

FILE COPY



City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

HYDROLOGY SECTION
123 Central NW, Albuquerque, NM 87102
(505) 768-7644

August 21, 1986

Tom Isaacs
Post Office Box 5486
Albuquerque, New Mexico 87185

RE: RETAINING WALL BETWEEN LOTS 9 & 10, CAMBRIDGE PARK
SUBDIVISION (H-23/D31)

Dear Mr. Isaacs:

We have reviewed the drainage plan and letters concerning the retaining wall between Lots 9 and 10 located in the referenced subdivision. The attached letter indicates that the developer would not construct the walls till the individual homes were built. We request that you contact the developer and determine his responsibility.

At present, we do review drainage plans, however, we do not inspect the individual lot grading. The lot owners are responsible for the drainage on their property. We are unable to inspect each lot for compliance to grading plan. Also, each owner and builder has their own preference on how the plan can be implemented.

If you have further questions, call me at 768-7644.

Cordially,

Carlos A. Montoya, P.E.
City/County Floodplain Administrator

Enclosure

CAM/bsj

PUBLIC WORKS DEPARTMENT

Walter Nickerson, P.E., City Engineer

ENGINEERING GROUP

Telephone (505) 768-2500

AN EQUAL OPPORTUNITY EMPLOYER



DALLAS, TEXAS • ALBUQUERQUE, NEW MEXICO • DENVER, COLORADO • PHOENIX, ARIZONA

21113

July 29, 1983

RECEIVED

JUL 29 1983

ENGINEERING

Mr. Fred Aguirre, P.E.
Engineering/Hydrology Division
City of Albuquerque
P.O. Box 1293
Albuquerque, New Mexico 87103

Re: Cambridge Park Subdivision

Dear Fred:

The Drainage Plan for the above referenced subdivision was approved by Brian Burnett on January 24, 1983. As part of the plat approval for the subdivision, Brian required the developer to obtain a letter of credit in an amount that provided the City sufficient security to insure that drainage improvements which included retaining walls and storm drains actually would be built.

A copy of the Irrevocable Letter of Credit and Agreement No. 56 between the developer and the City has been enclosed.

On July 29, 1983, I made a visual inspection of the site. Referring to the approved Drainage Plan dated January 24, 1983, which is also 3 of 8 of the construction set, the retaining walls have been constructed in accordance with the plans with the following exceptions:

1. The retaining walls between Lots 8 & 9 and Kachina Hills Unit 1 were not constructed because the existing wall was already a retaining wall. The existing difference is not greater than 16 inches and therefore additional retainage was not needed.
2. The wall between Lots 23, 24, 25 and 19 and 20 has been constructed as one large wall instead of two short walls. The grade difference remains the same and the height of the wall is approximately 5 1/2 feet.
3. The side yard retaining walls between Lots 9 and 10, 10 and 11, 11 and 12, 12 and 13, and 13 and 14 have not been constructed at this time because the developer wishes to use railroad ties combined with landscaping to create a visually appealing front yard. This concept should be satisfactory to prevent erosion and will be installed in conjunction with construction of the individual units.

Amirre
July 19, 1983
Page 2

Based on this information, I am now asking that the City Engineer issue a Certificate of Completeness and Acceptance pertaining to the portion of the required improvements as per the Drainage Ordinance.

I believe that a mistake was made concerning the amount of the first Letter of Credit. I have enclosed a copy of my estimate which was used for estimating the amount of that Letter of Credit. Note that the total cost of drainage improvements including retaining walls was \$48,601.00. 120% of that figure is \$58,321.20 which is also shown on the estimate. The actual Letter of Credit was for 120% of that number which was for \$69,985.44.

At this time I am requesting that the Letter of Credit be decreased by the sum of \$53,727.94. This will leave a sum of \$16,257.50 which represents 125% of the estimated cost of the remaining improvements which total \$13,006.00.

Please process the Certificate of Acceptance as soon as possible. If I can be of any help, do not hesitate to call. Thank you.

Sincerely,

TOM MANN & ASSOCIATES, INC.

Stephen D. Cannon
Stephen D. Cannon
Staff Engineer

SDC:kf
Encls. (3)

Done



City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

August 6, 1986

Oakwood Homes
~~5309 Del Vito Ct. NE~~
Albuquerque, NM ~~87117~~

TO WHOM IT MAY CONCERN:

Our office has received a complaint that a retaining wall which bounds Lots 9 & 10 of the Cambridge Park Subdivision has not been constructed. The owner of Lot 10 is somewhat concerned that their lot could be undermined due to the difference in elevation. It would be sincerely appreciated if you could look into this matter as soon as possible.

Thank you,

Richard L. Duran
Drainage Inspector

RLD:mrk

cc: Tom Isaacs, P.O. Box 5486, 87185

*I intent to build no retaining
wall - If they want one built -
let them build it —*

OAKWOOD HOMES, INC.
P.O. Box 20491
Albuquerque, NM 87154
1-505-821-4164

Sincerely

8/14/86

PUBLIC WORKS DEPARTMENT

George E. Selvia, P.E.,
Assistant Director Public Works

ENGINEERING GROUP

Telephone (505) 768-2500

AN EQUAL OPPORTUNITY EMPLOYER

CITY OF ALBUQUERQUE

ALBUQUERQUE, NEW MEXICO

INTER-OFFICE CORRESPONDENCE

August 11, 1983

REF. NO. _____

TO: Anita Miller, Assistant City Attorney, Legal Department

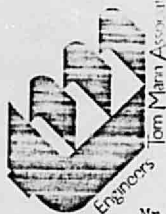
FROM: Fred J. Aguirre, Civil Engineer, Hydrology *FJA*

SUBJECT: LETTER OF CREDIT REDUCTION REQUEST FOR CAMBRIDGE SUBDIVISION

Attached is a letter from Mr. Steve Cannon of Tom Mann & Associates requesting a reduction on a letter of credit for partial improvements at Cambridge Subdivision. He is also requesting a reimbursement for a double charge of the 120% of the construction estimate. Also attached is a copy of the agreement and Engineer's Estimate for your reference.

The City Engineer's Office has no objection to this request. Please call me at Ext. 7467 if you have any questions regarding this matter.

FJA/fs
Attachment



21113
July 29, 1983

Mr. Fred Aguirre, P.E.
Engineering/Hydrology Division
City of Albuquerque
P.O. Box 1293
Albuquerque, New Mexico 87103

RECEIVED

JUL 29 1983

Re: Cambridge Park Subdivision

ENGINEERING

Dear Fred:

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Mr. Ammiré
July 29, 1983
Page 2

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At this time I am requesting that the Letter of Credit be decreased by the sum of \$53,727.94. This will leave a sum of \$16,257.50 which represents 125% of the estimated cost of the remaining improvements which total \$13,006.00.

Please process the Certificate of Acceptance as soon as possible. If I can be of any help, do not hesitate to call. Thank you.

Sincerely,

TOM MANN & ASSOCIATES, INC.



Stephen D. Cannon
Staff Engineer

SDC:kf
Encls. (3)

Dennis



811 DALLAS, N.E. • ALBUQUERQUE • NEW MEXICO • 87110 • 505-265-5611

21113
February 18, 1983

Mr. Brian Burnett
Civil Engineer/Hydrology
City of Albuquerque
P. O. Box 1293
Albuquerque, New Mexico 87103

Re: Cambridge Park

Dear Brian:

Transmitted herewith is the drainage plan and detail sheet revised as per our discussion on February 16, 1983. Included also is the estimate for storm drainage facilities, required as per Section 9-D of the Drainage Ordinance. Please review these submittals at your earliest possible convenience.

If you have any questions or comments, please do not hesitate to call. Thank you.

Sincerely,

TOM MANN & ASSOCIATES, INC.

RECEIVED

FEB 21 1983

ENGINEERING

SS:ns
enc.

Steve K. Schroll
Steve Schroll
Project Engineer



811 DALLAS, N.E. • ALBUQUERQUE • NEW MEXICO • 87110 • 505-265-5611

21113
February 15, 1983

Mr. Brian Burnett
Civil Engineer/Hydrology
City of Albuquerque
P. O. Box 1293
Albuquerque, New Mexico 87103

Re: Cambridge Park Drainage Plan

Dear Brian:

I have received your comments concerning the Cambridge Park drainage plan and have addressed them as follows:

Item 1: We have not eliminated the weep holes in the retaining wall along Butterfly Maiden. However, we have instructed that the houses be built with 4" underground canals to discharge through the retaining wall. We feel that the cost of constructing curb penetrations is not preferable to the nuisance of less than 0.3 cfs discharge across the sidewalk. In addition, we have provided weep holes to drain the small backyard basins at a height of 6" above finished grade. This will allow drainage only during large magnitude storms.

Item 2: We have designed ridge lines and swales to contain runoff within the lots in which it falls.

Item 3a: Standard curb and gutter will be constructed between drivepads to accommodate the single 'C' basin.

Item 3b: Should the storm drain system become clogged, the water will discharge into Menaul Boulevard. The low point of the flooded area would be the water block, where the elevation of the flowline at this point is 5877.81.

Item 3c: A complete set of construction drawings will be submitted to the design section.

Item 4a: See attached detail sheet.

Item 4b: The area between walls, approximately 3', will be landscaped. The amount of runoff, we feel, will be negligible.

Mr. Brian Burnett
February 15, 1983
Page 2

Item 5: We have provided an inlet and standard curb penetration. This requires standard curb and gutter which we have provided.

If you have any questions or comments, please do not hesitate to call.

Sincerely,

TOM MANN & ASSOCIATES, INC.

Steven K. Schroll
Steven K. Schroll
Project Engineer

SKS:ns



City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

H23 - D13

February 9, 1983

Mr. Steve Cannon
Tom Mann & Associates
811 Dallas N.E.
Albuquerque, N.M. 87110

RE: CAMBRIDGE PARK DRAINAGE PLAN

Dear Steve:

I have made an initial review and forward the following comments:

1. We discourage the use of weep holes due to the fact that irrigation runoff is continually impacting the sidewalk and street. I suggest that 4" standpipes be installed and discharged through the curb opening.
2. If runoff is going to "co-mingle" between units (for example 7 and 8, 8 and 9,) private common drainage easements must be provided on the plat.
3. Comment on the storm sewer:
 - a. The plans call for the single "C" basins to be constructed Block-to-Block Drawing K-4-2. This detail will need to be modified since mountable curb and gutter is proposed in the subdivision.
 - b. We are always concerned about the flow path if the storm drain system becomes clogged. Based on the computed 100-year flowrate of 11.5 cfs what is the direction of runoff assuming a non-functioning system?
 - c. Is Special Order No. 19 or a plan submitted through the Design Section process going to be utilized for the storm sewer design?
4. Comments on the various cross-sections:
 - a. Section C-C: What freeboard is provided by the lower wall?
 - b. Section D-D indicates that the lower wall extends higher than the adjacent ground. Will runoff stand behind this lip? Would it be appropriate to construct a swale behind the wall and provide several notches in the wall for runoff?

MUNICIPAL DEVELOPMENT DEPARTMENT

ENGINEERING DIVISION

Telephone (505) 766-7467

Richard S. Heller, P.E., City Engineer

AN EQUAL OPPORTUNITY EMPLOYER

Letter to Steve Cannon
CAMBRIDGE PARK DRAINAGE PLAN
PAGE 2

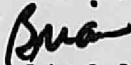
5. I am abit concerned about how runoff enters the concrete easement between units 21 and 22. How will this be accomplished? Also, will a run-down be required at the street ROW?

6. Per Section 9D of the Drainage Ordinance a bond or letter of credit will be required for the storm sewer system and retaining walls prior to plat signoff. The amount should be 120% of the estimated construction cost which must be approved by the Design Section. The bond or letter must also be accepted in form by the Legal Dept.

7. Engineer Certification by your firm will be required for the site grading (after units are constructed) and the retaining walls. No building permits will be issued prior to the installation and certification of all retaining walls. The DPM certification checklist should be utilized for this work.

Please call if you have any questions concerning these matters.

Very truly yours,



Brian G. Burnett
Civil Engineer/Hydrology

BGB/tsl



City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

FILE COPY

January 3, 1983

Steve Cannon
Tom Mann & Associates
811 Dallas NE
Albuquerque, NM 87110

REF: CAMBRIDGE PARK CONSTRUCTION PLAN CERTIFICATION (H23-D13)

Dear Mr. Cannon:

The certification of the private infrastructure improvements required by the subdivision agreement is in accordance with our discussion; therefore, I have advised the City Attorney's Office to release the letter of credit. This City Engineer's Office will advise your client when the letter of credit can be picked up.

If you have any further questions, please feel free to contact me at 766-7644.

Sincerely,

Fred J. Aguirre
Design Hydrologist

FJA:mrk

MUNICIPAL DEVELOPMENT DEPARTMENT

C. Wayne Sheppard, P.E.,

City Engineer ENGINEERING DIVISION

Telephone (505) 766-7467

AN EQUAL OPPORTUNITY EMPLOYER

DRAINAGE REPORT for the CAMBRIDGE PARK SUBDIVISION

RECEIVED

JAN 26 1983

ENGINEERING



811 DALLAS, N.E. • ALBUQUERQUE • NEW MEXICO • 87110
ENGINEERS

JOB No. 21111



City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

DRAINAGE REPORT INFORMATION SHEET

PROJECT TITLE Cambridge Park Subdivision

ZONE ATLAS PAGE NO. 11-23 CITY ADDRESS N/A

LEGAL ADDRESS (See Below)

ENGINEERING FIRM Tom Mann & Associates, Inc. CONTACT Steve Cannon

ADDRESS 811 Dallas, N.E. PHONE 265-5611

OWNER Ira Kitchens CONTACT

ADDRESS 7912 American Heritage PHONE

ARCHITECT/SURVEYOR Jerry Torr & Associates CONTACT Jerry Torr

ADDRESS 1919 Old Town Road N.W. PHONE 842-9183

DATE SUBMITTED 1/11/83

BY Steve Cannon

Legal Description: A certain parcel of land located within the city limits of Albuquerque, Bernalillo County, New Mexico, designated as Lot 94, Kachina Hills, Unit 1, filed in Book D7, Page 120, in the office of the Bernalillo County Clerk on February 25, 1977.

MUNICIPAL DEVELOPMENT DEPARTMENT

Richard S. Heller, P.E., City Engineer

ENGINEERING DIVISION

Telephone (505) 766-7467

DRAINAGE REPORT

FOR

CAMBRIDGE PARK

January, 1983

Prepared For: Ira Kitchens
7912 American Heritage
Albuquerque, New Mexico

Prepared By: Tom Mann & Associates, Inc.
811 Dallas, N.E.
Albuquerque, New Mexico 87110
(505) 265-5611



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PURPOSE AND SCOPE

The purpose of this drainage report is to establish the criteria for controlling runoff resulting from a development in a manner that is acceptable to the City of Albuquerque and to the Albuquerque Metropolitan Arroyo Flood Control Authority.

This plan determines the runoff resulting from a 100-year frequency storm falling on the site under existing and developed conditions.

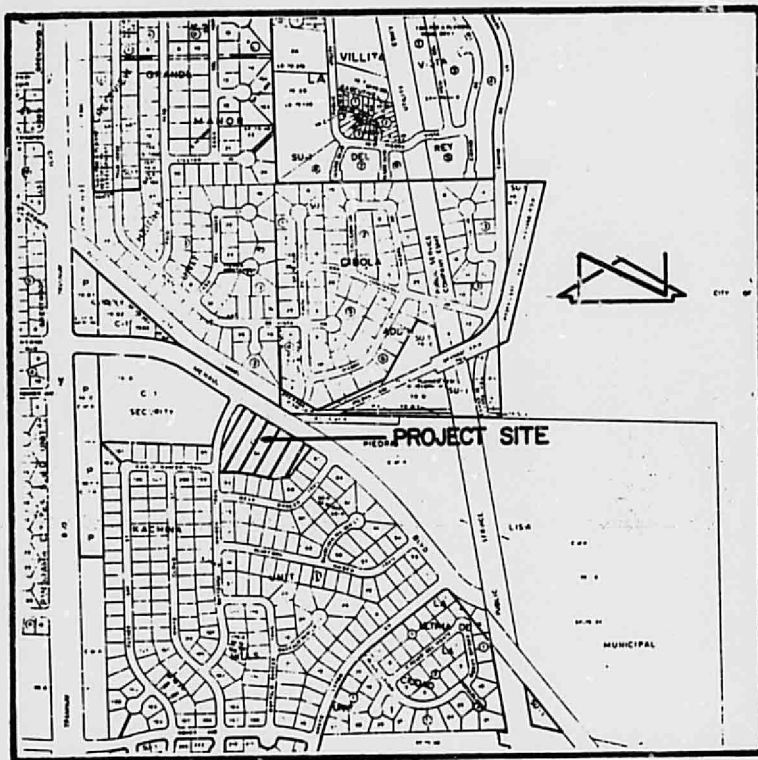
The scope of this plan is to ensure that the proposed project will be protected from storm runoff and that the development will not increase the flooding potential of adjacent properties.

LOCATION AND DESCRIPTION

Cambridge Park is located in the northeast quadrant of the city of Albuquerque, near the foothills of the Sandia Mountains. The site is more particularly described as a parcel of land situated in Section 11, Township 10 North, Range 3 East being more particularly described at Lot 94, Kachina Hills, Unit 1.

Figure 1, the Vicinity Map depicts the location of the site.

The parcel is approximately 3.6 acres in size and will be developed as a 25-unit townhouse complex with all units to be built on individually owned lots. Presently the site is undeveloped, with the terrain sloping east to west at approximately 5%.



VICINITY MAP
SCALE: 1" = 800'

H-23

FIGURE 1

DESIGN CRITERIA

The analysis of storm runoff for the site is based upon the Rational Method, as outlined, in the City of Albuquerque's "Development Process Manual" Volume II. This approach determines the peak discharge and associated volume of runoff for the specified design storm (100-year frequency, 6-hour duration) falling on the study area. Street capacities are determined by the Manning equation. Pipe capacities are determined by the Hazen-Williams equation and the orifice equation.

EXISTING DRAINAGE CONDITIONS

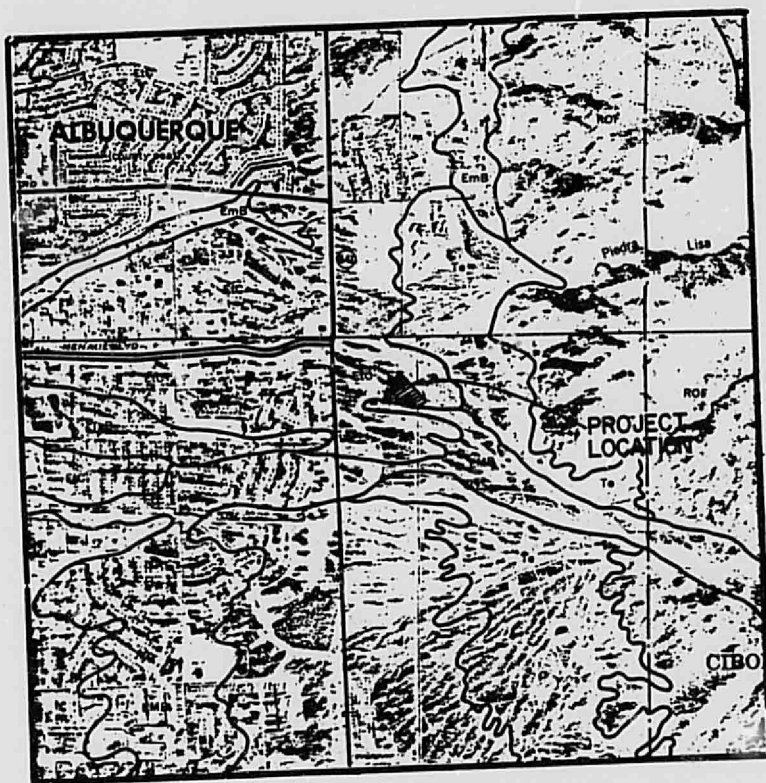
The site is bounded on the south and east by residential housing, on the west by Butterfly Maiden Trail, N.E. and on the north by Menaul Boulevard N.E. Butterfly Maiden Trail is a standard 32' wide residential paving section with Standard curb and gutter. Menaul Boulevard is a 37' wide asphalt street section with Standard curb and gutter on the south side and temporary extruded asphalt curb on the north side. The Menaul right-of-way is 106 feet wide.

The existing drainage scheme affecting the site is shown in Figure 2. Runoff generated within Basin "B" is collected in Butterfly Maiden Trail and conveyed northwestward. Cattle-guard type inlet spans Butterfly Maiden Trail approximately 85' south of Menaul. This catch basin diverts the flows into a 36" storm drain which runs under Menaul and discharges into the Piedra Lisa Channel on the northside of Menaul. This channel has the capacity to carry the storm flows downstream.

The project site is protected from offsite flows generated within Basin "B" by a CMU garden wall on the south and east property lines. Storm flows generated in the backyards of the abutting property are carried westward along the wall, discharging into Butterfly Maiden Trail. Storm water generated on the project site sheet flows westward, where it is collected in Butterfly Maiden Trail and conveyed to the catch basin.

Quantative analysis of existing peak storm flows for the 100-year event (see appendices) indicate that 106 cfs is generated by off-site basin "B" and 6.6 cfs is generated on-site. The storm drain system which conveys the flows to the Pedra Lisa Channel has the capacity to handle 132 cfs.

As shown in Figure 2, the soil on the site has been classified by the Soil Conservation Service at EtC, Embudo-Tijeras complex. This is a gravelly fine sandy loam with medium runoff potential and moderate potential of water erosion.



BERNALILLO COUNTY SCS SOILS MAP SHEET 22 & 32 OF 66
FIGURE 3

PROPOSED DRAINAGE CONDITIONS

The proposed drainage plan, Figure 7, is included at the back of this report. The plan shows: 1) existing drainage conditions 2) existing contours at 1'-0" intervals 3) proposed drainage conditions 4) proposed contours at 1'-0" intervals and spot elevations 5) limit and character of proposed improvements and 6) location of proposed retaining walls.

The site contains only one drainage basin in the developed state, Basin A. This basin includes runoff from rooftops, front and side yards, and the street. This runoff accumulates in Cambridge Place and is conveyed into two single-c catch basins located at a low point in front of Lot 4. A water block will be constructed in Cambridge Place to prevent flows from Menaul Blvd., from entering the site. The catch basins divert the flow into an 18" RCP which runs between lots 3 and 4 (in a dedicated easement) which conveys the flows westward. The east end of the existing cattle-guard type catch basin located in Butterfly Maiden Trail will be modified to accept flows from the 18" RCP. The calculations in Appendix C demonstrate: 1) The 100-year storm runoff from the site, approximately 11.55 cfs, is adequately handled by the street (see Figure 4, the street cross-section). The worst condition is for a street slope of 1.94% where the 100-year flow is 8.0 cfs, and the street capacity is 18.0 cfs. 2) The flow in the street at the knuckle does not have capacity to jump the curb. The maximum depth of flow is 4.2". The height of curb above flow line is 6" at this point. 3) The storm runoff is adequately handled by the proposed street inlets and storm sewer. The 100-year runoff from the site is 11.6 cfs. The capacity of the inlets is 15.5 cfs. The inlet conditions of the 18" pipe has a capacity of 20.8 cfs. 4) The capacity of the 36" pipe in Butterfly Maiden Trail is not exceeded. (This assumes high density residential development for the entire contributing basin, Basin B, as outlined in Figure 3). The inflow from Butterfly Maiden Trail is 106.0 cfs. The inflow from the site is 11.6 cfs. The capacity of the pipe is 132 cfs. The capacity of the cattle-guard is 153 cfs.

The plan calls for multi-level buildings and retaining walls in order to conform to the strong slope. In doing so, the rooftop on lots 19 and 20 must be discharged through a small concrete lined channel in the rear of lot 21. Thus, a drainage easement has been provided across lots 20 and 21.

No backyard ponding is proposed; however, it has been assumed the rainfall in the backyard area will remain there and will infiltrate. As an added precaution, weep holes in the proposed wall along Butterfly Maiden Trail should be provided at 6" below finish floor. Lot grading and landscaping will be done entirely by the developer.

CONCLUSIONS AND RECOMMENDATIONS

1. The Piedra Lisa Channel has sufficient capacity to permit discharge from the developed site via the existing inlet and 36" pipe in butterfly Maiden Trail.
2. The individual lots shall be graded to provide positive drainage away from the pad in all directions.
3. Side yards (where possible), rooftops and front yards shall drain towards the street.
4. No backyard ponding is provided. However, the rain falling in the back yard will be retained and will infiltrate.
5. A storm drain easement will be dedicated between lots 3 and 4. Lots 20 and 21 shall also contain a drainage easement. No construction within the drainage easement which blocks storm flows shall be allowed.
6. No other drainage easements are required, as each lot shall be graded to contain flows within its property lines.
7. In the existing state, the peak discharge for the 100-year, 6-hour storm exiting the site is equal to 6.6 cfs; the peak discharge for Basin B is 106 cfs. This results in a peak discharge into the existing inlet in Butterfly Maiden Trail of 112.6 cfs.
8. In the fully developed state, the peak discharge for the 100-year, 6-hour storm exiting the site is 11.5 cfs; the peak discharge exiting Basin B (assuming high density development) is 106.0 cfs. This results in a peak discharge entering the existing inlet in Butterfly Maiden Trail of 117.5 cfs. The capacity of the inlet and storm sewer will not be exceeded, as it can handle 132.0 cfs.
9. The proposed improvements will not contribute to the flooding potential of adjacent sites.

CAMBRIDGE PARK HYDROLOGY - EXISTING STATE

Site:

Area = 155,945 sf = 3.58 Ac

% impervious = 0

C = 0.34 DMP Plate 22.2C-1

$Q_{100} = C i A$

$i = 6.84 P_6^{T_c^{-0.51}} = 5.39 \text{ in/hr}$

Where $P_6 = 2.55 \text{ in DPM Plate 22.1D-1}$

$T_c = 0.0078 L^{0.77} S^{-0.385} = 10 \text{ minutes (minimum)}$

$Q_{100} = 0.34 (5.39) 3.58 = 6.6 \text{ cfs}$

$V_{100} = C P_6 A = 11,270 \text{ cf}$

CAMBRIDGE PARK HYDROLOGY - DEVELOPED STATE

Basin A:

Area of basin = 137,400 sf = 3.15 Ac
Impervious area = 98,060 sf
Z impervious = 71
C = 0.68 DPM Plate 22.2C-1
Q₁₀₀ = C_{1A} Rational Equation

Where $i = 6.84 P_6 T_c^{-0.51} = 5.39$ in/hr

P₆ = 2.55 in/hr DPM Plate 22.1D-1

T_c = 10 minutes (minimum)

Q₁₀₀ = 11.55 cfs

V₁₀₀ = 19855 cf

Basin B:

(Contributory basin to inlet in Butterfly Maiden Trail)

Area of basin = 31.2 Ac

L = 2000 ft

Drop = 46 ft

Slope = 0.0023 ft/ft

Z impervious = 71 (Assumes high density development)

C = 0.68

i = 5.0 in/hr

T_c = 11.6 minutes

Q₁₀₀ = 106.0 cfs

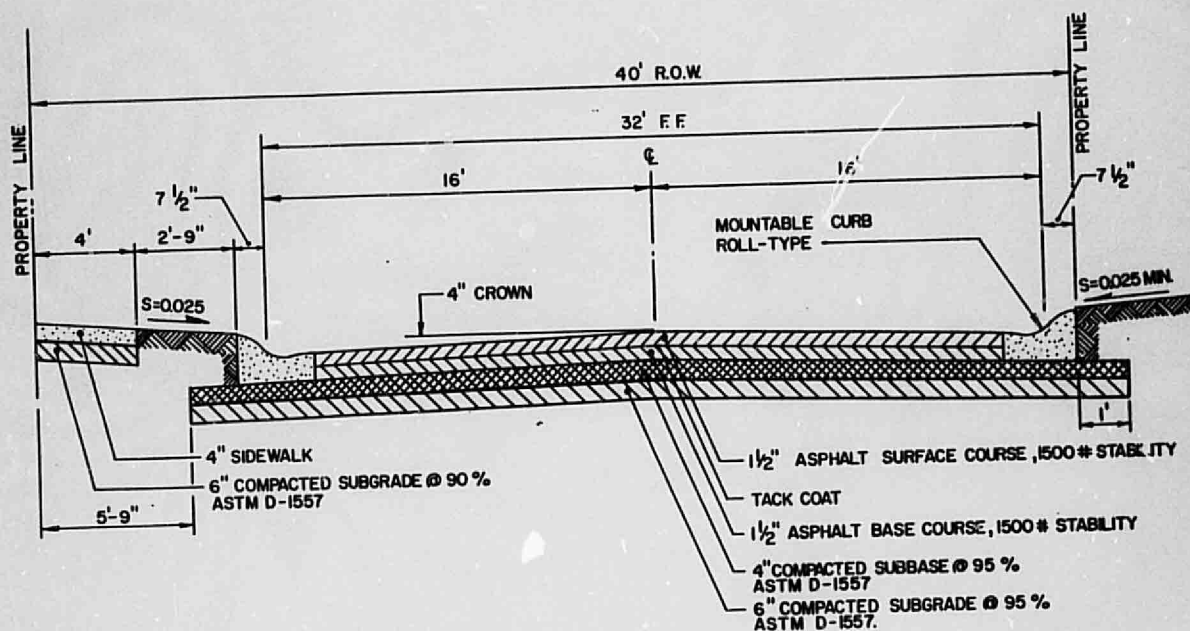
I) Street Capacities (see figure 4)

Manning Equation: $Q = \frac{1.49}{n} AR^{2/3} S^{1/2}$

Where

1.49 = conversion
 n = Manning coefficient = 0.020 for streets
 A = cross sectional area, sf (= 5.62sf)
 R = hydraulic radius, ft (= 0.169 ft)
 S = slope, ft/ft (varies, see table)
 Q = capacity, cfs (see table)
 V = velocity, fps = Q/A (see table)

S	Q	V
Slope	Capacity	Velocity
0.0075	11.0	1.96
0.0180	17.1	3.04
0.0194	17.7	3.15
0.0700	33.6	5.99



STREET PAVING SECTION
NO SCALE

FIGURE 4

II) Depth of Water at Knuckle

Contributing basin:

Area = 98,900 sf = 2.3 Ac
Q = 0.68(5.39)2.3 = 8.4 cfs
A_{8.4} = 1.93 sf
depth y = 0.196 ft

Flow around bend:

$$\Delta y = \frac{v^2 B}{gr}$$

Where

v = velocity, fps
B = width of channel (street), ft
g = acceleration of gravity ft/sec²
r = radius of bend, ft

at knuckle, slope = 0.01945:

$$\Delta y = \frac{(3.2)^2 (33.25)}{32.2 (63.24)} = 0.167 \text{ ft}$$

Y + Δy = 4.3" at critical point.
Height of curb from flowline = 6"

III) Capacity of Proposed catch-basins in Cambridge Place

Inlets:

Single C

$$Q = C_d K A \sqrt{2gh}$$

$$C_d = 0.74$$

$$K = \text{clog factor} = 0.67$$

$$A = \text{effective area of inlet} = 3.14 \text{ sf}$$

$$Q = \text{inlet capacity}$$

$$g = \text{acceleration of gravity} = 32.2 \text{ ft/sec}^2$$

$$h = \text{head} = 0.67 \text{ ft}$$

$$Q = 10.2 \text{ cfs (each side)}$$

IV) Capacity of Storm Drain between lots 3 and 4:

18" PIPE:

$$Q_{100} = 11.55 \text{ cfs}$$

Orifice equation:

$$Q = C_d A_d \sqrt{2gh}$$

$$C_d = \text{coefficient} = 0.74$$

$$A_d = \text{cross sectional area} = \frac{\pi d^2}{4} = 1.77 \text{ sf}$$

$$g = 32.2 \text{ ft/sec}^2$$

$$h = \text{head} = 3.92 \text{ ft}$$

$$Q = 20.8 \text{ cfs pipe capacity}$$

V) Street Capacity of Butterfly Maiden Trail

- a) curb to curb
DPM Plate 22.3 D-1
Full street capacity = 54 cfs

- b) right-of-way to right-of-way

Manning Equation:

$$Q = \frac{1.49}{n} AR^{2/3} S^{1/2}$$

$$\begin{aligned} A &= 29.60 \text{ sf} \\ R &= 1.15 \text{ ft} \\ n &= 0.025 \\ S &= 0.013 \text{ ft/ft} \\ Q &= 122.3 \text{ cfs} \end{aligned}$$

VI) Butterfly Maiden Trail cattleguard catch basin capacity

Orifice Equation:

$$\begin{aligned} Q &= C_d K A \sqrt{2gh} \\ A &= 0.6(2.46) \text{ } 32 = 47.2 \text{ sf} \\ C_d &= 0.74 \\ K &= \text{clog factor} = 0.67 \\ h &= 0.67 \text{ ft} \\ Q &= 153 \text{ cfs} \end{aligned}$$

VII) 36" Storm Sewer capacity

Orifice Equation:

$$\begin{aligned} Q &= C_d A_d \sqrt{2gh} \\ C_d &= 0.74 \\ A_d &= 7.07 \text{ sf} \\ g &= 32.2 \text{ ft/sec}^2 \\ h &= 4.17 \text{ ft} \\ Q &= 132 \text{ cfs} \end{aligned}$$