	ft/s
Velocity Head	0.12	ft
Specific Energy	2,224.37	ft
Froude Number	1.01	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 29-L
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.034000	ft/ft
Elevation range: 2,184.00 ft to 2,186.00 ft.		
Discharge	188.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,186.00	100.00	585.00	0.035
275.00	2,184.00			
430.00	2,184.00			
585.00	2,186.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,184.31	ft
Flow Area	56.83	ft²
Wetted Perimeter	206.83	ft
Top Width	206.83	ft
Height	0.31	ft
Critical Depth	2,184.34	ft
Critical Slope	0.026919	ft/ft
Velocity	3.31	ft/s
Velocity Head	0.17	ft
Specific Energy	2,184.48	ft
Froude Number	1.11	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 29-M
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.034000	ft/ft
Elevation range: 2,196.00 ft to 2,198.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,198.00	100.00	400.00	0.035
275.00	2,196.00			
380.00	2,196.00			
400.00	2,198.00			

Discharge	188.00	cfs

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,196.40	ft
Flow Area	49.10	ft²
Wetted Perimeter	143.55	ft
Top Width	143.53	ft
Height	0.40	ft
Critical Depth	2,196.43	ft
Critical Slope	0.024866	ft/ft
Velocity	3.83	ft/s
Velocity Head	0.23	ft
Specific Energy	2,196.62	ft
Froude Number	1.15	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 29-N
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.030000	ft/ft
Elevation range: 2,208.00 ft to 2,210.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,210.00	100.00	350.00	0.035
120.00	2,208.00			
330.00	2,208.00			
350.00	2,210.00			

Discharge	188.00	cfs

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,208.28	ft
Flow Area	59.99	ft²
Wetted Perimeter	215.67	ft
Top Width	215.64	ft
Height	0.28	ft
Critical Depth	2,208.29	ft
Critical Slope	0.027072	ft/ft
Velocity	3.13	ft/s
Velocity Head	0.15	ft
Specific Energy	2,208.43	ft
Froude Number	1.05	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 29-O
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.030000	ft/ft
Elevation range: 2,216.00 ft to 2,218.00 ft.		
Discharge	100.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,218.00	100.00	290.00	0.035
130.00	2,216.00			
260.00	2,216.00			
290.00	2,218.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,216.26	ft
Flow Area	34.33	ft^2
Wetted Perimeter	137.71	ft
Top Width	137.69	ft
Height	0.26	ft
Critical Depth	2,216.26	ft
Critical Slope	0.028194	ft/ft
Velocity	2.91	ft/s
Velocity Head	0.13	ft
Specific Energy	2,216.39	ft
Froude Number	1.03	
Flow is supercritical.		

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\cr_fpln.fm2
Worksheet	Cross Section 29-P
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.030000	ft/ft
Elevation range: 2,222.00 ft to 2,224.00 ft.		
Discharge	100.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
100.00	2,224.00	100.00	360.00	0.035
185.00	2,222.00			
310.00	2,222.00			
360.00	2,224.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	2,222.26	ft
Flow Area	34.81	ft²
Wetted Perimeter	142.57	ft
Top Width	142.56	ft
Height	0.26	ft
Critical Depth	2,222.26	ft
Critical Slope	0.028419	ft/ft
Velocity	2.87	ft/s
Velocity Head	0.13	ft
Specific Energy	2,222.39	ft
Froude Number	1.02	
Flow is supercritical.		

EFFECTIVE FIRM PANELS

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE DATE shown on this map to determine when actuarial rates apply to structures in zones where elevations or depths have been established.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE IN FEET

1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

PIMA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 1605 OF 4700

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
MARANA, TOWN OF	040118	1605	K
PIMA COUNTY, UNINCORPORATED AREAS	040073	1605	K

MAP NUMBER 04019C1605 K

EFFECTIVE DATE: FEBRUARY 8, 1999

Federal Emergency Management Agency

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE DATE shown on this map to determine when actuarial rates apply to structures in zones where elevations or depths have been established.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE IN FEET

1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

PIMA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 1610 OF 4700
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
MARANA, TOWN OF	040118	1610	K
ORO VALLEY TOWN OF	040109	1610	K
TUCSON, CITY OF	040076	1610	K
PIMA COUNTY, UNINCORPORATED AREAS	040073	1610	K

MAP NUMBER 04019C1610 K

EFFECTIVE DATE: FEBRUARY 8, 1999

Federal Emergency Management Agency

HYDRAULIC CALCULATIONS

EXISTING CULVERTS

EXISTING 24" CMP @ C.P. 12 & 13

RESULTS

```
==========================================
Entrance Type: PROJECTING (CMP)
Discharge is  17.00 cfs
 1  X  24 " CMP X  70  FT. LONG
Manning's  'n' 0.024
Inlet  Control HW/D   1.43
Inlet Control HW     2.87
Ke      0.90
H        2.21
Critical Depth  1.49
Dc+D/2          1.74
Tailwater       1.49
H0              1.74
L*S0            0.98
Outlet HW    2.97

OUTLET CONTROL  GOVERNS   HW=  2.97
Outlet Velocity  6.77 fps
```

EXISTING 2-24" RCP @ C.P. 16

RESULTS

==========

Entrance Type: SQUARE HEADWALL (RCP)
Discharge is 49.00 cfs
2 X 24 " RCP X 70 FT. LONG
Manning's 'n' 0.012
Inlet Control HW/D 1.87
Inlet Control HW 3.74
Ke 0.50
H 2.12
Critical Depth 1.75
Dc+D/2 1.87
Tailwater 1.75
H0 1.87
L*S0 0.70
Outlet HW 3.29

INLET CONTROL GOVERNS HW= 3.74
Outlet Velocity 8.89 fps

EXISTING 3 – 4' X 8' RCBC @ C.P. 18

SOLUTION

==========

```
 3  Cells X  4  High X  8  Wide
Discharge   740.00CFS
Length (Ft)  115    Slope    1.80%
Manning's 'n' 0.012
Entrance Type:
 SQR. TOP EDGE, 30-75DEG. WW FLAIR
Inlet Control HW/D  1.25
Inlet Control HW = 5.02
Ke 0.40
H  1.60
Critical Depth  3.10
Dc+D/2  3.55
Tailwater  3.10
H0  3.55
L*S0  2.07
Outlet HW  3.07
INLET Control Governs  HW= 5.02
Outlet Velocity 18.49fps
Normal Depth  1.67
```

EXISTING 24" RCP @ C.P. 19

RESULTS

```
========================================
Entrance Type: SOCKET HEADWALL (RCP)
Discharge is  23.00 cfs
 1  X  24 " RCP X  66  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   1.51
Inlet Control HW     3.02
Ke       0.20
H         1.58
Critical Depth  1.71
Dc+D/2          1.85
Tailwater       1.71
H0              1.85
L*S0            0.86
Outlet HW    2.57

INLET CONTROL  GOVERNS   HW=  3.02
Outlet Velocity  9.92 fps
```

EXISTING 24" RCP @ C.P. 20

RESULTS

```
========================================
Entrance Type: SOCKET HEADWALL (RCP)
Discharge is  29.00 cfs
 1  X  24 " RCP X  83  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   1.98
Inlet Control HW     3.96
Ke      0.20
H        2.75
Critical Depth  1.85
Dc+D/2          1.92
Tailwater       1.85
H0              1.92
L*S0            1.02
Outlet HW    3.65

INLET CONTROL  GOVERNS   HW=  3.96
Outlet Velocity  9.23 fps
```

EXISTING 36" RCP @ C.P. 21

RESULTS

==========

Entrance Type: SOCKET HEADWALL (RCP)
Discharge is 56.00 cfs
1 X 36 " RCP X 119 FT. LONG
Manning's 'n' 0.012
Inlet Control HW/D 1.34
Inlet Control HW 4.01
Ke 0.20
H 1.88
Critical Depth 2.43
Dc+D/2 2.71
Tailwater 2.43
H0 2.71
L*S0 2.90
Outlet HW 1.69

INLET CONTROL GOVERNS HW= 4.01
Outlet Velocity 15.95 fps

EXISTING 2-24" CMP @ C.P. 24

```
                    RESULTS
=======================================
Entrance Type: PROJECTING (CMP)
Discharge is  33.00 cfs
 2  X  24 " CMP X  80  FT. LONG
Manning's  'n' 0.024
Inlet  Control HW/D   1.39
Inlet Control HW     2.78
Ke       0.90
H         2.26
Critical Depth  1.46
Dc+D/2          1.73
Tailwater       1.46
H0              1.73
L*S0            1.04
Outlet HW    2.96

OUTLET CONTROL  GOVERNS   HW=  2.96
Outlet Velocity  6.69 fps
```

EXISTING 3 – 30" CMP @ C.P. 25

```
                    RESULTS
=======================================
Entrance Type: PROJECTING (CMP)
Discharge is  83.00 cfs
 3  X  30 " CMP X  60  FT. LONG
Manning's  'n' 0.024
Inlet  Control HW/D   1.34
Inlet Control HW     3.34
Ke       0.90
H         1.87
Critical Depth  1.79
Dc+D/2          2.15
Tailwater       1.79
H0              2.15
L*S0            0.50
Outlet HW    3.52

OUTLET CONTROL  GOVERNS   HW=  3.52
Outlet Velocity  7.34 fps
```

EXISTING 18" CMP @ C.P. 26

```
                    RESULTS
==========================================
Entrance Type: PROJECTING (CMP)
Discharge is  10.50 cfs
 1  X  18 " CMP X  60  FT. LONG
Manning's  'n' 0.024
Inlet  Control HW/D   1.90
Inlet Control HW     2.85
Ke       0.90
H         3.08
Critical Depth  1.25
Dc+D/2          1.37
Tailwater       1.25
H0              1.37
L*S0            0.50
Outlet HW    3.96

OUTLET CONTROL  GOVERNS   HW=  3.96
Outlet Velocity  6.67 fps
```

PROPOSED CULVERT CALCULATIONS

C.P. 2: 2 – 12' X 5' RCBC @ STA 224+56 (Q_{100})

SOLUTION

==========

2 Cells X 5 High X 12 Wide
Discharge 511.00CFS
Length (Ft) 156 Slope 1.09%
Manning's 'n' 0.012
Entrance Type:
SQR. TOP EDGE, 30-75DEG. WW FLAIR
Inlet Control HW/D 0.75
Inlet Control HW = 3.73
Ke 0.40
H 0.48
Critical Depth 2.42
Dc+D/2 3.71
Tailwater 2.42
H0 3.71
L*S0 1.70
Outlet HW 2.49
INLET Control Governs HW= 3.73
Outlet Velocity 14.47fps
Normal Depth 1.47

C.P. 2: 2 – 12' X 5' RCBC @ STA 224+56 (CAPACITY)

SOLUTION

==========

2 Cells X 5 High X 12 Wide
Discharge 985.00CFS
Length (Ft) 156 Slope 1.09%
Manning's 'n' 0.012
Entrance Type:
SQR. TOP EDGE, 30-75DEG. WW FLAIR
Inlet Control HW/D 1.20
Inlet Control HW = 6.01
Ke 0.40
H 1.79
Critical Depth 3.75
Dc+D/2 4.37
Tailwater 3.75
H0 4.37
L*S0 1.70
Outlet HW 4.46
INLET Control Governs HW= 6.01
Outlet Velocity 18.04fps
Normal Depth 2.27

C.P. 3: 2 – 36" RCP @ STA 222+00 (Q_{100})

```
                    RESULTS
=======================================
Entrance Type: SQUARE HEADWALL (RCP)
Discharge is  70.00 cfs
 2  X  36 " RCP X  158  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   1.00
Inlet Control HW     2.99
Ke      0.50
H        0.94
Critical Depth  1.92
Dc+D/2          2.46
Tailwater       1.92
H0              2.46
L*S0            2.61
Outlet HW    0.80

INLET CONTROL  GOVERNS   HW=  2.99
Outlet Velocity 12.21 fps
```

C.P. 3: 2 – 36" RCP @ STA 222+00 (CAPACITY)

```
                    RESULTS
=========================================
Entrance Type: SQUARE HEADWALL (RCP)
Discharge is 112.00 cfs
 2  X  36 " RCP X  158  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   1.50
Inlet Control HW     4.49
Ke      0.50
H        2.41
Critical Depth  2.43
Dc+D/2          2.71
Tailwater       2.43
H0              2.71
L*S0            2.61
Outlet HW    2.52

INLET CONTROL  GOVERNS   HW=  4.49
Outlet Velocity 13.73 fps
```

C.P. 8: 8' X 4' RCBC @ STA 212+47 (Q_{100})

SOLUTION

==========

1 Cells X 4 High X 8 Wide
Discharge 172.00CFS
Length (Ft) 174 Slope 0.42%
Manning's 'n' 0.012
Entrance Type:
SQR. TOP EDGE, 30-75DEG. WW FLAIR
Inlet Control HW/D 0.94
Inlet Control HW = 3.78
Ke 0.40
H 0.85
Critical Depth 2.44
Dc+D/2 3.22
Tailwater 2.42
H0 3.22
L*S0 0.73
Outlet HW 3.34
INLET Control Governs HW= 3.78
Outlet Velocity 10.02fps
Normal Depth 2.15

C.P. 8: 8' X 4' RCBC @ STA 212+47 (CAPACITY)

SOLUTION

==========

1 Cells X 4 High X 8 Wide
Discharge 246.00CFS
Length (Ft) 174 Slope 0.42%
Manning's 'n' 0.012
Entrance Type:
SQR. TOP EDGE, 30-75DEG. WW FLAIR
Inlet Control HW/D 1.25
Inlet Control HW = 5.01
Ke 0.40
H 1.74
Critical Depth 3.09
Dc+D/2 3.55
Tailwater 3.09
H0 3.55
L*S0 0.73
Outlet HW 4.56
INLET Control Governs HW= 5.01
Outlet Velocity 11.14fps
Normal Depth 2.76

C.P. 11: 2 – 36" RCP @ STA 202+65 (Q_{100})

```
                    RESULTS
=======================================
Entrance Type: SOCKET HEADWALL (RCP)
Discharge is 125.00 cfs
 2  X  36 " RCP X  192  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   1.49
Inlet Control HW     4.47
Ke      0.20
H        2.89
Critical Depth  2.55
Dc+D/2          2.77
Tailwater       2.55
H0              2.77
L*S0            1.32
Outlet HW    4.34

INLET CONTROL  GOVERNS   HW=  4.47
Outlet Velocity  8.84 fps
```

C.P. 11: 2 – 36" RCP @ STA 202+65 (CAPACITY)

```
                RESULTS
=======================================
Entrance Type: SOCKET HEADWALL (RCP)
Discharge is 137.00 cfs
 2  X  36 " RCP X  192  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   1.65
Inlet Control HW     4.94
Ke      0.20
H        3.47
Critical Depth  2.64
Dc+D/2          2.82
Tailwater       2.64
H0              2.82
L*S0            1.32
Outlet HW    4.97

OUTLET CONTROL  GOVERNS   HW=  4.97
Outlet Velocity 10.40 fps
```

C.P. 12: 30" RCP @ STA 198+40 (Q_{100})

```
                    RESULTS
=========================================
Entrance Type: SQUARE HEADWALL (RCP)
Discharge is  32.00 cfs
 1  X  30 " RCP X  131  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   1.35
Inlet Control HW     3.37
Ke      0.50
H        1.67
Critical Depth  1.93
Dc+D/2          2.21
Tailwater       1.93
H0              2.21
L*S0            0.90
Outlet HW    2.98

INLET CONTROL  GOVERNS   HW=  3.37
Outlet Velocity  8.47 fps
```

C.P. 12: 30" RCP @ STA 198+40 (CAPACITY)

```
                RESULTS
=======================================
Entrance Type: SQUARE HEADWALL (RCP)
Discharge is  33.00 cfs
 1  X  30 " RCP X  131  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   1.39
Inlet Control HW     3.47
Ke       0.50
H         1.77
Critical Depth  1.96
Dc+D/2          2.23
Tailwater       1.96
H0              2.23
L*S0            0.90
Outlet HW    3.10

INLET CONTROL  GOVERNS   HW=  3.47
Outlet Velocity  8.51 fps
```

C.P. 13: 48" RCP @ STA 196+00 (Q_{100})

```
                RESULTS
=======================================
Entrance Type: SQUARE HEADWALL (RCP)
Discharge is  32.00 cfs
 1  X  48 " RCP X  146  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   0.60
Inlet Control HW     2.40
Ke      0.50
H        0.21
Critical Depth  1.68
Dc+D/2          2.84
Tailwater       1.68
H0              2.84
L*S0            1.56
Outlet HW    1.49

INLET CONTROL  GOVERNS   HW=  2.40
Outlet Velocity  9.98 fps
```

C.P. 13: 48" RCP @ STA 196+00 (CAPACITY)

```
                    RESULTS
=======================================
Entrance Type: SQUARE HEADWALL (RCP)
Discharge is  85.00 cfs
 1  X  48 " RCP X  146  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   1.13
Inlet Control HW     4.52
Ke      0.50
H        1.50
Critical Depth  2.79
Dc+D/2          3.40
Tailwater       2.79
H0              3.40
L*S0            1.56
Outlet HW    3.34

INLET CONTROL  GOVERNS   HW=  4.52
Outlet Velocity 12.97 fps
```

C.P. 16: 2 – 36" RCP @ STA 189+38 (Q_{100})

```
                    RESULTS
=========================================
Entrance Type: SQUARE HEADWALL (RCP)
Discharge is  19.00 cfs
 2  X  36 " RCP X  130  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   0.44
Inlet Control HW     1.31
Ke       0.50
H         0.06
Critical Depth  0.97
Dc+D/2          1.99
Tailwater       0.97
H0              1.99
L*S0            2.59
Outlet HW   -0.54

INLET CONTROL  GOVERNS   HW=  1.31
Outlet Velocity  9.04 fps
```

C.P. 16: 2 – 36" RCP @ STA 189+38 (CAPACITY)

```
                    RESULTS
=========================================
Entrance Type: SQUARE HEADWALL (RCP)
Discharge is  86.00 cfs
 2  X  36 " RCP X  130  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   1.17
Inlet Control HW     3.50
Ke      0.50
H        1.32
Critical Depth  2.14
Dc+D/2          2.57
Tailwater       2.14
H0              2.57
L*S0            2.59
Outlet HW    1.30

INLET CONTROL  GOVERNS   HW=  3.50
Outlet Velocity 13.81 fps
```

C.P. 18: 3 – 8' X 4' RCBC @ STA 182+46 (Q_{100})

SOLUTION

==========

3 Cells X 4 High X 8 Wide
Discharge 326.00CFS
Length (Ft) 180 Slope 1.81%
Manning's 'n' 0.012
Entrance Type:
SQR. TOP EDGE, 30-75DEG. WW FLAIR
Inlet Control HW/D 0.69
Inlet Control HW = 2.77
Ke 0.40
H 0.34
Critical Depth 1.79
Dc+D/2 2.90
Tailwater 1.79
H0 2.90
L*S0 3.26
Outlet HW -0.02
INLET Control Governs HW= 2.77
Outlet Velocity 14.09fps
Normal Depth 0.96

C.P. 18: 3 – 8' X 4' RCBC @ STA 182+46 (CAPACITY)

SOLUTION

==========

3 Cells X 4 High X 8 Wide
Discharge 735.00CFS
Length (Ft) 180 Slope 1.81%
Manning's 'n' 0.012
Entrance Type:
SQR. TOP EDGE, 30-75DEG. WW FLAIR
Inlet Control HW/D 1.25
Inlet Control HW = 4.99
Ke 0.40
H 1.74
Critical Depth 3.08
Dc+D/2 3.54
Tailwater 3.08
H0 3.54
L*S0 3.26
Outlet HW 2.03
INLET Control Governs HW= 4.99
Outlet Velocity 18.49fps
Normal Depth 1.66

C.P. 19: 36" RCP @ STA 179+38 (Q_{100})

```
                    RESULTS
=======================================
Entrance Type: SQUARE HEADWALL (RCP)
Discharge is  10.00 cfs
 1  X  36 " RCP X  121  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   0.45
Inlet Control HW     1.36
Ke       0.50
H         0.07
Critical Depth  1.00
Dc+D/2          2.00
Tailwater       1.00
H0              2.00
L*S0            4.63
Outlet HW   -2.56

INLET CONTROL  GOVERNS   HW=  1.36
Outlet Velocity 11.55 fps
```

C.P. 19: 36" RCP @ STA 179+38 (CAPACITY)

```
                    RESULTS
=========================================
Entrance Type: SQUARE HEADWALL (RCP)
Discharge is  35.00 cfs
 1  X  36 " RCP X  121  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   1.00
Inlet Control HW     2.99
Ke       0.50
H         0.85
Critical Depth  1.92
Dc+D/2          2.46
Tailwater       1.92
H0              2.46
L*S0            4.63
Outlet HW   -1.32

INLET CONTROL  GOVERNS   HW=  2.99
Outlet Velocity 16.58 fps
```

C.P. 20: 36" RCP @ STA 172+74 (Q_{100})

```
                    RESULTS
=========================================
Entrance Type: SQUARE HEADWALL (RCP)
Discharge is  16.00 cfs
 1  X  36 " RCP X  149  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   0.61
Inlet Control HW     1.83
Ke      0.50
H        0.19
Critical Depth  1.28
Dc+D/2          2.14
Tailwater       1.28
H0              2.14
L*S0            1.74
Outlet HW    0.59

INLET CONTROL  GOVERNS   HW=  1.83
Outlet Velocity  8.69 fps
```

C.P. 20: 36" RCP @ STA 172+74 (CAPACITY)

```
                    RESULTS
=======================================
Entrance Type: SQUARE HEADWALL (RCP)
Discharge is  25.00 cfs
 1  X  36 " RCP X  149  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   0.80
Inlet Control HW     2.41
Ke      0.50
H        0.47
Critical Depth  1.61
Dc+D/2          2.31
Tailwater       1.61
H0              2.31
L*S0            1.74
Outlet HW    1.03

INLET CONTROL  GOVERNS   HW=  2.41
Outlet Velocity  9.84 fps
```

C.P. 21: 36" RCP @ STA 168+82 (Q_{100})

RESULTS

```
==========================================
Entrance Type: SQUARE HEADWALL (RCP)
Discharge is  25.00 cfs
 1  X  36 " RCP X  210  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   0.80
Inlet Control HW     2.41
Ke      0.50
H        0.54
Critical Depth  1.61
Dc+D/2          2.31
Tailwater       1.61
H0              2.31
L*S0            8.97
Outlet HW   -6.12

INLET CONTROL  GOVERNS   HW=  2.41
Outlet Velocity 15.68 fps
```

C.P. 21: 36" RCP @ STA 168+82 (CAPACITY)

RESULTS

```
==========================================
Entrance Type: SQUARE HEADWALL (RCP)
Discharge is  61.00 cfs
 1  X  36 " RCP X  210  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   1.65
Inlet Control HW     4.95
Ke      0.50
H        3.23
Critical Depth  2.52
Dc+D/2          2.76
Tailwater       2.52
H0              2.76
L*S0            8.97
Outlet HW   -2.98

INLET CONTROL  GOVERNS   HW=  4.95
Outlet Velocity 20.06 fps
```

C.P. 24: 2 – 10' X 5' RCBC @ STA 158+88 (Q_{100})

SOLUTION

==========

2 Cells X 5 High X 10 Wide
Discharge 393.00CFS
Length (Ft) 298 Slope 2.13%
Manning's 'n' 0.012
Entrance Type:
SQR. TOP EDGE, NORMAL HDWL TO 45 SK
Inlet Control HW/D 0.78
Inlet Control HW = 3.88
Ke 0.20
H 0.44
Critical Depth 2.29
Dc+D/2 3.65
Tailwater 2.29
H0 3.65
L*S0 6.35
Outlet HW -2.26
INLET Control Governs HW= 3.88
Outlet Velocity 17.18fps
Normal Depth 1.14

C.P. 24: 2 – 10' X 5' RCBC @ STA 158+88 (CAPACITY)

SOLUTION

==========

2 Cells X 5 High X 10 Wide
Discharge 410.00CFS
Length (Ft) 298 Slope 2.13%
Manning's 'n' 0.012
Entrance Type:
SQR. TOP EDGE, NORMAL HDWL TO 45 SK
Inlet Control HW/D 0.80
Inlet Control HW = 3.99
Ke 0.20
H 0.48
Critical Depth 2.36
Dc+D/2 3.68
Tailwater 2.36
H0 3.68
L*S0 6.35
Outlet HW -2.19
INLET Control Governs HW= 3.99
Outlet Velocity 17.46fps
Normal Depth 1.17

C.P. 25: 2 – 8' X 5' RCBC @ STA 149+39 (Q_{100})

SOLUTION

==========

2 Cells X 5 High X 8 Wide
Discharge 435.00CFS
Length (Ft) 144 Slope 1.00%
Manning's 'n' 0.012
Entrance Type:
SQR. TOP EDGE, 30-75DEG. WW FLAIR
Inlet Control HW/D 0.88
Inlet Control HW = 4.40
Ke 0.40
H 0.80
Critical Depth 2.85
Dc+D/2 3.92
Tailwater 2.85
H0 3.92
L*S0 1.44
Outlet HW 3.28
INLET Control Governs HW= 4.40
Outlet Velocity 14.53fps
Normal Depth 1.87

C.P. 25: 2 – 8' X 5' RCBC @ STA 149+39 (CAPACITY)

SOLUTION

==========

2 Cells X 5 High X 8 Wide
Discharge 655.00CFS
Length (Ft) 144 Slope 1.00%
Manning's 'n' 0.012
Entrance Type:
SQR. TOP EDGE, 30-75DEG. WW FLAIR
Inlet Control HW/D 1.20
Inlet Control HW = 6.00
Ke 0.40
H 1.81
Critical Depth 3.74
Dc+D/2 4.37
Tailwater 3.74
H0 4.37
L*S0 1.44
Outlet HW 4.74
INLET Control Governs HW= 6.00
Outlet Velocity 16.47fps
Normal Depth 2.49

C.P. 26: 36" RCP @ STA 144+62 (Q_{100})

```
                    RESULTS
==========================================
Entrance Type: SQUARE HEADWALL (RCP)
Discharge is  18.00 cfs
 1  X  36 " RCP X  126  FT. LONG
Manning's  'n' 0.012
Inlet  Control HW/D   0.66
Inlet Control HW     1.97
Ke       0.50
H         0.23
Critical Depth  1.36
Dc+D/2          2.18
Tailwater       1.36
H0              2.18
L*S0            4.38
Outlet HW   -1.98

INLET CONTROL  GOVERNS   HW=  1.97
Outlet Velocity 13.26 fps
```

C.P. 26: 36" RCP @ STA 144+62 (CAPACITY)

RESULTS

==========

Entrance Type: SQUARE HEADWALL (RCP)
Discharge is 71.00 cfs
1 X 36 " RCP X 126 FT. LONG
Manning's 'n' 0.012
Inlet Control HW/D 2.00
Inlet Control HW 5.99
Ke 0.50
H 3.57
Critical Depth 2.67
Dc+D/2 2.84
Tailwater 2.67
H0 2.84
L*S0 4.38
Outlet HW 2.02

INLET CONTROL GOVERNS HW= 5.99
Outlet Velocity 19.29 fps

C.P. 32: 13 – 38" X 24" HERCP @ STA 107+87

PROJECT: CORTARO FARMS ROAD

STATION: 107+87

SHEET 1 OF 1

CULVERT DESIGN FORM

DESIGNER / DATE: SP / 10/02

REVIEWER / DATE: ____ / ____

SEE ADD'L SHTS.

HYDROLOGICAL DATA

☒ METHOD: HEC-1 (REFERENCE 1)

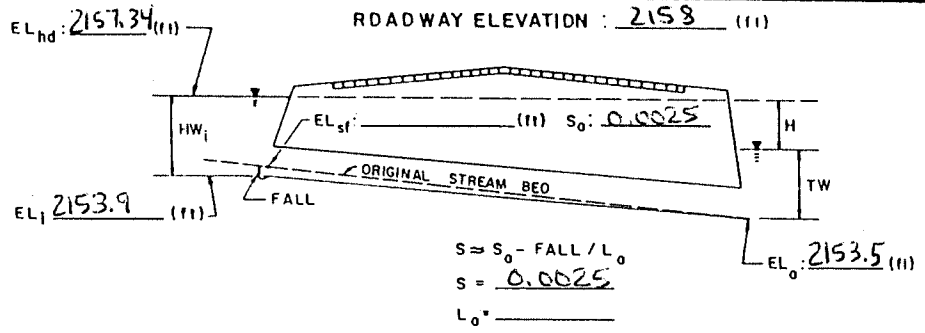
☐ DRAINAGE AREA: ____ ☐ STREAM SLOPE: ____

☐ CHANNEL SHAPE: ____

☐ ROUTING ____ ☐ OTHER ____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
25	481	



CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	k_e	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
13 - 38" X 24" HERCP	481	37	1.72	3.44	—	57.34	—	1.72	1.86	1.86	0.5	2.4	55.90	57.34	7.5	

TECHNICAL FOOTNOTES:

(1) USE O/NB FOR BOX CULVERTS

(2) HW_i/D = HW/O OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + O/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f CULVERT FACE
hd. DESIGN HEADWATER
hi HEADWATER IN INLET CONTROL
ho HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf STREAMBED AT CULVERT FACE
tw TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

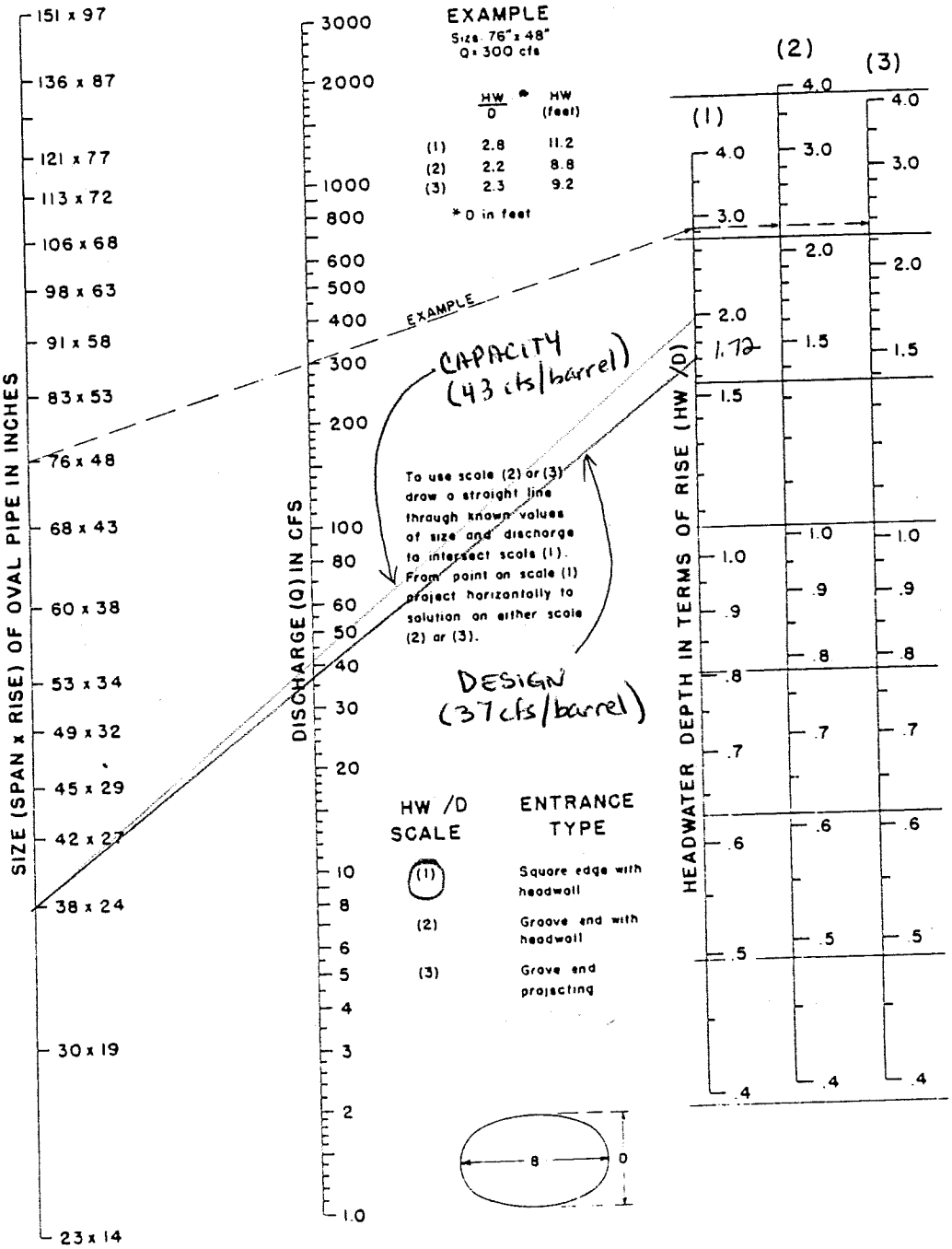
SIZE: ____

SHAPE: ____

MATERIAL: ____ n: ____

ENTRANCE: ____

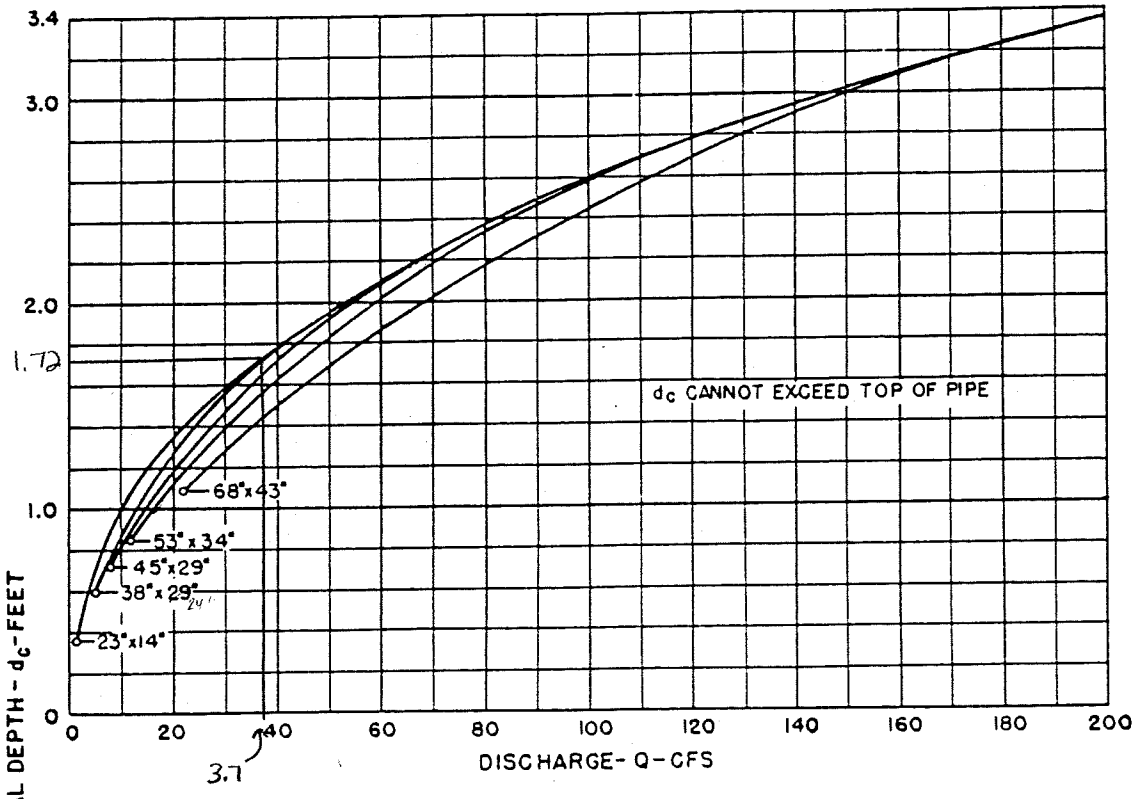
CHART 29

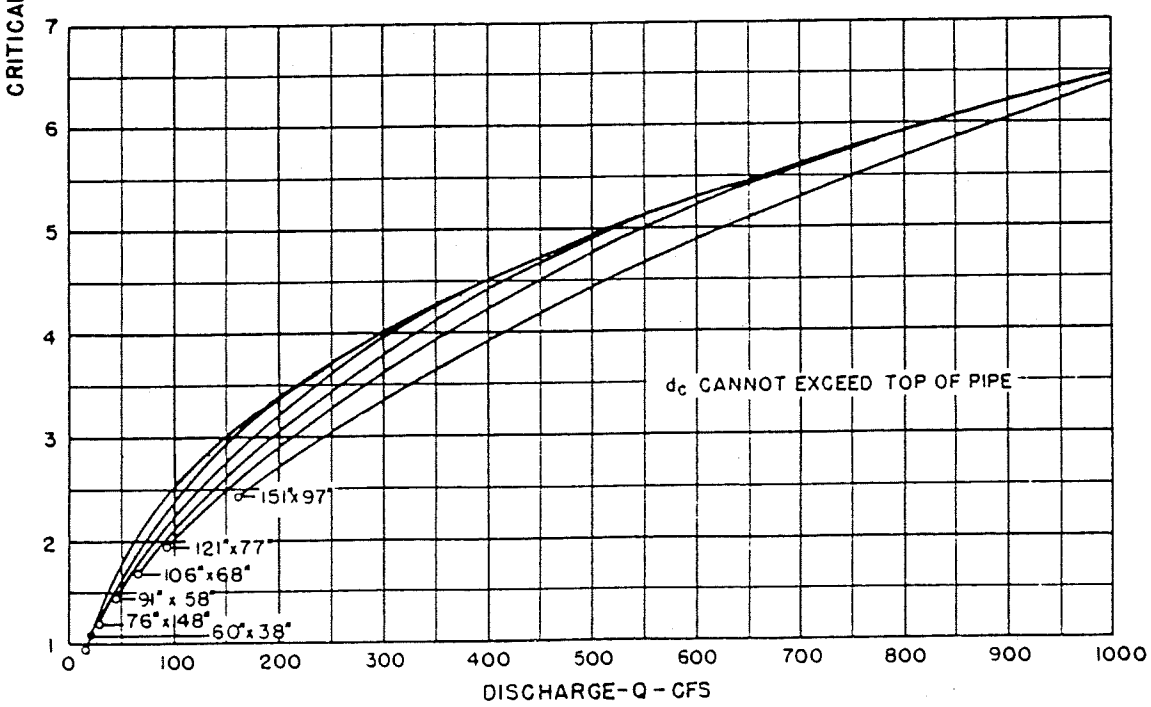


HEADWATER DEPTH FOR OVAL CONCRETE PIPE CULVERTS LONG AXIS HORIZONTAL WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN 1963

CHART 31





BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
OVAL CONCRETE PIPE
LONG AXIS HORIZONTAL

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 22, 2002

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.5 ⇒ Equivalent 38" x 24" Diameter
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.5
Culvert Length (ft)	158.0
Invert Elevation at Downstream end of Culvert (ft)	2,153.5
Invert Elevation at Upstream end of Culvert (ft)	2,153.9
Culvert Slope (ft/ft)	0.0025
Starting Flow Rate (cfs)	1.0
Incremental Flow Rate (cfs)	6.0
Ending Flow Rate (cfs)	61.0
Starting Tailwater Depth (ft)	1.86
Incremental Tailwater Depth (ft)	0.0
Ending Tailwater Depth (ft)	1.86

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
1.0	1.86	0.43	1.46	0.36	0.32	1.86	0.26	
7.0	1.86	1.22	1.62	0.96	0.88	1.86	1.79	
13.0	1.86	1.75	1.96	1.37	1.21	1.86	3.32	
19.0	1.86	2.24	2.39	1.77	1.48	1.86	4.85	
25.0	1.86	2.72	2.86	2.5	1.7	1.86	6.38	
31.0	1.86	3.26	2.83	2.5	1.9	2.5	6.32	
37.0	1.86	3.93	3.42	2.5	2.06	2.5	7.54	⇒ Q_{des}
43.0	1.86	4.73	4.04	2.5	2.19	2.5	8.76	⇒ Q_{cap}
49.0	1.86	5.64	4.71	2.5	2.29	2.5	9.98	
55.0	1.86	6.67	5.44	2.5	2.35	2.5	11.2	
61.0	1.86	7.82	6.24	2.5	2.4	2.5	12.43	

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POST-DEVELOPMENT FLOODPLAIN CALCULATIONS

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Worksheet	Cross Section 2-A (Developed)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.020000	ft/ft
Discharge	511.00	cfs

Options	
Current Roughness Method	mproved Lotter's Method
Open Channel Weighting Method	mproved Lotter's Method
Closed Channel Weighting Metho	Horton's Method

Results		
Mannings Coefficient	0.035	
Water Surface Elevation	2,343.25	ft
Elevation Range	2,341.00 to 2,348.00	
Flow Area	88.3	ft²
Wetted Perimeter	93.30	ft
Top Width	92.99	ft
Actual Depth	2.25	ft
Critical Elevation	2,343.29	ft
Critical Slope	0.018179	ft/ft
Velocity	5.79	ft/s
Velocity Head	0.52	ft
Specific Energy	2,343.77	ft
Froude Number	1.05	
Flow Type	Supercritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
1+00	2+65	0.035

Natural Channel Points

Station (ft)	Elevation (ft)
1+00	2,344.00
1+70	2,343.00
2+15	2,342.00
2+25	2,341.00
2+35	2,341.00
2+40	2,342.00
2+65	2,348.00

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37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Worksheet	Cross Section 2-A2 (Developed
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.014000	ft/ft
Discharge	511.00	cfs

Options	
Current Roughness Method	mproved Lotter's Method
Open Channel Weighting Method	mproved Lotter's Method
Closed Channel Weighting Metho	Horton's Method

Results		
Mannings Coefficient	0.035	
Water Surface Elevation	2,340.92	ft
Elevation Range	2,339.00 to 2,346.00	
Flow Area	114.1	ft²
Wetted Perimeter	137.31	ft
Top Width	137.01	ft
Actual Depth	1.92	ft
Critical Elevation	2,340.84	ft
Critical Slope	0.019211	ft/ft
Velocity	4.48	ft/s
Velocity Head	0.31	ft
Specific Energy	2,341.23	ft
Froude Number	0.86	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
1+00	2+74	0.035
2+74	2+95	0.022

Natural Channel Points

Station (ft)	Elevation (ft)
1+00	2,342.00
1+37	2,341.00
1+77	2,340.00
1+83	2,339.00
1+90	2,340.00
2+74	2,340.00
2+95	2,346.00

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Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Worksheet	Cross Section 2-B2 (Developed
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.083300	ft/ft
Discharge	511.00	cfs

Options	
Current Roughness Method	mproved Lotter's Method
Open Channel Weighting Method	mproved Lotter's Method
Closed Channel Weighting Metho	Horton's Method

Results		
Mannings Coefficient	0.030	
Water Surface Elevation	2,343.86	ft
Elevation Range	2,342.94 to 2,347.00	
Flow Area	43.0	ft²
Wetted Perimeter	56.80	ft
Top Width	56.71	ft
Actual Depth	0.92	ft
Critical Elevation	2,344.49	ft
Critical Slope	0.012443	ft/ft
Velocity	11.88	ft/s
Velocity Head	2.19	ft
Specific Energy	2,346.05	ft
Froude Number	2.40	
Flow Type	Supercritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
1+00	2+20	0.035
2+20	3+13	0.030
3+13	4+25	0.035

Natural Channel Points

Station (ft)	Elevation (ft)
1+00	2,347.00
2+20	2,346.00
2+30	2,345.20
2+50	2,342.94
2+87	2,342.94
3+13	2,345.00
3+90	2,345.00
4+25	2,346.00

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Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Worksheet	Cross Section 11-A2 (Developed
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.006900	ft/ft
Discharge	120.00	cfs

Options	
Current Roughness Method	mproved Lotter's Method
Open Channel Weighting Method	mproved Lotter's Method
Closed Channel Weighting Metho	Horton's Method

Results		
Mannings Coefficient	0.020	
Water Surface Elevation	2,319.12	ft
Elevation Range	2,318.08 to 2,325.00	
Flow Area	20.9	ft²
Wetted Perimeter	23.22	ft
Top Width	22.83	ft
Actual Depth	1.04	ft
Critical Elevation	2,319.15	ft
Critical Slope	0.006079	ft/ft
Velocity	5.75	ft/s
Velocity Head	0.51	ft
Specific Energy	2,319.63	ft
Froude Number	1.06	
Flow Type	Supercritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
1+00	2+18	0.035
2+18	2+76	0.020
2+76	2+86	0.035

Natural Channel Points

Station (ft)	Elevation (ft)
1+00	2,325.00
1+90	2,324.00
2+18	2,323.00
2+39	2,321.77
2+49	2,318.08
2+66	2,318.08
2+76	2,321.77
2+86	2,323.00

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Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Worksheet	Cross Section 18-C2 (Developed
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.045000	ft/ft
Discharge	326.00	cfs

Options	
Current Roughness Method	mproved Lotter's Method
Open Channel Weighting Method	mproved Lotter's Method
Closed Channel Weighting Metho	Horton's Method

Results		
Mannings Coefficient	0.021	
Water Surface Elevation	2,289.59	ft
Elevation Range	2,288.84 to 2,295.00	
Flow Area	30.0	ft²
Wetted Perimeter	48.43	ft
Top Width	48.22	ft
Actual Depth	0.75	ft
Critical Elevation	2,290.10	ft
Critical Slope	0.006550	ft/ft
Velocity	10.86	ft/s
Velocity Head	1.83	ft
Specific Energy	2,291.42	ft
Froude Number	2.43	
Flow Type	Supercritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
1+00	1+51	0.035
1+51	1+83	0.020
1+83	2+27	0.035

Natural Channel Points

Station (ft)	Elevation (ft)
1+00	2,292.00
1+47	2,291.00
1+51	2,288.84
1+83	2,288.84
2+06	2,290.00
2+27	2,295.00

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Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Worksheet	Cross Section 24-B2 (Developed
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.083300	ft/ft
Discharge	393.00	cfs

Options	
Current Roughness Method	mproved Lotter's Method
Open Channel Weighting Method	mproved Lotter's Method
Closed Channel Weighting Metho	Horton's Method

Results		
Mannings Coefficient	0.030	
Water Surface Elevation	2,234.82	ft
Elevation Range	2,233.93 to 2,239.00	
Flow Area	34.8	ft²
Wetted Perimeter	48.64	ft
Top Width	48.54	ft
Actual Depth	0.89	ft
Critical Elevation	2,235.39	ft
Critical Slope	0.013055	ft/ft
Velocity	11.31	ft/s
Velocity Head	1.99	ft
Specific Energy	2,236.80	ft
Froude Number	2.36	
Flow Type	Supercritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
1+00	2+15	0.035
2+15	2+45	0.030
2+45	3+15	0.035

Natural Channel Points

Station (ft)	Elevation (ft)
1+00	2,239.00
1+36	2,238.00
1+70	2,237.00
2+15	2,233.93
2+45	2,233.93
2+58	2,236.00
2+83	2,237.00
3+15	2,238.00

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Cortaro Farms - Floodplain Analysis
Worksheet for Irregular Channel

Project Description	
Worksheet	Cross Section 25-C2 (Developed
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.083300	ft/ft
Discharge	435.00	cfs

Options	
Current Roughness Method	mproved Lotter's Method
Open Channel Weighting Method	mproved Lotter's Method
Closed Channel Weighting Metho	Horton's Method

Results		
Mannings Coefficient	0.027	
Water Surface Elevation	2,207.90	ft
Elevation Range	2,206.69 to 2,215.00	
Flow Area	27.4	ft²
Wetted Perimeter	27.65	ft
Top Width	27.33	ft
Actual Depth	1.21	ft
Critical Elevation	2,208.91	ft
Critical Slope	0.009012	ft/ft
Velocity	15.89	ft/s
Velocity Head	3.92	ft
Specific Energy	2,211.82	ft
Froude Number	2.80	
Flow Type	Supercritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
1+00	2+15	0.035
2+15	2+33	0.025
2+33	2+98	0.035

Natural Channel Points

Station (ft)	Elevation (ft)
1+00	2,215.00
1+40	2,214.00
1+78	2,213.00
1+89	2,215.00
2+15	2,206.69
2+33	2,206.69
2+62	2,213.00
2+91	2,214.00
2+98	2,215.00

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DRAINAGE SWALE CALCULATIONS

Cortaro Farms Roadside Drainage
Worksheet for Triangular Channel

Project Description	
Worksheet	Drainage Swale 1
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.005000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Discharge	22.00	cfs

Results		
Depth	1.59	ft
Flow Area	7.6	ft²
Wetted Perimeter	10.05	ft
Top Width	9.54	ft
Critical Depth	1.27	ft
Critical Slope	0.016355	ft/ft
Velocity	2.90	ft/s
Velocity Head	0.13	ft
Specific Energy	1.72	ft
Froude Number	0.57	
Flow Type	Subcritical	

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Cortaro Farms Roadside Drainage
Worksheet for Triangular Channel

Project Description	
Worksheet	Drainage Swale 3
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.015000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Discharge	14.00	cfs

Results		
Depth	1.09	ft
Flow Area	3.6	ft^2
Wetted Perimeter	6.91	ft
Top Width	6.55	ft
Critical Depth	1.06	ft
Critical Slope	0.017371	ft/ft
Velocity	3.91	ft/s
Velocity Head	0.24	ft
Specific Energy	1.33	ft
Froude Number	0.93	
Flow Type	Subcritical	

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Cortaro Farms Road
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Drainage Swale 4 (Hartman to Exist. Basin)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.020	
Slope	0.003000	ft/ft
Depth	1.75	ft
Left Side Slope	0.00	H : V
Right Side Slope	1.00	H : V
Bottom Width	3.00	ft

Results		
Discharge	26.45	cfs
Flow Area	6.8	ft²
Wetted Perimeter	7.22	ft
Top Width	4.75	ft
Critical Depth	1.25	ft
Critical Slope	0.009072	ft/ft
Velocity	3.90	ft/s
Velocity Head	0.24	ft
Specific Energy	1.99	ft
Froude Number	0.58	
Flow Type	Subcritical	

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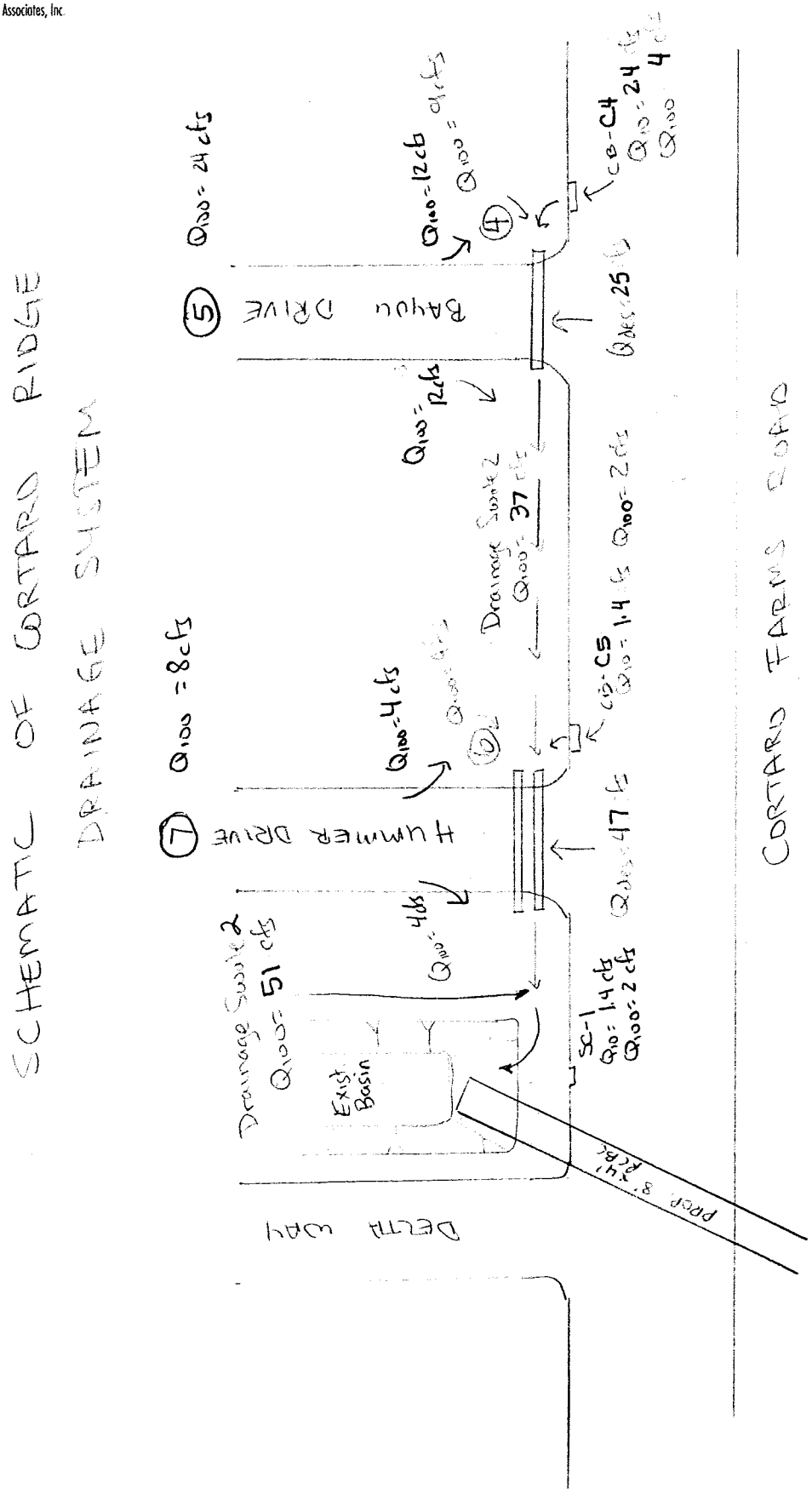
CORTARO RIDGE
DRAINAGE SWALE / DRIVEWAY CULVERT ANALYSIS

MMLA
McGovern MacVittie Lodge & Associates, Inc.

PROJECT NAME: Cortaro Farms Road

PROJECT NUMBER: 991067-01 MADE BY: SP DATE: 5/1/02

REFERENCE: _____ CHECKED BY: _____ DATE: _____



Cortaro Farms Road - Cortaro Ridge Drainage System
Worksheet for Triangular Channel

Project Description	
Worksheet	Drainage Swale 2 (Bayou to Hummer)
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.005000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Discharge	37.00	cfs

Results		
Depth	1.93	ft
Flow Area	11.2	ft²
Wetted Perimeter	12.22	ft
Top Width	11.59	ft
Critical Depth	1.57	ft
Critical Slope	0.015260	ft/ft
Velocity	3.30	ft/s
Velocity Head	0.17	ft
Specific Energy	2.10	ft
Froude Number	0.59	
Flow Type	Subcritical	

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Cortaro Farms Road - Cortaro Ridge Drainage System
Worksheet for Triangular Channel

Project Description	
Worksheet	Drainage Swale 2 (Hummer to Exist. Basin
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.005000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Discharge	51.00	cfs

Results		
Depth	2.18	ft
Flow Area	14.2	ft²
Wetted Perimeter	13.78	ft
Top Width	13.07	ft
Critical Depth	1.78	ft
Critical Slope	0.014621	ft/ft
Velocity	3.58	ft/s
Velocity Head	0.20	ft
Specific Energy	2.38	ft
Froude Number	0.60	
Flow Type	Subcritical	

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

May 1, 2002

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Culvert Diameter (ft)	2.0
FHWA Chart Number	1
FHWA Scale Number (Type of Culvert Entrance)	1
Manning's Roughness Coefficient (n-value)	0.012
Entrance Loss Coefficient of Culvert Opening	0.2
Culvert Length (ft)	60.0
Invert Elevation at Downstream end of Culvert (ft)	0.0
Invert Elevation at Upstream end of Culvert (ft)	0.3
Culvert Slope (ft/ft)	0.005
Starting Flow Rate (cfs)	25.0
Incremental Flow Rate (cfs)	2.0
Ending Flow Rate (cfs)	47.0
Starting Tailwater Depth (ft)	1.8
Incremental Tailwater Depth (ft)	0.03
Ending Tailwater Depth (ft)	2.13

COMPUTATION RESULTS

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)	
25.0	1.8	3.86	2.42	2.0	1.76	2.0	7.96	→ Culvert @ Bayou
27.0	1.83	4.27	2.58	2.0	1.81	2.0	8.59	
29.0	1.86	4.73	2.75	2.0	1.85	2.0	9.23	
31.0	1.89	5.21	2.92	2.0	1.88	2.0	9.87	
33.0	1.92	5.73	3.1	2.0	1.9	2.0	10.5	
35.0	1.95	6.27	3.29	2.0	1.92	2.0	11.14	
37.0	1.98	6.86	3.49	2.0	1.94	2.0	11.78	
39.0	2.01	7.47	6.1	2.0	1.95	2.0	12.41	
41.0	2.04	8.11	6.6	2.0	1.96	2.0	13.05	
43.0	2.07	8.79	7.11	2.0	1.96	2.0	13.69	
45.0	2.1	9.5	7.65	2.0	1.97	2.0	14.32	
47.0	2.13	10.24	8.21	2.0	1.97	2.0	14.96	→ Culvert @ Hummer

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HARTMAN LANE
CHANNEL CALCULATIONS

Cortaro Farms Road
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Hartman Collector Channel.
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.020	
Slope	0.018100	ft/ft
Left Side Slope	1.00	H : V
Right Side Slope	1.00	H : V
Bottom Width	12.00	ft
Discharge	380.00	cfs

Results		
Depth	2.00	ft
Flow Area	28.0	ft²
Wetted Perimeter	17.65	ft
Top Width	16.00	ft
Critical Depth	2.89	ft
Critical Slope	0.005137	ft/ft
Velocity	13.59	ft/s
Velocity Head	2.87	ft
Specific Energy	4.87	ft
Froude Number	1.81	
Flow Type	Supercritical	

SEE SHEET CD6
MATCH LINE STA 211+50

20 0 10 20 30 40

Sta 131+14.84, 80.46'Lt Cortaro Farms Rd ℄=
Sta 211+75.00, 0.46'Lt RCBC Cst ℄
New Cleanout Manhole

PC 211+79.17

New 2-10'x4'x2670'
RCBC Cst ℄

213+00

214+00

PT 212+13.98

PC 213+87.02

New R/W

2165

CORTARO FARMS ROAD

2" STL

Cortaro Farms Road
Survey & Cst ℄

CB3

Hartman Lane
Survey & Cst ℄

N00°03'38W

CB4

Exst R/W

N00°34'59"W

HARTMAN LANE

Marana Town Limits

215+00

12" PVC

Sta 132+12.58 Cortaro Farms Road=
Sta 50+00.00 Hartman Lane

Sta 46+42.28, 37.89'Lt Hartman Ln
Sta 215+20.00 RCBC

PT 215+03.33

N60°30'37"E

Gunite Bank Protection
(See Note 2)

Angle Point
Sta 45+70.06, 47' Lt Hartman Ln=
Sta 215+98.77 Channel

New Channel
See Sheet CD8

Inlet Headwall & Wings
ADOT Std B-04.70
30° Skew (See Note 1)

Sta 46+19.72, 52.71'Lt Hartman Ln=
Sta 215+48.78 Channel

MATCH LINE STA 216+00
SEE SHEET CD8

CB3 CURVE DATA
PI Sta 212+38.63
Δ=89°28'40" Lt
D=95°29'35"
R= 60.00'
L= 93.70'
T= 59.46

CB4 CURVE DATA
PI Sta 214+51.29
Δ=60°34'15" Rt
D=52°05'13"
R=110.00'
L=116.29'
T= 64.24'

NOTES:

1. Wingwalls must match existing ground and channel walls
2. 6" thick Gunite bank protection. 1:1 slope from bottom of drop inlet to match existing ground

211+00 212+00 213+00 214+00 215+00 216+00

Sta 215+48.78 Channel=
Sta 46+19.72, 52.71'Lt Hartman Ln
Begin Channel
Elev=2163.47

Sta 215+39.03 CBC=
Sta 46+28.92, 49.66'Lt Hartman Ln
End Drop Inlet
Inv Elev=2158.94

Sta 211+75.00, 0.46'Lt RCBC Cst ℄=
Sta 131+14.84, 80.46'Lt Cortaro Farms Rd ℄
New Cleanout Manhole

Hartman Ln
Finished Grade

Exst Ground

New RCBC

2170

2160

2150

1.81%

Inv Elev=2158.16

0.20%

0.20%

6"

Sta 215+20.00=
Sta 46+42.28, 37.89' Lt Hartman Ln
Inv Elev=2158.90

2670'

SEE SHEET CD6
MATCH LINE STA 211+50

MATCH LINE STA 216+00
SEE SHEET CD8

Q_{100} =486 cfs
Q_{CAP} =543 cfs
DHW = 4.1'

V_{100} =9.2 fps
V_{CAP} =9.6 fps

New 2-10'x4'x2670' RCBC

CALL FOR THE BLUE STAKES
1-800-STAKE-IT
BLUE STAKE CENTER
CALL COLLECT

VIEW NAME: M:\99867-81\Sheets\Drainage\drn_ppch7.dgn
10/24/2002 09:17:43 AM

SCALES
HORIZ. 1"=20'
VERT. 1"=4'

SHEET CD7 OF 23
SHEET 144 OF 381

PIMA COUNTY DEPARTMENT OF TRANSPORTATION AND FLOOD CONTROL DISTRICT

KURT WEINRICH, P.E., DIRECTOR

NO.	REVISION DESCRIPTION	DIV.- SECT. ENGR.	DATE

	DATE
DESIGNED KKH	9-02
DRAWN ODL	9-02
CHECKED BAB	9-02
PROJ. ENGR. BAB	9-02

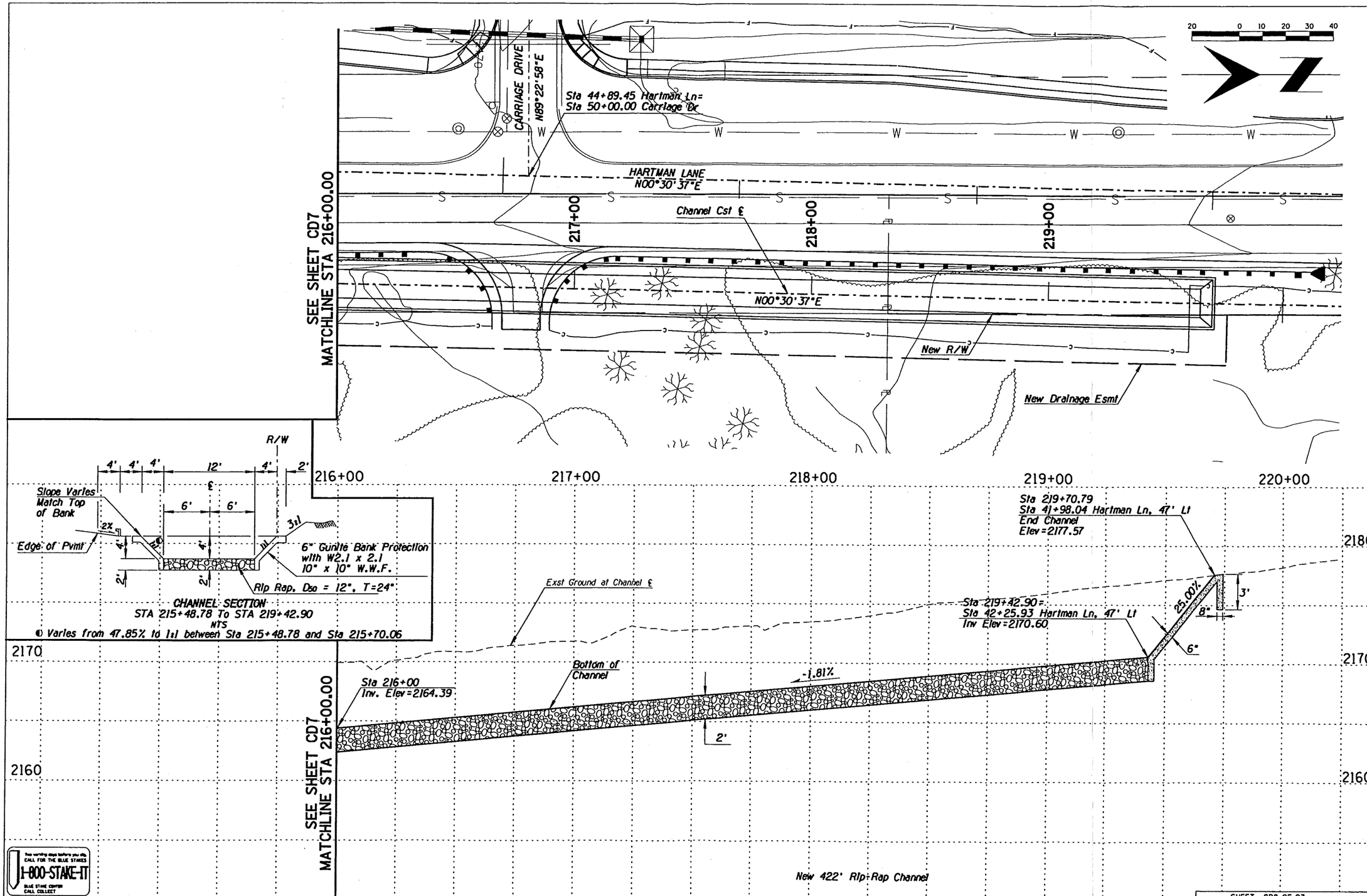
ROADWAY IMPROVEMENT PLANS
FOR
CORTARO FARMS ROAD
RCBC PLAN AND PROFILE
STA 211+50.00 - STA 216+00.00

PIMA COUNTY W.O. 4TCFIT

SCHEMATIC NOT FOR CONSTRUCTION

800 East Wetmore Road, Suite 110
Tucson, Arizona 85705
Telephone (520) 292-2300
Fax (520) 292-1290

MMLA
Marker Matkin Lindsey & Assoc.
Engineering • Planning • Environmental & Surveying • Water Resources



SCALES	HORIZ. 1"=20'	SHEET CD8 OF 23
	VERT. 1"=4'	SHEET 145 OF 381

PIMA COUNTY DEPARTMENT OF TRANSPORTATION AND FLOOD CONTROL DISTRICT

KURT WEINRICH, P.E., DIRECTOR

NO.	REVISION DESCRIPTION	DIV.- SECT. ENGR.	DATE

ROADWAY IMPROVEMENT PLANS
FOR
CORTARO FARMS ROAD
DRAINAGE CHANNEL - PLAN AND PROFILE
STA 216+00.00 - 220+00.00

		DATE
DESIGNED	KKH	09-02
DRAWN	ODL	09-02
CHECKED	BAB	09-02
PROJ. ENGR.	BAB	09-02

PIMA COUNTY W.O. 4TCFIT

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NOT FOR
CONSTRUCTION

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Midwestern Mechanical Laboratory, Inc.
Engineering • Planning • Environmental • Surveying • Water Resources

800 East Wetmore Road, Suite 110
Tucson, Arizona 85719
Telephone (520) 292-2300
Fax (520) 292-1290

VIEW NAME: W:\99067-01\Sheets\Drainage\drn_ppch8.dgn
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EROSION PROTECTION CALCULATIONS

CORTARO FARMS ROAD - PLUNGE BASIN SIZING

C.P.	Culvert Type	Q/cell	V_{100} (fps)	TW (ft)	Froude #	L/yi (see Figures 8.5&8.6)	L = Length of Jump (ft)	Plunge Basin Dimensions	Calculated d_{50}* (in)	Design d_{50} (in)
2	156' -2-12'x5' RCBC	256	14.5	2.42	1.6	6.3	15	21' L x 56' W x 1.5' D	11.69	12
13	146'-48" RCP	32	10.0	1.68	1.4	7.1	12	18' L x 12' W x 1.0' D	1.43	6
16	130'-2-36" RCP	9.5	9.0	0.97	1.6	8	8	15' L x 20' W x 1.0' D	0.72	6
18	180' -3-8'x4' RCBC	109	14.1	1.79	1.9	8.8	16	18' L x 58' W x 1.0' D	6.82	9
19	121'-36" RCP	10	11.6	1	2.0	12	12	15' L x 12' W x 1.0' D	0.75	6
20	149'-36" RCP	16	8.7	1.28	1.4	7.1	9	15' L x 12' W x 1.0' D	1.09	6
21	210'-36" RCP	25	15.7	1.61	2.2	13	21	21' L x 18' W x 2.0' D	1.57	6
24	298' -2-10'x5' RCBC	197	17.2	2.29	2.0	10	23	24' L x 51' W x 1.5' D	8.72	9
25	144' -2-8'x5' RCBC	218	14.5	2.85	1.5	5.8	17	21' L x 40' W x 1.0' D	8.02	9
26	126'-36" RCP	18	13.3	1.36	2.0	12	16	18' L x 15' W x 1.5' D	1.20	6

*$d_{50} = (0.0125\ Dc^2/TW\ R^{1.33})^* 12$

where D_c = culvert height (ft)

TW = Tailwater depth (ft)

$R = Q/D_c^{2.5}$

MMLA

McGovern MacVittie Lodge & Associates, Inc.

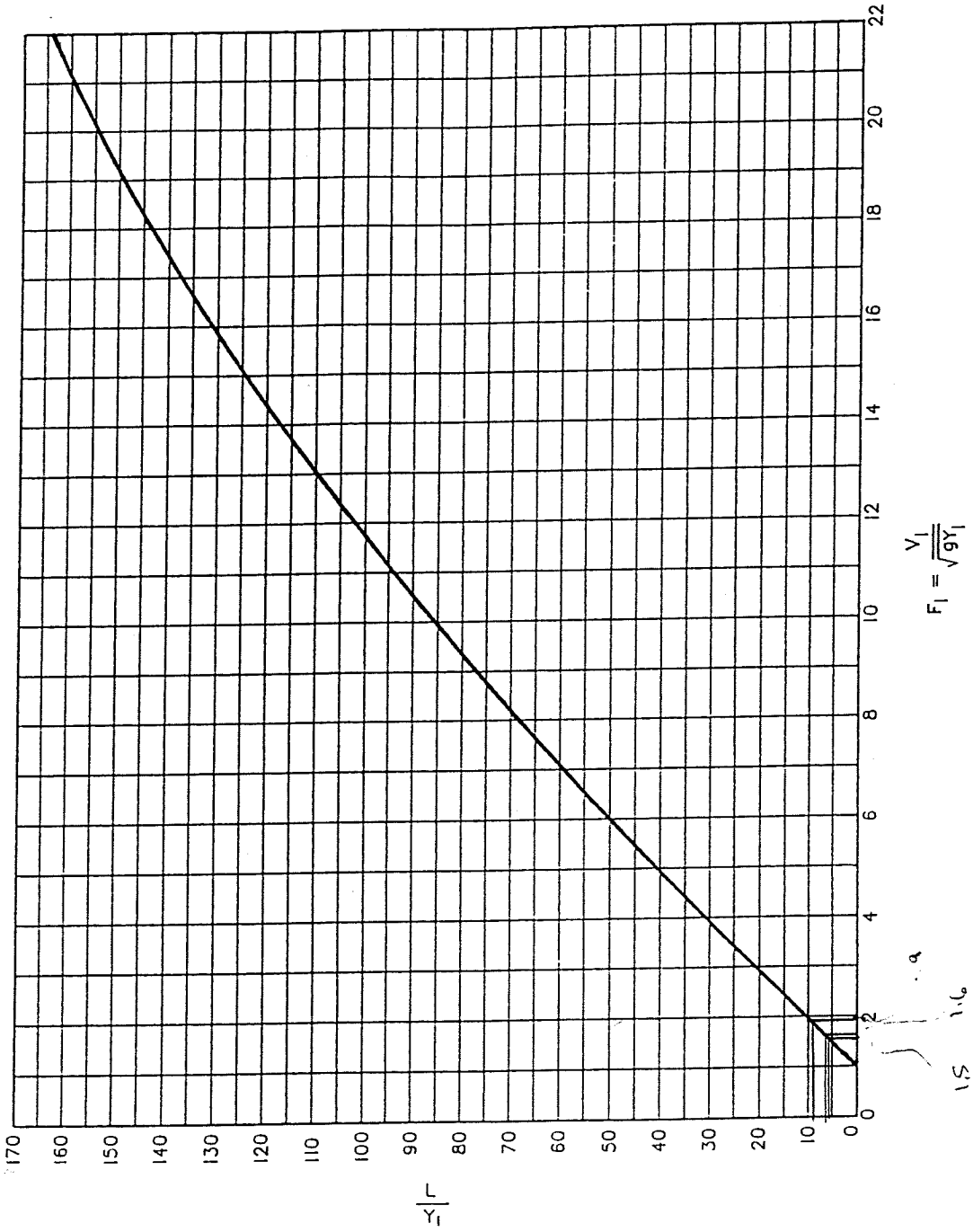
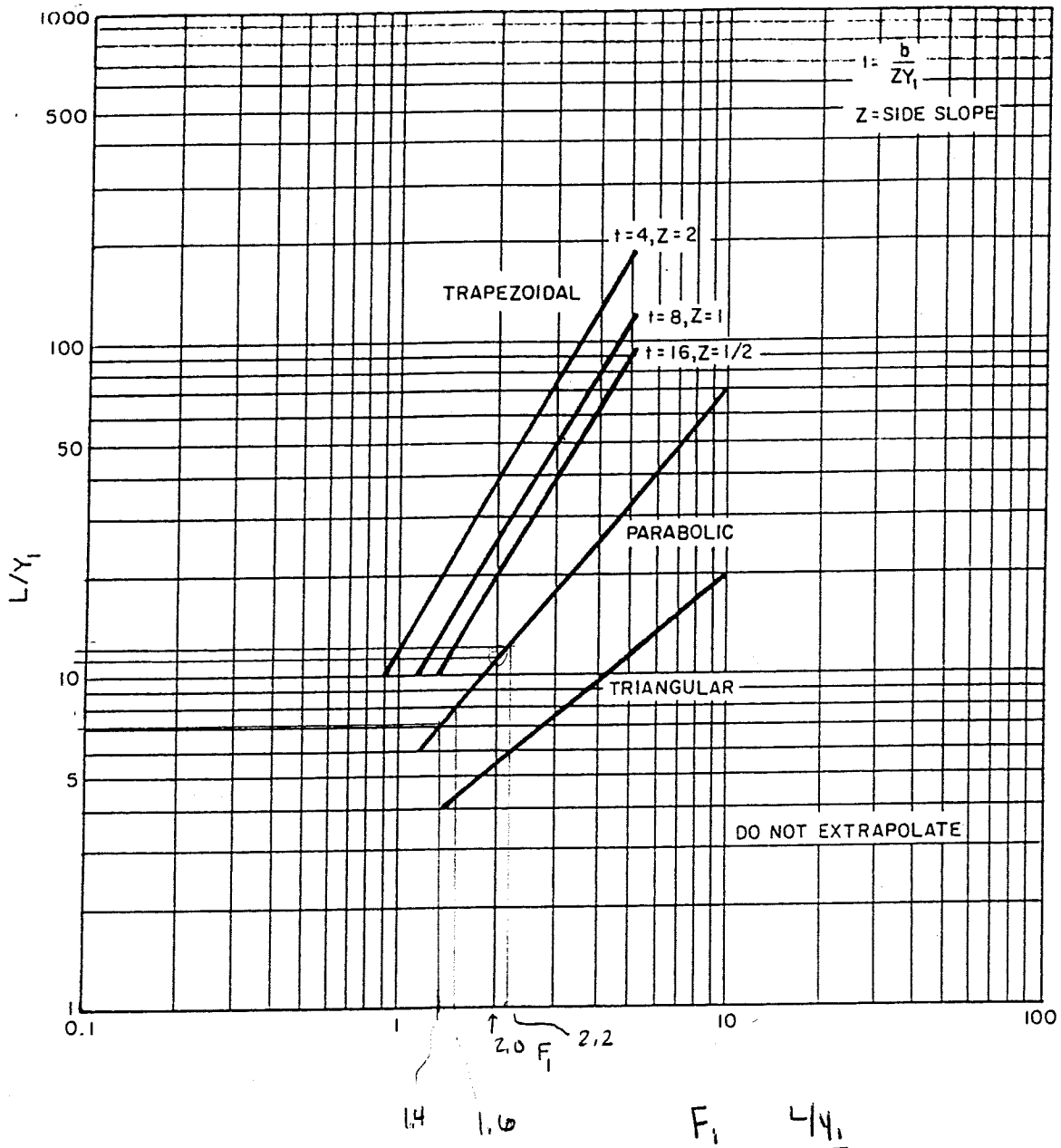


FIGURE 8.5
LENGTH OF A HYDRAULIC JUMP FOR A RECTANGULAR CHANNEL
(BOX CULVERTS)

F_1	L/Y_1
1.5	5.8
1.6	6.3
1.9	8.8
2.0	10



F_1	L/Y_1
1.4	7.1
1.6	8
2.0	12
2.2	13

FIGURE 8.6
LENGTH OF A HYDRAULIC JUMP FOR NONRECTANGULAR CHANNELS
(CIRCULAR PIPES)

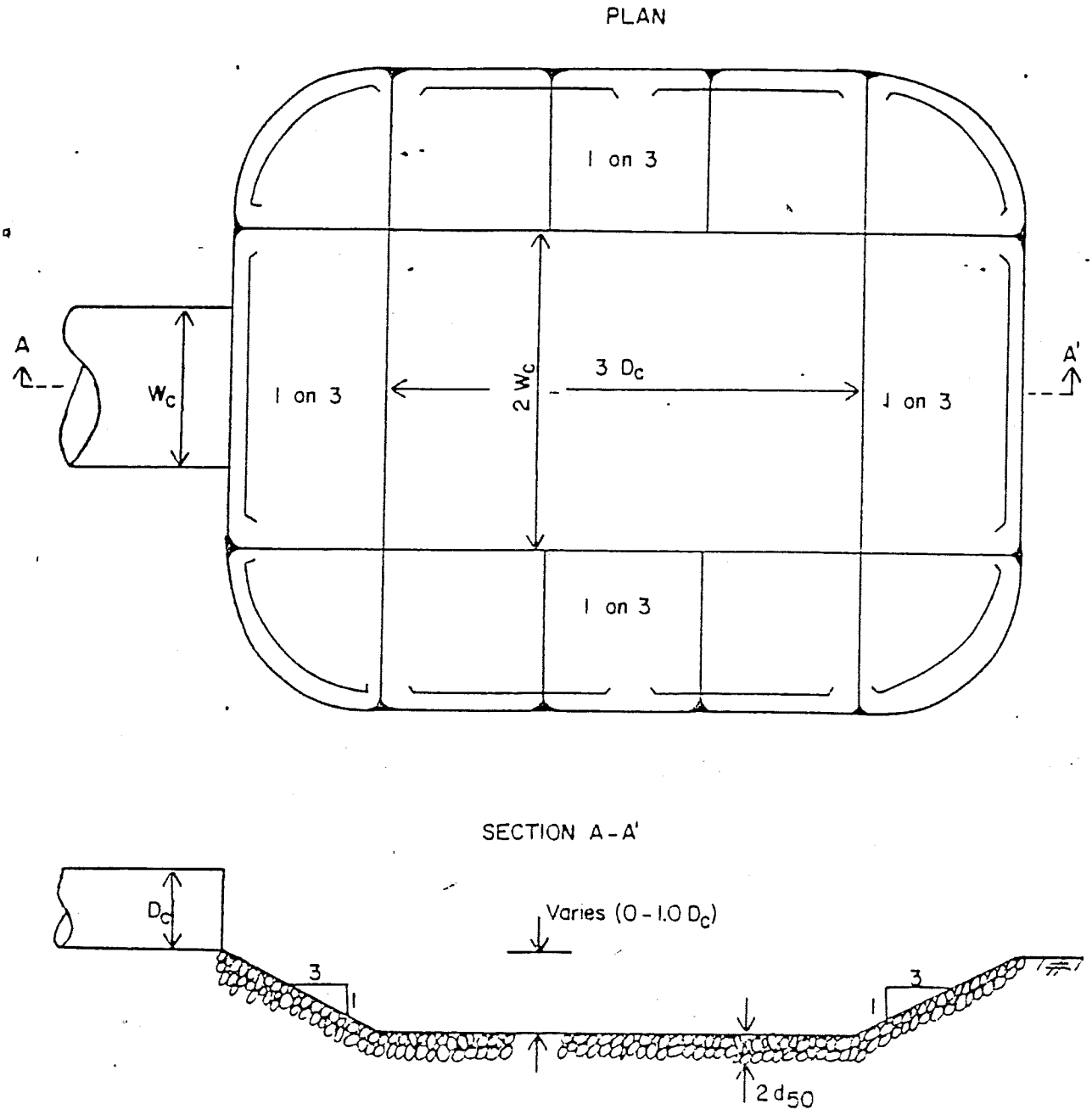


Figure 3-VI: Riprap-Lined, Preformed Scour Hole

W_c = Width of Culvert, ft.

D_c = Depth of culvert, ft.

d_{50} = Riprap medion size diameter, ft.

Cortaro Farms Road (Existing Stream @ Culvert Outlet)
Worksheet for Irregular Channel

Project Description	
Worksheet	Cross Section 13 (Scour Calcs)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.018000	ft/ft
Discharge	32.00	cfs

Options	
Current Roughness Method	mproved Lotter's Method
Open Channel Weighting Method	mproved Lotter's Method
Closed Channel Weighting Metho	Horton's Method

Results		
Mannings Coefficient	0.035	
Water Surface Elevation	2,310.37	ft
Elevation Range	2,310.00 to 2,312.00	
Flow Area	12.0	ft²
Wetted Perimeter	37.11	ft
Top Width	37.07	ft
Actual Depth	0.37	ft
Critical Elevation	2,310.33	ft
Critical Slope	0.026972	ft/ft
Velocity	2.68	ft/s
Velocity Head	0.11	ft
Specific Energy	2,310.48	ft
Froude Number	0.83	
Flow Type	Subcritical	

Roughness Segments		
Start Station	End Station	Mannings Coefficient
1+00	1+82	0.035

Natural Channel Points	
Station (ft)	Elevation (ft)
1+00	2,312.00
1+12	2,311.00
1+31	2,310.00
1+58	2,310.00
1+66	2,311.00
1+82	2,312.00

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Cortaro Farms Road (Existing Stream @ Culvert Outlet)
Worksheet for Irregular Channel

Project Description	
Worksheet	Cross Section 16 (Scour Calcs)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.029000	ft/ft
Discharge	19.00	cfs

Options	
Current Roughness Method	mproved Lotter's Method
Open Channel Weighting Method	mproved Lotter's Method
Closed Channel Weighting Metho	Horton's Method

Results		
Mannings Coefficient	0.035	
Water Surface Elevation	2,302.29	ft
Elevation Range	2,302.00 to 2,303.00	
Flow Area	6.5	ft²
Wetted Perimeter	24.92	ft
Top Width	24.89	ft
Actual Depth	0.29	ft
Critical Elevation	2,302.30	ft
Critical Slope	0.027936	ft/ft
Velocity	2.94	ft/s
Velocity Head	0.13	ft
Specific Energy	2,302.43	ft
Froude Number	1.02	
Flow Type	Supercritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
1+00	1+39	0.035

Natural Channel Points

Station (ft)	Elevation (ft)
1+00	2,303.00
1+10	2,302.00
1+29	2,302.00
1+39	2,303.00

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Cortaro Farms Road (Existing Stream @ Culvert Outlet)
Worksheet for Irregular Channel

Project Description	
Worksheet	Cross Section 19 (Scour Calcs)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.020000	ft/ft
Discharge	10.00	cfs

Options	
Current Roughness Method	mproved Lotter's Method
Open Channel Weighting Method	mproved Lotter's Method
Closed Channel Weighting Metho	Horton's Method

Results		
Mannings Coefficient	0.035	
Water Surface Elevation	2,286.42	ft
Elevation Range	2,286.00 to 2,287.00	
Flow Area	3.6	ft²
Wetted Perimeter	11.09	ft
Top Width	11.02	ft
Actual Depth	0.42	ft
Critical Elevation	2,286.39	ft
Critical Slope	0.026850	ft/ft
Velocity	2.81	ft/s
Velocity Head	0.12	ft
Specific Energy	2,286.54	ft
Froude Number	0.87	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
1+00	1+18	0.035

Natural Channel Points

Station (ft)	Elevation (ft)
1+00	2,287.00
1+08	2,286.00
1+14	2,286.00
1+18	2,287.00

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Cortaro Farms Road (Existing Stream @ Culvert Outlet)
Worksheet for Irregular Channel

Project Description	
Worksheet	Cross Section 20 (Scour Calcs)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.061000	ft/ft
Discharge	16.00	cfs

Options	
Current Roughness Method	mproved Lotter's Method
Open Channel Weighting Method	mproved Lotter's Method
Closed Channel Weighting Metho	Horton's Method

Results		
Mannings Coefficient	0.035	
Water Surface Elevation	2,275.35	ft
Elevation Range	2,275.00 to 2,276.00	
Flow Area	4.0	ft²
Wetted Perimeter	17.14	ft
Top Width	17.12	ft
Actual Depth	0.35	ft
Critical Elevation	2,275.42	ft
Critical Slope	0.027478	ft/ft
Velocity	3.98	ft/s
Velocity Head	0.25	ft
Specific Energy	2,275.59	ft
Froude Number	1.45	
Flow Type	Supercritical	

Roughness Segments		
Start Station	End Station	Mannings Coefficient
1+00	1+38	0.035

Natural Channel Points	
Station (ft)	Elevation (ft)
1+00	2,276.00
1+18	2,275.00
1+24	2,275.00
1+38	2,276.00

Cortaro Farms Road (Existing Stream @ Culvert Outlet)
Worksheet for Irregular Channel

Project Description	
Worksheet	Cross Section 21 (Scour Calcs)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.070000	ft/ft
Discharge	25.00	cfs

Options	
Current Roughness Method	mproved Lotter's Method
Open Channel Weighting Method	mproved Lotter's Method
Closed Channel Weighting Metho	Horton's Method

Results		
Mannings Coefficient	0.035	
Water Surface Elevation	2,263.82	ft
Elevation Range	2,263.00 to 2,264.00	
Flow Area	4.1	ft²
Wetted Perimeter	10.01	ft
Top Width	9.87	ft
Actual Depth	0.82	ft
Critical Elevation	2,264.01	ft
Critical Slope	0.022787	ft/ft
Velocity	6.16	ft/s
Velocity Head	0.59	ft
Specific Energy	2,264.41	ft
Froude Number	1.69	
Flow Type	Supercritical	

Roughness Segments		
Start Station	End Station	Mannings Coefficient
1+00	1+12	0.035

Natural Channel Points	
Station (ft)	Elevation (ft)
1+00	2,264.00
1+05	2,263.00
1+12	2,264.00

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Cortaro Farms Road (Existing Stream @ Culvert Outlet)
Worksheet for Irregular Channel

Project Description	
Worksheet	Cross Section 26 (Scour Calcs)
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	0.033000	ft/ft
Discharge	18.00	cfs

Options	
Current Roughness Method	mproved Lotter's Method
Open Channel Weighting Method	mproved Lotter's Method
Closed Channel Weighting Metho	Horton's Method

Results		
Mannings Coefficient	0.035	
Water Surface Elevation	2,189.11	ft
Elevation Range	2,189.00 to 2,190.00	
Flow Area	10.1	ft²
Wetted Perimeter	90.92	ft
Top Width	90.91	ft
Actual Depth	0.11	ft
Critical Elevation	2,189.11	ft
Critical Slope	0.037626	ft/ft
Velocity	1.78	ft/s
Velocity Head	0.05	ft
Specific Energy	2,189.16	ft
Froude Number	0.94	
Flow Type	Subcritical	

Roughness Segments		
Start Station	End Station	Mannings Coefficient
1+00	2+06	0.035

Natural Channel Points	
Station (ft)	Elevation (ft)
1+00	2,190.00
1+07	2,189.00
1+96	2,189.00
2+06	2,190.00

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