REVISED DRAINAGE REPORT
FOR
TUSCANY RIDGE UNIT 2

NOVEMBER 20, 1998

PREPARED FOR:

CENTEX REAL ESTATE CORP.
BUILDING B
6700 JEFFERSON NE
ALBUQUERQUE, NM 87109

PREPARED BY:

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NEW MEXICO
10596
REGISTERED PROFESSIONAL ENGINEER

PREPARED BY:

Bruce J. Stidworthy, E.I. — Date 11/20/98

UNDER THE SUPERVISION OF:

Rick L. Beltramo, P.E. — Date 11/20/98

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November 20, 1998

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Susan M. Calongne, P.E.
City/County Floodplain Administrator
Design Review Division/PWD
City of Albuquerque
P.O. Box 1293
Albuquerque, NM 87103

RE: COMMENT RESPONSES – TUSCANY RIDGE UNIT 2
DRB #98-363

Dear Susan:

Submitted are responses to your comments for both the Addendum to the Tuscany West Subdivision, Units I and II Drainage Report (Master Drainage Report) and our Tuscany Ridge, Unit 2 Drainage Report. As you recall, our office submitted an addendum to the Master Drainage Report due to problems with the McMahon Blvd. design.

The profile/design provided consists of placing a water block just east of Unser Blvd. and then maintaining a minimum grade to the east where a low point or sump inlet is located. Although many options to the McMahon Blvd. problem were considered, this design is most consistent with the intent of the Master Drainage Report. Please note that this design has been reviewed and found acceptable by Transportation Development with respect to traffic design issues. Below are specific responses to each and all of your comments.

Addendum to the Drainage Report for Tuscany West Subdivision, Units I & II (A11/D11)
Comments dated November 17, 1998

Comment No. 1 requests additional information related to the site topography. I am submitting a plan and profile which shows the additional information you have requested. The information provided shows additional contours based on F.E.M.A. topography and field surveys combined with recent topography developed for projects north and south of McMahon Blvd.

Comment No. 2 requests demonstrating that properties to the north of McMahon Blvd. can drain away from the road; i.e., to the north. In general, the land drains directly north or drains to arroyos which then flow north to the Black's Arroyo. These areas tend to be hills or high points. For these areas, development may require grading to convey runoff east or west along the roadway until an outfall to the north is reached. Where these conditions occur, more than adequate slope is available.

Comment No. 3 states that a temporary pond is not acceptable within City public right-of-way. Therefore, a catch basin will be placed at the west end of McMahon Blvd. to intercept interim, undeveloped flows. When the remainder of McMahon Blvd. is improved, catch basins will be placed at the low point to the west. The interim catch basins will provide additional inlet capacity in the future.

Drainage Report and Grading Plan for Tuscany Ridge, Unit 2 (A12/D15)
Comments dated November 17, 1998

Comment No. 1 The existing property is platted according to the owners' surveyor, and the legal description provided is the correct legal description. The parcel is approximately square in shape. However, the proposed development will be trapezoidal in shape after right-of-way for McMahon Blvd. is dedicated. Portions of McMahon Blvd. will be accommodated by public access, utility and drainage easements. It is anticipated that when the tract to the north is developed, the remaining right-of-way will be dedicated. McMahon Blvd. will not be constructed on unplatted land.

Comment No. 2 The Addendum to the Drainage Report for Tuscany West Subdivision, Units I and II (Master Drainage Report) addresses this comment in detail. The primary purpose of the Addendum is to address the fact that McMahon Blvd. cannot be constructed to the grades assumed in the report and therefore the assumed flow conveyed by McMahon Blvd. is also not possible. Because less downstream capacity is available than was previously assumed due to McMahon Blvd. limitations, less runoff can be released to McMahon Blvd. Therefore, the amendment proposes restricting runoff from properties that drain to McMahon Blvd.

In an effort to offset this impact, revisions to the Master Drainage Report were made to offset this impact, as follows:

1) McMahon Blvd. grades are proposed which do not allow Unser Blvd. to surface-drain to McMahon Blvd.;

2) The north half of McMahon Blvd. will drain north to the historic outfall of the area; and

3) Runoff generated by Tuscany Ridge, Unit 2 is less than allowed by the Master Drainage Report, therefore providing additional runoff capacity to other properties.

Comment No. 3 The grading plan and drainage report is revised to drain the entire lot, except backyards, to the front. The backyards drain to a private drainage easement and rundown.

Comment No. 4 In an effort to minimize earthwork costs and reduce retaining wall heights, the inlets are placed in a sump. The sump is only slight. Should the inlets fail or should a storm event greater than the 100-year occur, the runoff would overtop the sump and outfall to Tuscany Rd. before overtopping the curb.

Comment No. 5 The Tuscany Home Owners Association.

Comment No. 6 The temporary pond will be replaced with an interim catch basin. The interim catch basin will be placed at the west end of McMahon Blvd. to intercept interim, undeveloped flows. When the remainder of McMahon Blvd. is improved, catch basins will be placed at the low point to the west. The interim catch basins will provide additional inlet capacity in the future.

Comment No. 7 Additional analysis is provided which demonstrates that no condition can occur which allows runoff to overtop the curb or escape the public right-of-way. The analysis is attached and is based on two methods of analysis. First, the total energy is calculated for the incoming streets. The total energy is less than 0.67 ft. Theoretically, there is insufficient energy for the water to rise higher than the curb; therefore, since it is not possible for the sequent depth of the hydraulic jump to exceed the total energy, it is also not possible for the hydraulic jump to exceed the curb height. The second analysis reviews the capacity of the transverse street. A broad crested weir analysis is applied assuming a velocity of zero (0). Assuming a weir analysis and a velocity of zero is very conservative and proves adequate capacity.

Comment No. 8 The existing catch basins have been added to the plan. These basins do intercept flow from basin 110A.

The comments received to date are minor with minimal or no impact on the Preliminary Plat and Infrastructure List. The review comments have been adequately addressed, and the grading plan revised accordingly. The most significant comment is related to the proposed amendment to the Master Drainage Report, modifying the drainage concepts. The recommended plan is the most consistent with the original report and proposes a logical and enforceable plan. The proposed plan minimizes impacts due to McMahon Blvd. design problems and provides a multiple of solutions. As you know, the developer is very anxious to start construction on this project. For these reasons, I request that Preliminary Plat approval be granted at the Development Review Board (DRB) meeting scheduled for November 24, 1998.

Attached with this letter is a copy of the F.E.M.A. topographic mapping and the proposed plan and profile of McMahon Blvd. (previously submitted). If you have questions or comments, please call Bruce Stidworthy or me anytime at 823-1000.

Sincerely,
Bohannan Huston, Inc.

Rick L. Beltramo, P.E.
Community Development
and Planning

RLB/am
Enclosures

cc: Norm Gregory, Centex Real Estate Corp.
Bruce Stidworthy, Bohannan Huston, Inc.

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PLATES

I. INTRODUCTION

This report presents the Drainage Management Plan for the Tuscany Ridge Unit 2 Subdivision, a 9.8-acre site proposed to contain 44 detached single-family residential homes and the related streets and infrastructure. The proposed subdivision is within the area governed by the Tuscany area Master Drainage Plan, entitled *Drainage Report for The Tuscany West Subdivision, Units 1 & 2* (City drainage file A11/D1A, approved in a letter from Susan Calongne, dated 1/24/97). The property is zoned SU-1 for R-2 and has been reviewed and approved with findings and conditions, for site plan, by the EPC.

II. PURPOSE OF REPORT

The purpose of this drainage report is to analyze and assess the impacts of the proposed subdivision and to recommend support infrastructure. This report includes graphical description of the upstream drainage area, flowrates for storm water entering and being discharged from the site before and after development, and a graphic description of the direction of water flow and points of discharge from the site after development. The final purpose of this report is to obtain preliminary plat and construction approval.

III. METHODOLOGY

The undeveloped and developed conditions were analyzed for the 100-year, 6-hour storm event in accordance with the revised Section 22.2, Hydrology, of the Development Process Manual (DPM) for the City of Albuquerque, July 1997.

Part A of the DPM Section 22.2, 'Procedure for 40 acre and smaller basins', was used to determine the peak runoff from the basins analyzed in this report. The percentage of impervious area was calculated individually for each proposed basin. No AHYMO analysis was done for this report.

The site is designated as basin 115 in the *Drainage Report for The Tuscany West Subdivision, Units 1 & 2* (hereafter referred to as the Drainage Master Plan or DMP). As such, the guidelines provided in that report are followed to the greatest practical extent. The on-site design proposed by this report is in full compliance with the DMP. The off-site design, however, does not match the original intent of the DMP. For a thorough explanation of the extent and reason for the variation, please see Section VI.B. of this report. An addendum to the DMP will be submitted under separate cover.

IV. SITE LOCATION AND CHARACTERISTICS

The Tuscany Ridge Unit 2 subdivision is located in the northwest quadrant of the City of Albuquerque, Bernalillo County, New Mexico. The subdivision is west of Golf Course Road, south of McMahon Boulevard, and east of Unser Boulevard. The legal current legal description for the site is Tract 18, Lands of Lincoln Road, Ltd. The site is within City of Albuquerque Precipitation Zone 1. See the vicinity map for more detail.

The site is partially covered with native vegetation. Much of the site has been used as a barrow area, and new vegetation is not yet established. Soils on the site are sandy, as is typical for the area. The site slopes steeply to the south, toward the Calabacillas Arroyo.

V. EXISTING CONDITION HYDROLOGIC ANALYSIS

The area was divided into two basins that currently drain to the south to the boundary of the existing Tuscany Unit 3 subdivision. The flows are then diverted to the west, by a small earthen berm, to the surface of Tuscany Drive. The flows are then collected by inlets along Tuscany Drive and conveyed to the storm drain beneath the road. There are no significant off-site flows which affect the site under existing conditions. The undeveloped land north of McMahon drains to the north to the Black Arroyo. The flows from the existing 'Elder Care' facility to the east of the site drain to the south, in accordance with the Tuscany Unit 2 drainage report, and do not impact the site.

VI. PROPOSED CONDITIONS HYDROLOGIC ANALYSIS

A. On-Site Conditions

The Drainage Master Plan provides for free discharge of flows (within the limits identified in the DMP) from the developed site. The last sentence of the seventh paragraph of Section V., 'Off-Site Drainage,' states, "When these basins (Basin 115 included) are developed, the storm drain system proposed with the Tuscany #3 will provide capacity for these areas (Developed Q's)." The peak flow allowed by the DMP is 33.7cfs (please see the second page of Table 1 in the DMP).

For drainage analysis purposes, the site has been divided into a number of basins: 115.1, 115.2, 115.3, 115.4, 115.5 and 115.6. These basins correspond to basin 115 in the DMP. The total developed runoff from those basins is 26.25 cfs (as compared to 33.7 cfs allowed by the DMP; see paragraph above). A discussion of the hydrology and hydraulics for each basin is contained in the paragraphs below.

Basin 115.2 consists of Lots 26 - 28 and drains to Terra Forte. The flows in Terra Forte at the intersection with Albero Rosso are contained to the north side of the street by the roadway crown. This allows the flows from Basin 115.2 to continue eastward on Terra Forte, without turning south on Albero Rosso.

Basin 115.3 consists of Lots 21 - 25 and drains to Terra Forte, where the drainage is joined by the flows from Basin 115.2. The combined flows continue east on Terra Forte and enter Basin 115.4.

Basin 115.4 consists of Lots 15 - 20 and Lots 29 - 32, and drains to Monte De Neve. The combined flows from Basins 115.2 - 115.4 drain down Monte De Neve to Sole Grande. Hydraulic analysis demonstrating that the hydraulic jump is contained by the curb are provided in Appendix B. Basin 115.5 consists of the right-of-way of Sole Grande, as well as the house pads and front yards of lots 1 – 13, and accepts flows from Basins 115.1 and 115.4. The combined flows from Basins 115.1 – 115.5 are conveyed by Sole Grande to 3 inlets located near the intersection of Sole Grande and Albero Rosso. The inlets are designed to accept the 100-year flow. Although the Type Double 'A' inlet located between Lots 2 and 3 on the south side of Sole Grande is in sump condition, emergency overflow is

available at the intersection of Tuscany Drive (the flowline elevation at the curb return is only 0.5 feet above the flowline at the drop inlet).

Basin 115.6 consists of the backyards of Lots 1 – 13 and drains to a 2'-wide private drainage channel which discharges 1.6 cfs to the surface of Tuscany Dr. in the 100-year storm drain. Please see the grading details sheet for channel configuration.

Basin 115.8 (negligible flows) drains north to the McMahon right-of-way, where it will join the off-site flows from Basin 118A and flow west to inlets at the low point in McMahon Blvd.

B. Off-Site Conditions

Tuscany West Addendum

As discussed in the Methodology section above, the off-site conditions proposed by this report vary from the guidelines provided by the DMP. This variation is the result of assumptions that were made by the DMP which result in cost-prohibitive and unfeasible construction requirements. The issue is the ultimate design profile of McMahon. The DMP assumed that McMahon would have a continuous slope from west to east from Unser Boulevard to Bandelier Drive. This assumption requires that cuts of 10' to 15' in depth would have to made along the frontage of the existing 'Elder Care' facility. There are existing Water and Sewer lines in McMahon which would have to be removed and relayed, as well as all of the existing pavement in McMahon from the west boundary of the 'Elder Care' facility almost to Bandelier. In addition to the public paving and utilities, there is an existing gas line which runs along the north edge of McMahon which would have to be removed and relayed; or a retaining wall would have to installed to support the gas line. As the above narrative illustrates, it is impractical to construct McMahon with a continuous downgrade from Unser to Bandelier. For this reason, an addendum has been submitted for the Tuscany West DMP.

The addendum proposes to create a low point in McMahon just west of the intersection with Tuscany Drive. This differs with the DMP in that the DMP shows a

surface flow on McMahon draining east from Tuscany Drive of 40 cfs. The addendum proposes removing basins from the contributing area and restricting outfall from other basins. A copy of the addendum is included with this report.

The only basin considered by this report which is affected by the addendum to the DMP is 185A. Basin 185A is a portion of Basin 185.0 shown on the DMP. That basin was intended by the DMP to drain east on McMahon to future inlets located near Bandelier. This report proposes to drain that basin west to the future inlet at the low point in McMahon.

There are two off-site basins covered by this report which are not affected by the addendum to the DMP: Basins 116A and 110A. Those basins are composed primarily of the right-of-way of Tuscany Drive along the west edge of the subdivision, and they are compared to Basins 110 and 116 in the DMP (although they are not exactly the same in shape or size). Basin 110A drains to the south in Tuscany Drive, exactly as proposed by the DMP. The intent of the DMP for Basin 116A was for it to drain to the south in Tuscany Drive, to a pair of existing inlets located behind Lot 40. This report proposes to create a high point in Tuscany Drive, and drain Basin 116A to the north to McMahon, and west on McMahon to the proposed inlet located at the low point.

VII. CONCLUSIONS

The primary purpose of this drainage report is to obtain preliminary plat approval by demonstrating that the subdivision has been designed to safely drain the 100-year storm; that the design is in compliance with city requirements; and, to the greatest extent possible, is in compliance with the approved Drainage Master Plan. This report accomplishes the above purpose by providing; a graphical description of all appropriate drainage areas, flowrates for storm water entering and being discharged from the site before and after development, and a graphic description of the direction of water flow and points of discharge from the site after development.

VIII. REFERENCES

Development Process Manual, City of Albuquerque, Planning and Public Works Departments, January 1993.

Drainage Report for The Tuscany West Subdivision, Units 1 & 2, Community Sciences Corporation, October 28, 1996.

TUSCANY RIDGE - UNIT 2
UNDEVELOPED CONDITIONS

BASIN	AREA (ACRES)	% LAND TREATMENT* A	B	C	D	PEAK DISCHARGE - (CFS/ACRE)** A	B	C	D	(CFS/AC)	Q(100-YR) UNDEVELOPED (CFS)
1	0.82	0.00	55.00	0.00	45.00	1.29	2.03	2.87	4.37	3.08	2.53
2	8.70	100.00	0.00	0.00	0.00	1.29	2.03	2.87	4.37	1.29	11.22

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NOTES:

Obtained from Section 22.2, Hydrology of the Development Process Manual, Volume 2, Design Criteria for the City of Albuquerque, July 1997

* Table A-4

** Table A-9

TUSCANY RIDGE - UNIT 2
FULLY DEVELOPED CONDITIONS

BASIN **On-Site**	AREA (ACRES)	% LAND TREATMENT A	B	C	D	PEAK DISCHARGE - (CFS/ACRE)** A	B	C	D	(CFS/AC)	Q(100-YR) DEVELOPED (CFS)
115.1	2.38	0.00	55.00	0.00	45.00	1.29	2.03	2.87	4.37	3.08	7.34
115.2	0.47	0.00	39.00	0.00	61.00	1.29	2.03	2.87	4.37	3.46	1.62
115.3	0.75	0.00	37.50	0.00	62.50	1.29	2.03	2.87	4.37	3.49	2.62
115.4	2.26	0.00	62.40	0.00	37.60	1.29	2.03	2.87	4.37	2.91	6.58
115.5	1.99	0.00	22.00	17.00	61.00	1.29	2.03	2.87	4.37	3.60	7.16
115.6	0.54	0.00	0.00	90.00	10.00	1.29	2.03	2.87	4.37	3.02	1.63
115.7	0.06	0.00	0.00	0.00	100.00	1.29	2.03	2.87	4.37	4.37	0.26
Off-Site											**27.22**
110A	0.87	0.00	48.00	0.00	52.00	1.29	2.03	2.87	4.37	3.25	2.82
116A	0.35	0.00	50.00	0.00	50.00	1.29	2.03	2.87	4.37	3.20	1.12
185A	1.00	0.00	17.00	0.00	83.00	1.29	2.03	2.87	4.37	3.97	3.97
											7.92
TOTAL	10.67										35.13

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NOTES:

Obtained from Section 22.2, Hydrology of the Development Process Manual, Volume 2, Design Criteria for the City of Albuquerque, July 1997

* Table A-4

** Table A-9

APPENDIX A

INLET #3

NOTE: 2x100 FLOW CAPACITY NOT REQ'D. TUSCANY DRIVE ACTS AS EMER G. SPILLWAY.

Double A inlet, in sump condition:

Open Area (for orifice calc in sq. ft.):	7.7977431
Length of Weir (feet):	7.9791667
Orifice Coeficient	0.6
Weir Coeficient	3

Head (ft)	Head (in)	1 Wing Weir Q (cfs)	Grate Weir Q (cfs)	Grate Orifice Q (cfs)	Control Q Sgl Wing (cfs)	Control Q Dbl Wing (cfs)
0.05	0.6	0.13	0.27	8.40	0.40	0.54
0.1	1.2	0.38	0.76	11.87	1.14	1.52
0.15	1.8	0.70	1.39	14.54	2.09	2.78
0.2	2.4	1.07	2.14	16.79	3.21	4.29
0.25	3	1.50	2.99	18.77	4.49	5.99
0.3	3.6	1.97	3.93	20.56	5.91	7.88
0.35	4.2	2.48	4.96	22.21	7.44	9.93
0.4	4.8	3.04	6.06	23.75	9.09	12.13
0.45	5.4	3.62	7.23	25.19	10.85	14.47
0.5	6	4.24	8.46	26.55	12.71	16.95
0.55	6.6	4.89	9.76	27.84	14.66	19.55
0.6	7.2	5.58	11.13	29.08	16.70	22.28
0.65	7.8	6.29	12.54	30.27	18.83	25.12
0.667	8.0	6.54	13.04	30.66	19.58	26.11
0.7	8.4	7.03	14.02	31.41	21.05	28.08
0.75	9	7.79	15.55	32.52	23.34	31.14
0.8	9.6	8.59	17.13	33.58	25.71	34.30
0.85	10.2	9.40	18.76	34.62	28.16	37.57
0.9	10.8	10.25	20.44	35.62	30.68	40.93
0.95	11.4	11.11	22.16	36.60	33.28	44.39
1	12	12.00	23.94	37.55	35.94	47.94
1.05	12.6	12.91	25.76	38.47	38.67	51.58
1.1	13.2	13.84	27.62	39.38	41.46	55.31
1.15	13.8	14.80	29.52	40.26	44.32	59.12
1.2	14.4	15.77	31.47	41.13	47.24	63.02

Calculation of open area:

Total Grate Area	2000	13.888889
Cross Bar Area	-732	-5.083333
Supports (ends)	-115.625	-0.802951
(middle)	-100	-0.694444
Areas Counted Twice	70.5	0.4895833
	1122.875	7.7977431

Calculation of Length of Weir:

Total Perimeter of Grate	130	10.833333
Short Cross Bars	-7	-0.583333
Bearing Bars	-13	-1.083333
End Supports	-9.25	-0.770833
Middle Supports	-5	-0.416667
	110	7.9791667

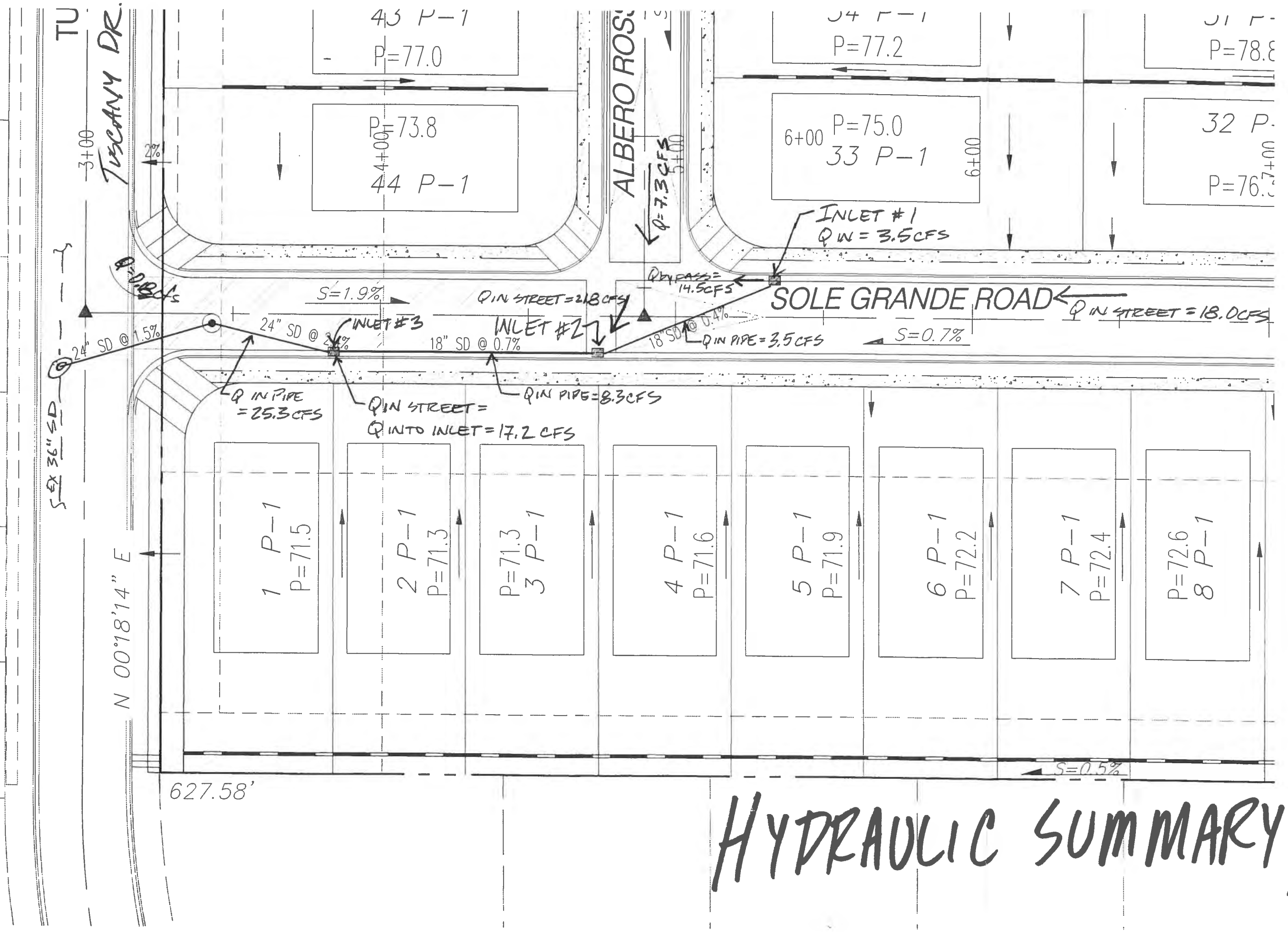
TOTAL CAPACITY OF A TYPE DOUBLE A INLET IN SUMP CONDITION W/ 0.6' WATER DEPTH.

Q100 at inlet = 12.6 cfs

14

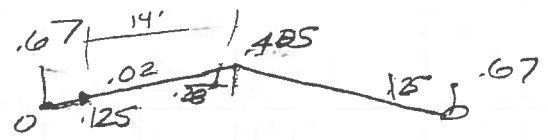
3/10

INLET HAS, $\frac{16.7}{12.6}$ = 1.33, 133% OF REQ'D CAPACITY



HYDRAULIC SUMMARY

4B/10



7 pts

Elev,	dist
.67	0
0	0
.125	2
.405	16
.125	30
0	32
.67	32

RP Stream.

7% slope

Flow rate = 1.4 CFS (½ flow of this basin)

.10	0.5	1.4
.20	3.3	
.1	X	
2.8	.9	

X = .032 depth = 0.132 < .405 okay

The flow will not cross Tuscany over the crown of the rd.

This analysis checked to see if the flow from the left side would cross over the crown of Tuscany and contribute to the flow at the rt side.

Conclusion: It will not.

NOTE: ALL SD FLOW IS NON-PRESSURE

Bohannan ▲ Huston

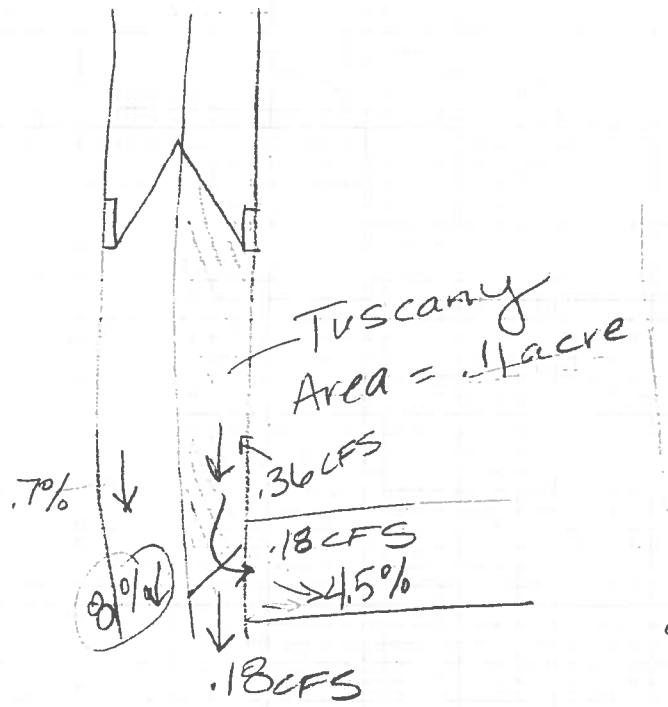
ENGINEERS PLANNERS PHOTOGRAMMETRISTS SURVEYORS SOFTWARE DEVELOPERS

PROJECT NAME _____ SHEET _____ OF _____

PROJECT NO. _____ BY M.L. DATE _____

SUBJECT _____ CH'D _____ DATE _____

6/10



CFS/ACRE

= 2.82/.87

= 3.24

CFS/ACRE · AREA

= (3.24)·(.11)

= .36 CFS

PROJECT NAME _____ SHEET _____ OF _____

PROJECT NO. _____ BY _____ DATE _____

SUBJECT _____ CH'D _____ DATE _____

Bohannan ▲ Huston

ENGINEERS PLANNERS PHOTOGRAMMETRISTS
SURVEYORS SOFTWARE DEVELOPERS

7/10

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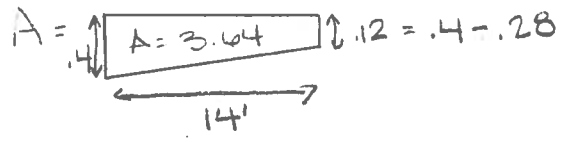
TUSCANY RIDGE UNIT 2

Demonstrate that the tee intersection at Monte De Nevi and Alberto Rosso Dr. contain the flow within the road. This is demonstrated by two analysis, ① the hydraulic jump and ② the weir depth analysis.

Monte De Nevi Dr.

$Q_{100} = 10.9$ cfs $S = 5.79\%$ $d = 0.41'$



Area of ½ the road

$$V = \frac{Q^{1/2}}{A^{1/2}} = \frac{5.4 cfs}{3.64 ft^2} = 1.48 fps$$

$$E = d + \frac{V^2}{2g} = 0.41 + \frac{1.48^2}{64.4} = 0.444 < .67 \text{ OK}$$

HYDRAULIC JUMP ANALYSIS

The total flow from Monte De Nevi Drive is 10.9 cfs with a flow depth of approximately 0.41' and a flow velocity of 1.48 fps. The total energy E is 0.5 ft. Therefore, the subsequent depth for hydraulic jump is always less than the total energy available. In addition, the 'E' is less than the curb height, .67'. Therefore, the hydraulic jump is contained within the street.

Since the flows in Alberto Rosso Dr. are substantially less, no analysis is [illegible].

8/10

Weir Analysis

Q_{100} @ AP4 in Sole Grande ROAD =

10.8 cfs + Sole Grande (4 lots × 3 cfs/acre / 5 du/acre)

10.8 + 2.4 = 13.2 cfs

USE BROADCRESTED WEIR:

assume V = D (conservative)

FROM KING & BRATHER

TABLE 5-3 page 5-40

$Q = CLH^{3/2}$

$C = 2.7$

$L = 28'$ F-F

$Q = 2.7 \times 28 \times H^{3/2} = 13.2$ cfs

$H^{3/2} = .1746$

$H = 0.312$ ft.

The required head needed to accelerate the flow from a velocity of ∅ and discharge through a 28' wide weir is 0.3 ft, less than the available 0.67 ft.

Q_{100} at AP5 = 24.64 cfs

$24.64 = 2.7 \times 28 \times H^{3/2}$

$0.3259 = H^{3/2}$

$0.474 = H$

$0.474 < 0.67$ OK

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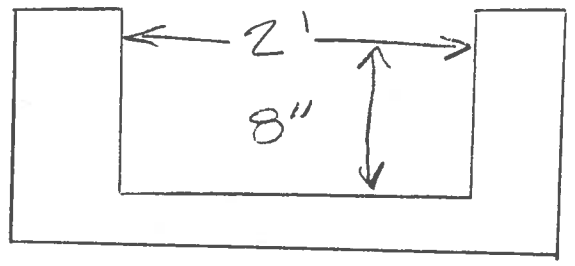
RIBBON CHANNEL BEHIND LOTS 1-13



$Q_{100} = 1.63$

$A = 1.34\ ft^2$

$S = 0.5\%$

$n = 0.013$

$$Q = \frac{1.486}{n} A \left(\frac{A}{WP}\right)^{2/3} S^{1/2}$$

$$Q_{capacity} = \frac{1.486}{.013}(1.34)\left(\frac{1.34}{3.34}\right)^{2/3}(.005)^{1/2}$$

$Q = 114.3(1.34)(.544)(.0707)$

$Q_{cap} = 5.89\ cfs > 1.6\ cfs$ OK

Avg = .33'.

$$Q = \frac{1.486}{.015}(.33' \times 2')\left(\frac{.33' \times 2'}{(.33' \times 2') + 2}\right)^{2/3}\sqrt{.005}$$

$= 1.8\ cfs > 1.6\ cfs$ OK

10/10

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