MASTER DEVELOPMENT DRAINAGE STUDY FOR SKYWAY HEIGHTS COLORADO SPRINGS, COLORADO

April 1992

Prepared for:

SCHUCK INTERESTS

Prepared by:

KLH Engineering, Inc.
208 Sutton Lane
Colorado Springs, CO 80907
(719) 594-4200

May 11, 1992

Mr. Dave Lethbridge
City of Colorado Springs
Engineering Division
30 South Nevada Avenue
Colorado Springs, CO 80903

Re: Master Development Drainage Study for Skyway Heights
(KLH Project No. 91-559-00)

Dear Dave:

In accordance with the subdivision regulations for the City of Colorado Springs, a Master Development Drainage Study has been completed for the above referenced project. The results of the study are included herein.

Please contact us if you have any questions or desire further information.

Sincerely,
KLH Engineering, Inc.

Brian J. Huth

Brian J. Huth, P.E.

Enclosure
skyway\mstrdrpt.doc

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DRAINAGE PLAN STATEMENTS

ENGINEER'S STATEMENT:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City/County for drainage reports and said report is in conformity with the master plan of the basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Kent D. Rockwell, P.E. 23086 3/11/92

Kent D. Rockwell, P.E.

COLORADO REGISTERED KENT D. ROCKWELL 23086 PROFESSIONAL ENGINEER

DEVELOPER'S STATEMENT:

I, the developer, have read and will comply with all the requirements in this drainage report and plan.

BY: Jay E Hilbert Agent Date: _____

TITLE: Skyway Heights LTD.

ADDRESS: Suite 1280 Holly Sugar Bld

Colo Spgs Co 80903

CITY OF COLORADO SPRINGS

Filed in accordance with Section 15-3-906 of the code of the City of Colorado Springs, 1980, as amended.

for. 3/11/92

CITY ENGINEER DATE

SKYWAY HEIGHTS
MASTER DEVELOPMENT DRAINAGE STUDY
April 1992

I. INTRODUCTION

This study, titled the "Master Development Drainage Study for Skyway Heights", was authorized by Schuck Interests. This study has been prepared and submitted in conjunction with the approval process for this development, and fulfills the drainage and flood plain management requirements for the City of Colorado Springs.

The approved "Skyway Heights Subdivision, Drainage Report and Plan", dated January, 1982, by Leigh Whitehead and Associates preceded this study and is on file with the City of Colorado Springs. This Whitehead study was developed under the 1977 criteria and does contain topography of the original site.

FLOOD PLAIN

Flood Insurance Rate Map (FIRM) Community Panel Number 080060-0259 B, indicates that no portion of this site is located within or adjacent to a flood hazard area.

SUMMARY OF DATA

The sources of information used in the development of this study are listed below:

1. City of Colorado Springs and El Paso County "Drainage Criteria Manual", October 1987.

2. Soil Survey for El Paso County, Colorado, U.S. Department of Agriculture, Soil Conservation Service, June 1980.

3. "Flood Insurance Studies for Colorado Springs and El Paso County, Colorado", prepared by the Federal Emergency Management Agency (FEMA), 1985.

4. "Bear Creek - Drainage Basin Planning Study", prepared by Kiowa Engineering Corporation, November 1991. This study has been approved by City of Colorado Springs Drainage Board and is waiting for approval from City Council.

5. "Skyway Heights Subdivision, Drainage Report and Plan", prepared by Leigh Whitehead and Associates, January, 1982.

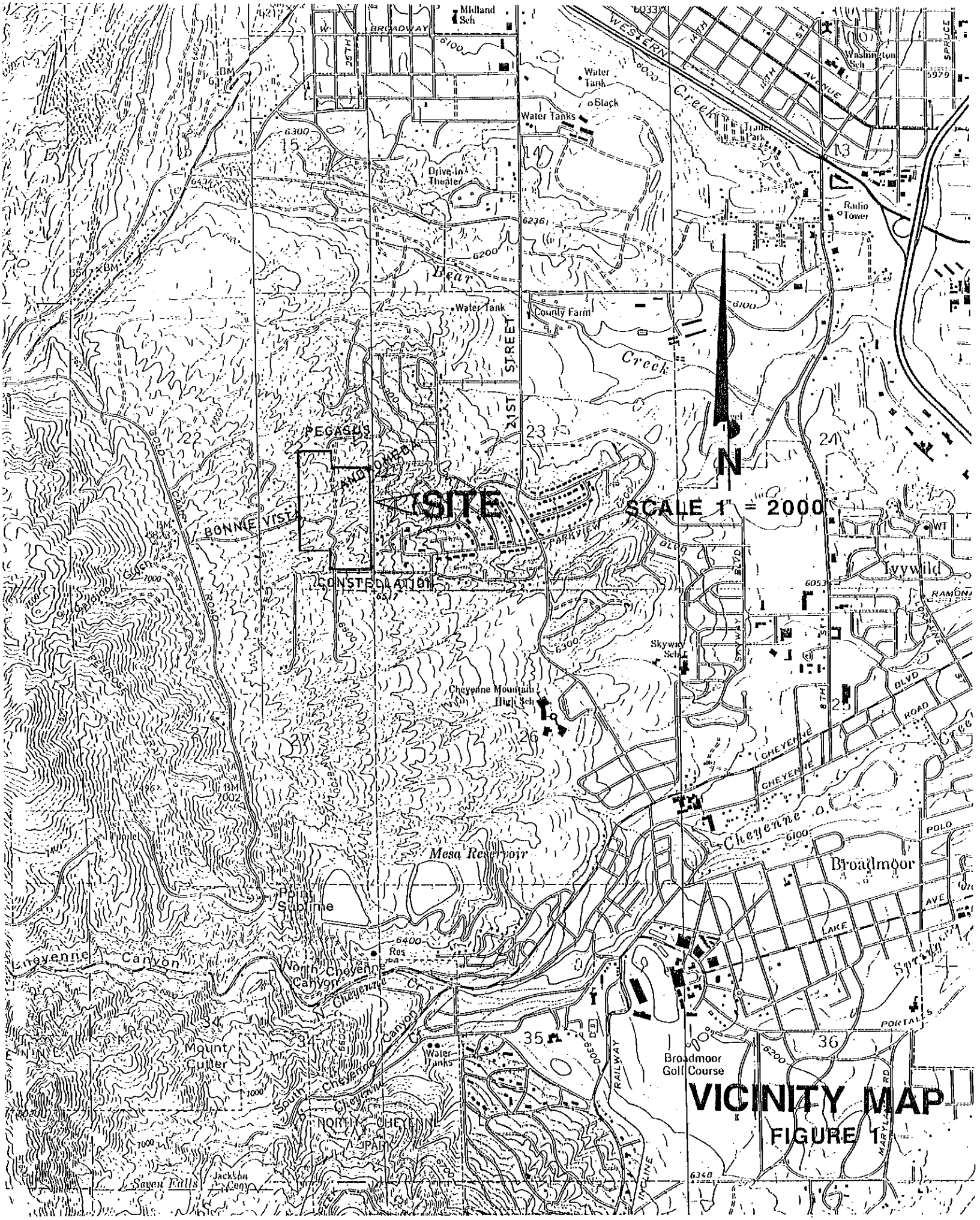
6. "Drainage Report Addendum for Skyway Heights Subdivision", prepared by United Planning and Engineering Co., Inc, June 26, 1986.

MAPPING AND SURVEYING

The sources of mapping and field information used in this study are listed below:

1. "Colorado Springs" and "Manitou Springs" 7.5 Minute Series Quadrangle Maps prepared by the U.S. Geological Survey (USGS).

2. Topographic Map, scale 1"=50', provided by KLH Engineering, Inc. on February 3, 1992.



VICINITY MAP

FIGURE 1

II. HYDROLOGIC ANALYSIS

STUDY AREA DESCRIPTION

The site is located within the southeast quarter of section 22, Township 14 South, Range 67 West of the 6th P.M., City of Colorado Springs, El Paso County, Colorado (see Vicinity Map, Figure 1). The site is bounded on the north, west and east by private land and on the south by Constellation Drive. The intersection of Andromeda Drive and Pegasus Drive is situated within the site. The area is drained by Bear Creek (see Appendix A). The parcel is approximately 2280 feet long (north to south) by 1300 feet wide and contains 59.57 acres (54.20 acres are being platted).

The site is located within Colorado Springs and is zoned "Planned Unit Development" (PUD). Adjacent zoning and landuses consists of "Agricultural" (A) to the south and west, "Estate - Single Family Residential" (R) to the north, southeast and southwest. Densities range from 1/2 acre to over 3 acres per unit. Development in the site will consist of about 94 lots for single family residences with densities around 1.6 dwelling units per acre. The original PUD zoning created a higher density development resulting in increased impervious areas and runoff. With the replatting of the site to a lower density use, the impervious areas are reduced, thereby decreasing the potential runoff.

SOILS DESCRIPTION

According to the Soil Survey of El Paso County, the underlying soils on the site consists of the Chaseville series (No. 17). This soil type falls within the hydrological group "A". Due to the "hillside" nature of the area with the restricted construction and controlled grading, the soil classification of "A" will also be used for the developed condition. The Kutler series (No. 46) is located on the off-site area west of Gold Camp Road. This is classified as a "C/D" soil. See the Soils Map, Figure 2.

CLIMATE

This area of El Paso County can be described as the foot-hills, with total precipitation amounts typical of a semi-arid region. Winters are generally cold and dry, and summers relatively warm and dry. Precipitation averages about 17 inches per year, with the majority of this moisture occurring in spring and summer in

the form of rainfall. Thunderstorms are common during the summer months.

DRAINAGE CRITERIA

The current City of Colorado Springs/El Paso County Drainage Criteria was utilized in the preparation of this study. Calculations were performed to determine the runoff quantities generated during the 10 year and 100 year frequency storms for both the historic and developed conditions. The Rational Method was used according to criteria for basins less than 100 acres.

The Soil Conservation Service (SCS) method was used in the routing of flows through detention ponds and was used for the Gardiner Gulch drainageway. This gulch has a tributary area greater than 100 acres. Excerpts from the proposed Bear Creek Drainage Basin Planning Study are included in Appendix A which includes basin maps and flow summaries.

EXISTING DRAINAGE PATTERNS

ON-SITE FLOWS:

The terrain of the area slopes to the east with approximate slopes along the ridges and channels of ten to eleven percent (10% - 11%) (see Drainage Plan, Exhibit 1). Slopes adjacent to drainageways approach 40%. The site is situated on the foothills in the southwest portion of Colorado Springs. These foothills are made up of decomposed granite alluvium which has eroded from the adjacent mountain side. The existing ground cover consists of scrub oak with sparse native grasses. The existing development consists of a network of paved streets, 1 single family home and infrastructure including drainage improvements.

For the historic condition runoff calculations, the site is described by 8 primary and 12 secondary on-site basins (see Existing Drainage Plan, Exhibit 1). See Table 1, the Basin Flow Master Summary, and Appendix B, for more hydrologic sub-basin information.

For this study, the historic condition represents the existing platted site. This includes the existing infrastructure, with the streets and drainage structures in place at the date of this report. For hydrologic calculation purposes, the basin areas and time of concentrations for the primary drainageways will be the same for the historic and developed flows. This assumption seems reasonable due to the shape and natural state of these

drainageways. The shapes of the basins will remain long and thin and the natural ground will remain mostly undisturbed through development. The 8 primary basins represents the site outfall locations with developed tributary areas greater than 2 acres.

The 12 secondary basins are small basins, less than 2 developed acres, that sheet flow off the site. These secondary basins will have little to no change in runoff and do not show any signs of detrimental erosion or flooding danger. Some of these basins have a decrease in flow due to development. The secondary basins are labeled M1 through M12, (M for Miscellaneous). The historic basin areas of these 12 basins are representative of the true historic basins and may vary from the developed areas. These historic areas and flow paths were checked with the original pre-construction topo as found in the 1982 Leigh Whitehead drainage study.

OFF-SITE FLOWS:

The existing 2-3 acre hillside residential development status will be used for the developed and existing off-site hydrologic calculations. There are 13 off-site basins tributary to the site (see Off-Site Basin Map, Figure 3). The sizes of these basins range from less than 1 acre to 25 acres. These are long thin basins with length-to-width ratios ranging from 5:1 to 9:1. The basins lengths range from 200 feet long to 2500 feet long. The hydrology summary tables are in Appendix B.

Basin OS-9 receives additional flow from a flow diversion that occurs at Gold Camp Road (GCR) and Bonnie Vista Drive. The 100 year flows tributary to this intersection are split with 50% (approximately 80 cfs) flowing north along GCR and 50% flowing into off-site basin 9 (see Appendix A for an excerpt of the proposed Bear Creek DBPS). The tributary area to this intersection is about 0.29 square miles (185 acres). The total tributary area to Skyway Heights from this drainageway is about 205 acres. This tributary is called Gardiner Gulch. The hydrologic model, HEC-1, was used to supplement the Rational Method calculations for this gulch. This supplement provided only the 100 year flow. The 10 year flow was determined from the Rational Method and did not include the area west of GCR.

PROPOSED DRAINAGE PATTERNS

Previous studies provided information on the pond capacities, inlet sizes, culverts (types, sizes, slopes, lengths and invert elevations), and street slopes. These drainage structures were field verified by KLH.

There are four sets of basins delineated and analyzed in this study; 1) the 13 off-site basins tributary to the site, (OS-1 through OS-13) 2) the 12 small miscellaneous basins that sheet flow off the site onto private land, (M1 through M12) 3) the 8 primary drainageways that flow through the site, (1 through 8) and 4) the small "inlet" basins within the primary drainageways that drain to inlets or swales (I1 through I21). Appendix B contains hydrologic summary tables of these four analysis groups. An additional analysis in Appendix B, "On-site Flows", compares the developed and the historic flow generated on site through the primary drainageways. See the Master Development Drainage Plan in the pocket and the off-site drainage map, Figure 3.

The design points for the primary drainageways include flows from the off-site basins and flows from the inlet basins. Many of the inlets are on a slope and do not pick up all the flows tributary to them. Due to the street layout, some of these "flow-by" flows pass one drainageway and continue into another. Each "inlet" basin area is proportioned and divided according to the percent of flow captured at that inlet. That proportioned inlet area is added to the area of the primary basin draining that inlet. Inlets in sump have 100 percent capture of flows. See Table 3 for a summary of inlet flows and hydraulics.

The 12 small miscellaneous basins generate runoff that sheetflows off the site on to adjacent private land. Historically, these locations have always drained onto private land. The differences in flow from historic to the proposed developed condition will be based on the historic state that existed prior to the installation of roads (1987). Typically, the historic basins were larger than their present size. The topographic map representing this historic state is available in the previous 1982 drainage study. Of the 12 miscellaneous basins, only M8 has increased flows above the historic rate. The outfall for drainageway 7 also discharges developed flows that are higher than the historic rate. A letter was provided by the adjacent land owner accepting developed flows based on the previous development plan and drainage criteria from basin M8 (Carina View) and a copy of this letter is in the previous drainage study. All the remaining discharge points release runoff at a rate equal to or below the developed rate, or discharge into public systems.

Increased volumes have been proposed for several of the ponds to increase the detention capabilities. The existing culverts have been determined to be hydraulically adequate to pass the flows without requiring overtopping of the ponds (with the proposed volumes). Several of the ponds have more capacity than is needed. See Table 2 for a summary of pond flows and water depths.

The table below provides a comparison of the basin flows from the Bear Creek DBPS with the flows calculated in this study. There are four locations within Skyway Heights where a similar comparison can be made. Skyway Heights design points; 1.4, 2.4, 5.3 and 678 are at the same locations as the respective Bear Creek basins; 33, 32, 31 and 28. Design point 678 (and basin 28) is located about 100 feet north of the site on Pegasus Drive where basins 6, 7 and 8 combine.

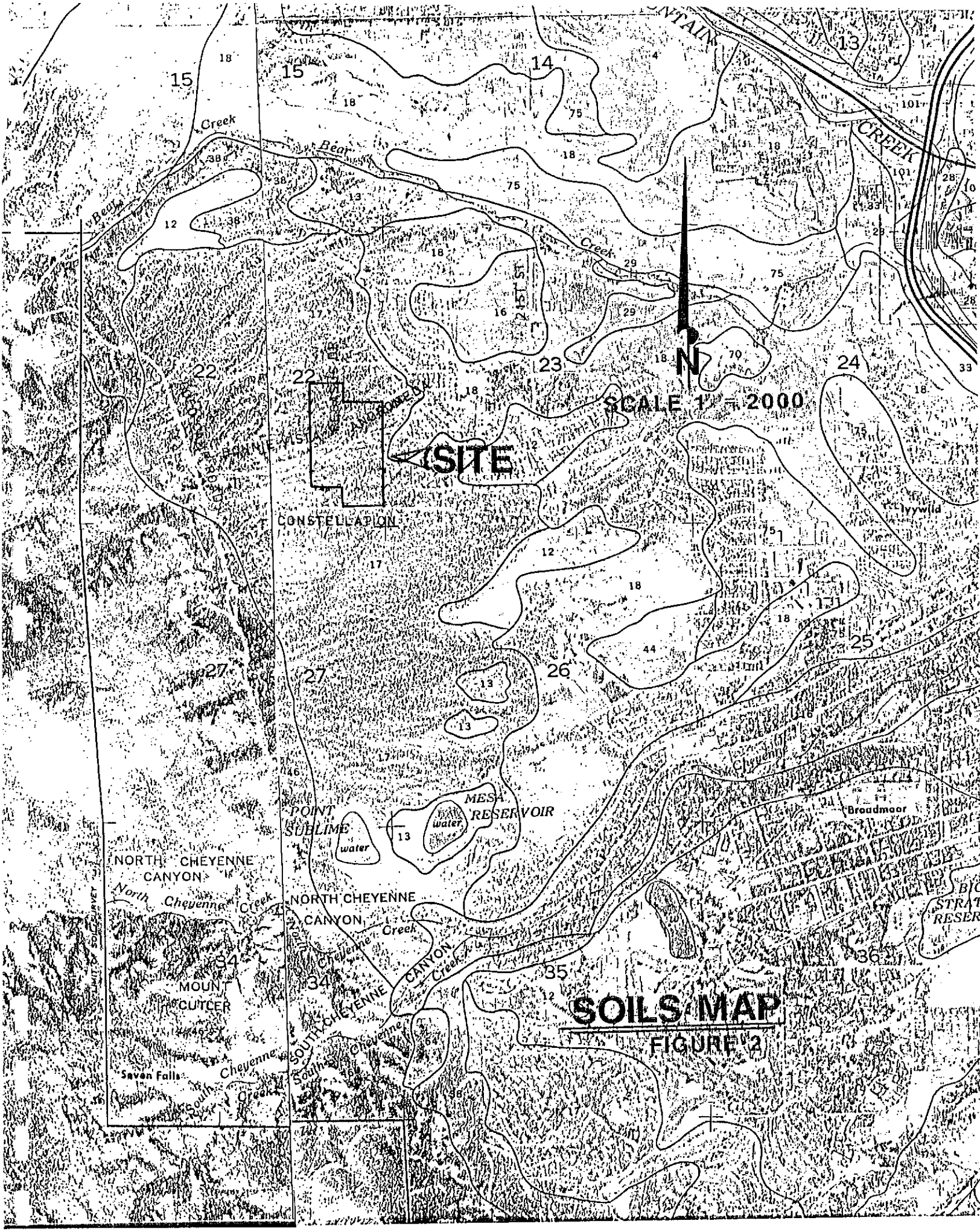
The following is a comparison of these flows. The higher of the 2 hour or 24 hour flow from the Bear Creek Study is shown.

Skyway Heights		**Bear Creek**	
	10 yr / 100 yr		10 yr / 100 yr
DP 1.4	31 / 60	Basin 33	20 / 60
DP 2.4	24 / 47	Basin 32	10 / 30
DP 5.3	30 / 121	Basin 31	20 / 50
DP 678	50 / 94	Basin 28	20 / 70

As you can see, the Rational Method used in the Skyway Heights study provides higher results.

HEC-1, HYDROLOGIC MODEL

For modelling the ponds, the Corps of Engineers HEC-1 model was used. This model uses the kinematic wave method along with the SCS curve numbers. The models were set up and the basin parameters were adjusted to match the Rational Method flows for each basin. Once the HEC-1 flows matched the Rational flows, the pond stage-storage-discharge relationships were installed and routed to determine the impacts, if any, the ponds had on the HEC-1 flows. Two different runs were performed based on the volumes of the ponds. One used actual, existing volumes as calculated from the topo, the other run used volumes derived from regrading the ponds to increase their volumes. These HEC-1 models were used for routing flows through the ponds and were used to route the 80 cubic feet per second flow diversion from Gold Camp Road through Gardiner Gulch. The results of the HEC-1 runs are shown on Table 2. The HEC-1 printouts are in the technical addendum and are on file at KLH for review.



SOILS MAP

FIGURE 2

MATCHLINE SHEET 1

GOLD CAMP ROAD OUTFALL SEGMENT 5, SEE TYPICAL SECTION SHT. 5

CONCRETE CHECK

PROVIDE 4'H x 7' W SBC w/ WINGWALLS @ 1.0% & OUTLET STRUCTURE

SEGMENT 6

6700

6750

6800

6850

6900

6950

7000

7050

7100

7150

7200

7250

7300

E-22

E-23

E-24

PROVIDE OUTLET STRUCTURE

GOLD CAMP ROAD OUTFALL SEGMENT 5 SEE TYPICAL SECTION SHT. 7, S = 3.0%

TYPE 'D' INLETS

APPROX. LOCATION OF FUTURE ORION DR.

UNPLATTED

CITY BNDRY BOUNDARY

GOLD CAMP ROAD OUTFALL SEGMENT 4, SEE TYPICAL DETAIL SHT. 7. S = 4.6%

8 DROP STRUCTURES SEE DETAIL SHT. 5A

PROVIDE OUTLET STRUCTURE

GOLD CAMP ROAD OUTFALL CHANNEL

TYPE 'L' INLET

GOLD CAMP ROAD OUTFALL SEGMENT 3, SEE TYPICAL SECTION THIS SHEET. S = 2.0%

UNPLATTED

TOP OF SKYWAY (UNPLATTED)

SUBDIVISION BOUNDARY

CITY OF COLO. SPGS.

EL PASO COUNTY

PROVIDE OUTLET STRUCTURE

PROVIDE 40 LF 48" RCPA w/ FES & OUTLET STRUCTURE

PROVIDE 350 LF 24" RCP

PROVIDE OUTLET STRUCTURES

TO POINT OF BEGIN.

ROAD — SHOULDER, 4' typ. 16' — EX. SLOPE

1.5' — 2.0' — 1 — 3

100 YR. WS

4' — GRASS-LINED SLOPE w/ EROSION NETTING, SEE DETAIL THIS SHEET — TYPE 'L' INVERT

GOLD CAMP ROAD OUTFALL CHANNEL SECTION SEGMENT 3

ALL DRAINAGE/FACILITIES SHOWN ARE FOR PLANNING PURPOSES ONLY. THE DESIGNER IS RESPONSIBLE FOR VERIFICATION OF THE HYDROLOGY, THE HYDRAULICS, & THE REQUIRED LOCATIONS OF ALL FACILITIES DURING FINAL DESIGN.

PROVIDE OUTLET STRUCTURE SEE DETAIL SHEET 4

PROVIDE OUTFALL STRUCTURE

PROVIDE OUTFALL STRUCTURE

PROVIDE OUTFALL STRUCTURE, SEE DETAIL SHT. 5A

GULCH

CHANNEL IMPROVED

KNOX VISTA

PROVIDE OUTLET STRUCTURE

PROVIDE OUTLET STRUCTURE

PROVIDE 2-30" R-10-R INLETS OVER EX. 30" RCP & INSTALL 2 CONC. PIPE FROM INLET TO GOLD CAMP ROAD

13

12

11

10

9

8

7

6

5

4

3

2

1

SKYWAY HEIGHTS

MATCHLINE SHEET 5

MATCHLINE SHEET 7

N

0 100 200 300 400 500

SCALE IN FEET

OFF-SITE BASIN MAP

FIGURE 3

Kiowa Engineering Corporation
418 W. Bijou Street
Colorado Springs, Colorado
80905-1308

BEAR CREEK DRAINAGE BASIN PLANNING STUDY

PRELIMINARY PLAN

Project No.	88.12.26
Date:	10/89
Design:	RNW
Drawn:	EAK
Check:	
Revisions:	

BEAR CREEK 4

SKYWAY HEIGHTS
JOB NO. 91-559-00

TABLE 1
BASIN HYDROLOGY - HISTORIC & DEVELOPED
- MASTER SUMMARY -

	LOCATION	TRIBUTARY AREA (ACRES)	***** PEAK FLOW ***** **** HISTORIC **** 10 YEAR (CFS)	100 YEAR (CFS)	*** DEVELOPED *** 10 YEAR (CFS)	100 YEAR (CFS)
OFF-SITE FLOWS:	OS-1	25.56			25	48
	OS-2	2.4			2.7	5.5
	OS-3	1.43			1.8	3.5
	OS-4	7.69			7.6	15.4
	OS-5	8.98			9	18
	OS-6	n/a				
	OS-7	4.04			4.6	9.2
	OS-8	0.24			0.3	0.7
	OS-9	209 (19.65)			20	112 (39)
	OS-10	4.61			5.3	10.5
	OS-11	0.7			1	2.1
	OS-12	3.16			3.9	7.8
	OS-13	21.33			21	42
PRIMARY DRAINAGEWAYS: On-site Flows only	1	6.26	8.1	16.8	9.7	19.3
	2	13.37	17	36	23	45
	3	2.61	3.7	7.4	4.5	8.5
	4/5	15.71	20	42	29	56
	6	8.9	10	20	16	28
	7	3.27	4.7	9.5	6.3	11.9
	8	1.88	2.9	5.8	2.9	5.8
PRIMARY DRAINAGEWAYS: With On-site and Off-site Flows	1	34.22	31	62	27 [32]	43 [64]
	2	31.31	29	57	19 [33]	33 [63]
	4	8.35	11	22	17	30
	5	220 (30.59)	28	96 (56)	27 [30]	99 [119 (59)]
	4/5	228 (39.44)	37	99 (73)	35 [43]	108 [129 (82)]
	6	9.14	11	21	17	29
	7	7.88	8	16	9.1	18
	8	27.07	26	52	26	52
	6/7/8	45.64	44	86	50	94

By: bjh 04-Mar-92 Skyway\flowsmry.wq1

NOTE: 1) For the other minor on-site basins, (the inlet and miscellaneous basins), see the appropriate tables.
2) The figures in ( ) do not include flows from Gold Camp Road.
3) The figures in [ ] are undetained flows.

III. HYDRAULIC ANALYSIS

GENERAL DESCRIPTION

The hydraulic analysis for Skyway Heights includes detention ponds, inlets, street capacities, natural drainageways, drop structures and erosion control structures. The natural state of the existing drainageways will be left undisturbed as much as possible. Where erosion or hydraulic flow control is needed, a natural approach to the problem will be utilized as much as possible.

ON-SITE HYDRAULICS

DETENTION PONDS:

The 10 and 100 year flows were routed through the existing detention ponds to determine the character of each pond. As mentioned above, two different pond volumes were tested while utilizing the existing outlet hydraulics. New volumes were proposed to try to maximize the detention to reduce the runoff leaving the site. With the proposed volumes it was determined that the existing pond culverts would be adequate without any revisions, except for inlet or outlet repair, where necessary. See table 2 for a summary of pond hydraulics with inlet/outlet flows and water surface depths. Some of the ponds will require regrading to increase the storage volume. Rip-rap and/or timbers may be installed where required to attain the increased volumes. Some of the ponds may require a low-flow channel that would be able to carry the sediment supply through the pond. This would maintain the sediment supply and demand balance which would reduce some of the erosion occurring below some of the ponds.

INLET/STREET CAPACITY:

Hydrologic basins were analyzed and flows determined for each of the inlets on the site. Then for each inlet, the flow "pick-up" and "flow-by" was calculated knowing the inlet size and street slope. It is determined that all the inlets provided proper street drainage. There were no locations on the site where the street capacities were exceeded. (See Table 3, "Inlet Hydraulic Summary" for more information). The street classification used was the "residential" street which allowed 10 year flow depth to reach the crown, and the 100 year depth to be no more than 12 inches. For additional protection, an 8 inch maximum depth was used for the 100 year storm. The "hillside residential" classification was ruled out for the public streets because the

actual public streets are 32 feet wide where the "hillside residential" street is for widths less than 32 feet. For the private streets, the capacities were calculated with a full street flow to the top of a type II curb, (6" ramp curb).

GRADE CONTROL STRUCTURES:

Grade control structures will be installed at locations where erosion or headcutting exists or is expected. The structures will be constructed out of rock and/or timber. The slopes of the stable channels through the site may be changed slightly. These relatively stable drainageways are in an equilibrium with respect to the sediment demand/supply. The off-site basins will not change enough to significantly alter the sediment supply or runoff required to carry the sediment through the natural drainageways. The natural drainageways require this sediment supply to maintain the supply/demand balance required to keep these channels from eroding or silting.

OFF-SITE HYDRAULICS

The outfalls for runoff from Skyway Heights are both public and private. The two public outfalls are Andromeda Drive and Pegasus Drive. These will convey the largest volumes of flow from the site.

Andromeda Drive has an existing storm sewer that extends into the site. This storm sewer drains two inlets, a 10 foot (inlet 14) and a 15 foot (inlet 15) D-10-R type curb opening inlet with rear opening for additional flow. An 18 inch RCP connects inlet 14 to inlet 15 which is then drained by a 21 inch RCP. According to the June of 1989 construction drawings by HDR Engineering, the design flows of the 21 and 16 inch pipes are 37.7 cfs and 16.5 cfs, respectively. This leaves 3.6/71 cfs (10yr/100yr) in the street. These flows are within the allowable street flows of 47/221 cfs (full street flow) for Andromeda Drive which has a street slope of 10%.

Where street flows in Pegasus Drive leave the site at the north property line, the street capacity is not exceeded (17/29 cfs). Drainageways 7 and 8 combine with street flows in Pegasus (DP6) about 100 feet north of Skyway Heights (DP 678). Assuming the landuse densities will remain the same for the off-site areas, these combined developed flows to Pegasus are 50/94 cfs (Off-site Design Point 678). Pegasus is 32 feet wide at the north end of the site, increasing to 36 feet wide north of Skyway Heights and the street slope starts out at 6.7% and increases to 8% and 9%. Using the 32 foot width with the 6.7% slope and the residential

classification, the 10 and 100 year street capacities (100 feet north of the site at DP 678) are 38 and 181 cfs. About 200 feet north of the property the street slope increases to 8% which provides about 41 cfs capacity (10 yr). Most of this proposed flow is from undeveloped areas above Skyway Heights.

SKYWAY HEIGHTS
JOB NO. 91-559-00

TABLE 2
POND HYDRAULIC SUMMARY
Existing Ponds - (10 year / 100 year Data)

Pond	1	2	3	4	5	6	8	9	10
Depth, Max (ft)	9.5'	5'	11.5'	10'	6'	7'	8'	9'	5.5'

ORIGINAL DESIGN VOLUMES:

Volume (cf)	39300	3025	24700	20550	2750	3975	21500	28550	4175
Flow In (cfs)	31/60	20/37	24/47	21/37	4/6	3/5	30/121	26/113	7/14
Flow Out (cfs)	19/36	20/37	15/26	21/34	3/5	2/5	25/112	23/100	7/15
Depth, Actual (ft)	5.4'/7.6'	3.6'/4.5'	4.1'/6.0'	4.5'/6.5'	2.7'/3.2'	2.6'/3.1'	1.9'/7.8'	2.2'/8.1'	2.1'/3.4'

EXISTING VOLUMES:

Volume (cf)	18557	1555	9906	20159	3940	6288	5258	1891	3570
Flow In (cfs)	31/60	27/47	21/37	29/49	4/6	4/6	30/121	31/121	7/14
Flow Out (cfs)	26/45	28/47	21/34	26/41	4/6	1/3	31/121	33/121	7/15
Depth, Actual (ft)	6.3'/9.6'	4.0'/5.0'	5.0'/8.2'	5.2'/8.1'	2.9'/3.5'	2.3'/2.7'	3.3'/8.9'	3.8'/10.2'	2.1'/3.4'

PROPOSED VOLUMES:

Volume (cf)	39065	1555	36342	20159	3940	6288	23898	22327	3570
Flow In (cfs)	31/60	27/42	24/47	21/35	4/3	3/5	30/121	27/109	7/14
Flow Out (cfs)	26/40	22/38	27/42	19/32	6/5	3/4	26/109	26/98	7/15
Depth, Actual (ft)	5.6'/7.6'	3.7'/4.6'	3.8'/5.4'	4.3'/6.1'	2.9'/3.2'	2.7'/3.1'	2.0'/7.6'	2.4'/7.9'	2.1'/3.4'

DETENTION SUMMARY:

Basin	1	2	4/5	7
W/O Detention	32/64	33/63	43/129 (82)	9/18
W/ Detention	27/43	19/33	35/108 (61)	9/18
Detained amounts	5/21	14/30	8/21 (21)	0/0

By: bjh 10-Apr-92 Skyway\Pondsmry.wq1

Note: The flows in ( ) do not include the overflow from Gold Camp Road.

SKYWAY HEIGHTS
JOB NO.91-559-00

TABLE 3
INLET HYDRAULICS

INLET #	SIZE (ft)	STREET SLOPE (%)		DESIGN FLOW (cfs)	FLOW SPREAD (ft)	DEPTH AT PAN (ft)	% of flow PICKUP (%)	INLET FLOW PICKUP (cfs)	INLET FLOW BYPASS (cfs)	ALLOWABLE STREET CAPACITY (1/2) ST. SECTION
5	6.0'	8.3%	10 YR.	1.7	5.90	0.12	0.28	0.5	1.2	20.6
			100 YR.	3	7.30	0.15	0.25	0.8	2.2	99
6	6.0'	8.3%	10 YR.	2.4	6.70	0.13	0.23	0.6	1.8	20.6
			100 YR.	4.1	8.20	0.16	0.22	0.9	3.2	99
8	6.0'	6.7%	10 YR.	0.9	4.90	0.10	0.38	0.3	0.6	18.8
			100 YR.	1.4	5.70	0.11	0.36	0.5	0.9	90
11	6.0'	4.0%	10 YR.	5.2	10.30	0.21	0.22	1.1	4.1	14.6
			100 YR.	9.2	12.80	0.26	0.22	2	7.2	70
12	8.0'	6.0%	10 YR.	0.9	5.00	0.10	0.50	0.45	0.45	17.8
			100 YR.	1.7	6.30	0.13	0.40	0.7	1	86
13	8.0'	6.0%	10 YR.	2.9	7.70	0.15	0.38	1.1	1.8	17.8
			100 YR.	5	9.40	0.19	0.30	1.5	3.5	86
14	10.0'	10.0%	10 YR.	4.5	8.20	0.16	0.34	1.5	3	23.6
			100 YR.	7.6	10.00	0.20	0.27	2.1	5.5	110
15	15.0'	10.0%	10 YR.	1.6	5.60	0.11	0.65	1	0.6	23.6
			100 YR.	2.8	6.90	0.14	0.56	1.6	1.2	110

Skyway\inlet.wq1

Inlets-on-grade (10 yr./100 yr.data)
Note: Inlets #1,2,3,4,7,9 &10 are sump inlets

IV. EROSION CONTROL PLAN

GENERAL DESCRIPTION

The objectives of this plan are to analyze the drainage characteristics of the site and to provide necessary designs so as to prevent damage to adjacent properties due to sediment or storm water runoff and to regulate the on-site effects of erosion. This study will present the methods to be used to control erosion.

The locations of drainage control and erosion control measures are shown on the erosion control plans, Exhibit 2. There is expected to be three phases of construction. The anticipated phases are described in a letter from the developer, as reproduced in Appendix C.

EROSION CONTROL MEASURES

Erosion control measures include treatment of cut and fill slopes, grade control structures, energy dissipators at pipe outfalls and low flow channels through the sediment ponds. The locations of the proposed features are shown on the erosion control and are approximate. These will require field verification prior to final design.

The approximate locations of cut and fill slopes requiring erosion control treatment are also shown on the erosion control plan. Field inspection prior to final design, was conducted during the week of April 30, 1992, to map anticipated areas requiring protection measures. Cut and fill slopes at Skyway Heights are generally steep, making reseeding efforts difficult. To control erosion from these areas, steep slopes may be reduced by terracing. Nutrient rich topsoil will then be graded into the reduced slopes to form a seedbed that will allow the establishment of vegetation to control erosion. The type of vegetation used will depend upon location. Mulching and netting may be used to provide a stable seedbed until a healthy vegetation cover can be established.

Erosion control in the form of hay-bale dams will be provided at locations of minor concentrated or sheet flow to provide temporary sediment control.

Due to the steep natural slopes and oversteepening caused by previous excavation of detention ponds, active channel erosion is a significant problem at the site. Much of the active erosion is due to headcuts that are migrating upstream from excavated detention ponds. To control this erosion, drop structures are included as a major component of the erosion construction.

Sloped drop structures are shown on the drainage plan at the inlet to each of the detention ponds. Two alternatives for drop structures include a sloping rip-rap drop and a small wooden drop structure. The wooden design has the advantage of requiring less heavy equipment for construction. The vertical drops into detention ponds 8 and 9 are on the order of 10 to 15 feet, which may require a series of drop structures to obtain the necessary drop. An alternative for these locations would be the use of a concrete or rip-rap chute channel. An important consideration in the design of the drop structures or chute channels is to ensure adequate transitions from the upstream channel to prevent flow from flanking the structures. This may require some grading or the use of additional rip-rap protection.

Excessive sedimentation in the existing detention ponds has resulted in buried outlet pipes and loss of pond capacity. The magnitude of this problem will be reduced when effective upstream erosion control measures are implemented (slope protection, channel stabilization). The problem can further be reduced during low flows by constructing a low flow channel from the inlet to the outlet structure. This will allow sediment to be flushed through the structure during times that flow is low enough that water is not detained in the pond. During large events when water is detained in the ponds, some sedimentation will be inevitable. For this reason, periodic maintenance will be required to ensure adequate detention capacity and operation of the outlets.

The maintenance of the ponds and the drainageways within Skyway Heights will be the responsibility of the Homeowners Association, as stated on the plat. It should be noted that the City Parks Department requested the dedication of Tract D, which contains drainage facilities. These facilities in Tract D, however, appear to be in stable condition and no additional improvements are proposed.

V. COST ESTIMATE

BASIN FEE DISCUSSION

The drainage fees for Skyway Heights are $ 1,520 per acre (1987 fees). The original acreage was 59.57 acres which included lot 113 (0.43 acres) which has been eliminated from this plat. Fees are required on the remaining acreage of 59.14 acres for a total of $ 89,893.00. The public streets have been eliminated from this re-plat but the fees are still required on this area. The bridge fees have previously been paid with the original plat.

CONSTRUCTION COST ESTIMATE

The drainage related construction costs for Skyway Heights fall into the three categories of; public drainage improvements, private drainage improvements and private erosion control. See the construction cost estimate, Table 4.

Proposed public drainage costs consist of regrading and stabilizing three detention ponds (1, 8 & 9). Although these ponds are private, these costs are considered public due to two reasons: 1) they receive developed flows from offsite properties and 2) the improvements will reduce the risk of overtopping onto public streets. The cost estimate for this work is $ 54,300. In addition, the original developer installed $ 41,509 worth of public inlets and culverts which would apply as a credit toward the required fees.

Private drainage improvements consist of regrading and/or stabilizing the remaining six detention ponds and stabilizing drainageways with timber or rip-rap drops and installing outfall protection at pipe discharge points. The costs for the private drainage improvements are approximately $ 158,700.

Erosion control consists of regrading portions of the site and installing slope protection at various locations through the site. The cost for the erosion control is approximately $ 75,200.

FEE SUMMARY

Lot 113 on the original plat was previously sold and $ 1000 in fees were paid. The $ 1000 paid was an estimate and exceeded the required amount due of $ 654 resulting in a credit of $ 346. This developer proposes additional public construction in the amount of $ 54,300. The City has agreed to allow this additional

construction cost as credit against the outstanding fees that are due. The total public improvements of $ 95,809 exceed the drainage fees due, therefore, no fees are required. However, any public costs in excess of the fees due are not eligible for reimbursement due to the current Bear Creek study.

It has been agreed upon between the developer and the City of Colorado Springs that financial assurances will be filed with the City of Colorado Springs prior to each phase of construction according to the anticipated drainage and erosion control costs for each phase of construction.

Cost Summary - Total Project

Previously Installed Public Drainage Improvements:	$ 41,509
Public Drainage Improvements To Be Installed:	$ 54,300
Private Drainage Improvements To Be Installed:	$ 158,700
Erosion Control:	$ 75,200
Total Construction Costs =	$ 329,709
Drainage Fees Due:	$ 89,893

Note: Public drainage facilities will be constructed in lieu of paying drainage fees. The City and the developer have agreed the cost of public drainage improvements in excess of drainage fees are not eligible for reimbursement.

TABLE 4 SKYWAY HEIGHTS - PHASE I

Private Cost Estimates:

Item	UNIT	Grade Control	Culvert Outlets	Wooden Drops	Pond Inlets & Trickle Channels	TOTAL	UNIT COST	TOTAL COST
Excavation	CY		521.1	436.8	791.4	1749.3	$7.00	$12,200
Riprap Type L	CY		115.3	218.4	22.8	356.5	$30.00	$10,700
Filter Fabric	SY		193.5	388.3	60.7	642.5	$3.00	$1,900
Grout	SY		193.5	388.3	60.7	642.5	$15.00	$9,600
Concrete	CY				1.9	1.9	$200.00	$400
Timbers 8' long	EA			437.0		437.0	$25.00	$10,900
saw cut	EA			112.0		112.0	$26.00	$2,900
Channel Vegetation	LF			960.0		960.0	$10.00	$9,600
SUBTOTAL								$58,200
Contingency 10%								$5,800
TOTAL								$64,000

Public Cost Estimates:

(For Ponds 8 and 9)

Item	UNIT	Grade Control	Culvert Outlets	Wooden Drops	Pond Inlets & Trickle Channels	TOTAL	UNIT COST	TOTAL COST
Excavation	CY					0.0	$7.00	$0
Riprap Type L	CY		145.3		372.9	518.2	$30.00	$15,500
Filter Fabric	SY		244.0		994.1	1238.1	$3.00	$3,700
Grout	SY		244.0		994.1	1238.1	$15.00	$18,600
Concrete	CY				12.7	12.7	$200.00	$2,500
Timbers 8' long	EA					0.0	$25.00	$0
saw cut	EA					0.0	$26.00	$0
Channel Vegetation	LF					0.0	$10.00	$0
SUBTOTAL								$40,300
Contingency 10%								$4,000
TOTAL								$44,300

Private Cost Estimates For Site Grading And Revegetation:

Item	UNIT	UNIT COST	Quantity	TOTAL COST
Excavation	CY	$4.00	8059	$32,200
Revegetation	SF	$0.25	57000	$14,300
SUBTOTAL				$46,500
Contingency 10%				$4,700
TOTAL				$51,200

TOTAL FOR PHASE I = $159,500.00 (Proposed Phase I Escrow Amount Per Letter From Schuck Interests, Inc.)

TABLE 4 SKYWAY HEIGHTS - PHASE II

Private Cost Estimates:

Item	UNIT	Grade Control	Culvert Outlets	Wooden Drops	Pond Inlets & Trickle Channels	TOTAL	UNIT COST	TOTAL COST
Excavation	CY	127.0	275.0	315.2	335.2	1052.4	$7.00	$7,400
Riprap Type L	CY	63.5	137.5	157.6	167.6	526.2	$30.00	$15,800
Filter Fabric	SY	149.4	230.8	280.3	447.2	1107.7	$3.00	$3,300
Grout	SY	149.4	230.8	280.3	447.2	1107.7	$15.00	$16,600
Concrete	CY	4.1			6.4	10.5	$200.00	$2,100
Timbers 8' long	EA			322.0		322.0	$25.00	$8,100
saw cut	EA			78.0		78.0	$26.00	$2,000
Channel Vegetation	LF			750.0		750.0	$10.00	$7,500
SUBTOTAL								$62,800
Contingency 10%								$6,300
TOTAL								$69,100

Public Cost Estimates:

Item	UNIT	Grade Control	Culvert Outlets	Wooden Drops	Pond Inlets & Trickle Channels	TOTAL	UNIT COST	TOTAL COST
Excavation	CY					0.0	$7.00	$0
Riprap Type L	CY					0.0	$30.00	$0
Filter Fabric	SY					0.0	$3.00	$0
Grout	SY					0.0	$15.00	$0
Concrete	CY					0.0	$200.00	$0
Timbers 8' long	EA					0.0	$25.00	$0
saw cut	EA					0.0	$26.00	$0
Channel Vegetation	LF					0.0	$10.00	$0
SUBTOTAL								$0
Contingency 10%								$0
TOTAL								$0

Private Cost Estimates For Site Grading And Revegetation:

Item	UNIT	UNIT COST	QUANTIT	TOTAL COST
Excavation	CY	$4.00	813	$3,300
Revegetation	SF	$0.25	49500	$12,400
SUBTOTAL				$15,700
Contingency 10%				$1,600
TOTAL				$17,300

TOTAL FOR PHASE II = $86,400.00 (Proposed Phase II Escrow Amount Per Letter From Schuck Interests, Inc.)

TABLE 4 SKYWAY HEIGHTS - PHASE III

Private Cost Estimates:

Item	UNIT	Grade Control	Culvert Outlets	Wooden Drops	Pond Inlets & Trickle Channels	TOTAL	UNIT COST	TOTAL COST
Excavation	CY		237.0	119.2	254.4	610.6	$7.00	$4,300
Riprap Type L	CY		58.8	59.6	63.8	182.2	$30.00	$5,500
Filter Fabric	SY		98.7	105.9	170.0	374.6	$3.00	$1,100
Grout	SY		98.7	105.9	170.0	374.6	$15.00	$5,600
Concrete	CY				3.3	3.3	$200.00	$700
Timbers 8' long	EA			120.0		120.0	$25.00	$3,000
saw cut	EA			30.0		30.0	$26.00	$800
Channel Vegetation	LF			230.0		230.0	$10.00	$2,300
SUBTOTAL								$23,300
Contingency 10%								$2,300
TOTAL								$25,600

Public Cost Estimates:

(For Pond 1)

Item	UNIT	Grade Control	Culvert Outlets	Wooden Drops	Pond Inlets & Trickle Channels	TOTAL	UNIT COST	TOTAL COST
Excavation	CY					0.0	$7.00	$0
Riprap Type L	CY		59.7		63.4	123.1	$30.00	$3,700
Filter Fabric	SY		100.2		169.1	269.3	$3.00	$800
Grout	SY		100.2		169.1	269.3	$15.00	$4,000
Concrete	CY				3.2	3.2	$200.00	$600
Timbers 8' long	EA					0.0	$25.00	$0
saw cut	EA					0.0	$26.00	$0
Channel Vegetation	LF					0.0	$10.00	$0
SUBTOTAL								$9,100
Contingency 10%								$900
TOTAL								$10,000

Private Cost Estimates For Site Grading And Revegetation:

Item	UNIT	UNIT COST	QUANTIT	TOTAL COST
Excavation	CY	$4.00	815	$3,300
Revegetation	SF	$0.25	11250	$2,800
SUBTOTAL				$6,100
Contingency 10%				$600
TOTAL				$6,700

TOTAL FOR PHASE III = $42,300.00 (Proposed Phase III Escrow Amount Per Letter From Schuck Interests, Inc.)

APPENDIX A

PROPOSED BEAR CREEK DRAINAGE BASIN PLANNING STUDY

- FLOW SUMMARIES AND BASIN MAPS -

BEAR CREEK

DRAINAGE BASIN PLANNING STUDY

Volume I

Prepared for:

City of Colorado Springs
Department of Planning and Development
City Engineering Division - MAIL CODE 435
Post Office Box 1575
Colorado Springs, Colorado 80901-1575

Prepared by:

Kiowa Engineering Corporation
419 West Bijou Street
Colorado Springs, Colorado 80905-1308

KIOWA Project No. 88.12.26
D15/R43

November 1991

TABLE 6: SUMMARY OF PEAK FLOW RATES FOR SUBBASINS

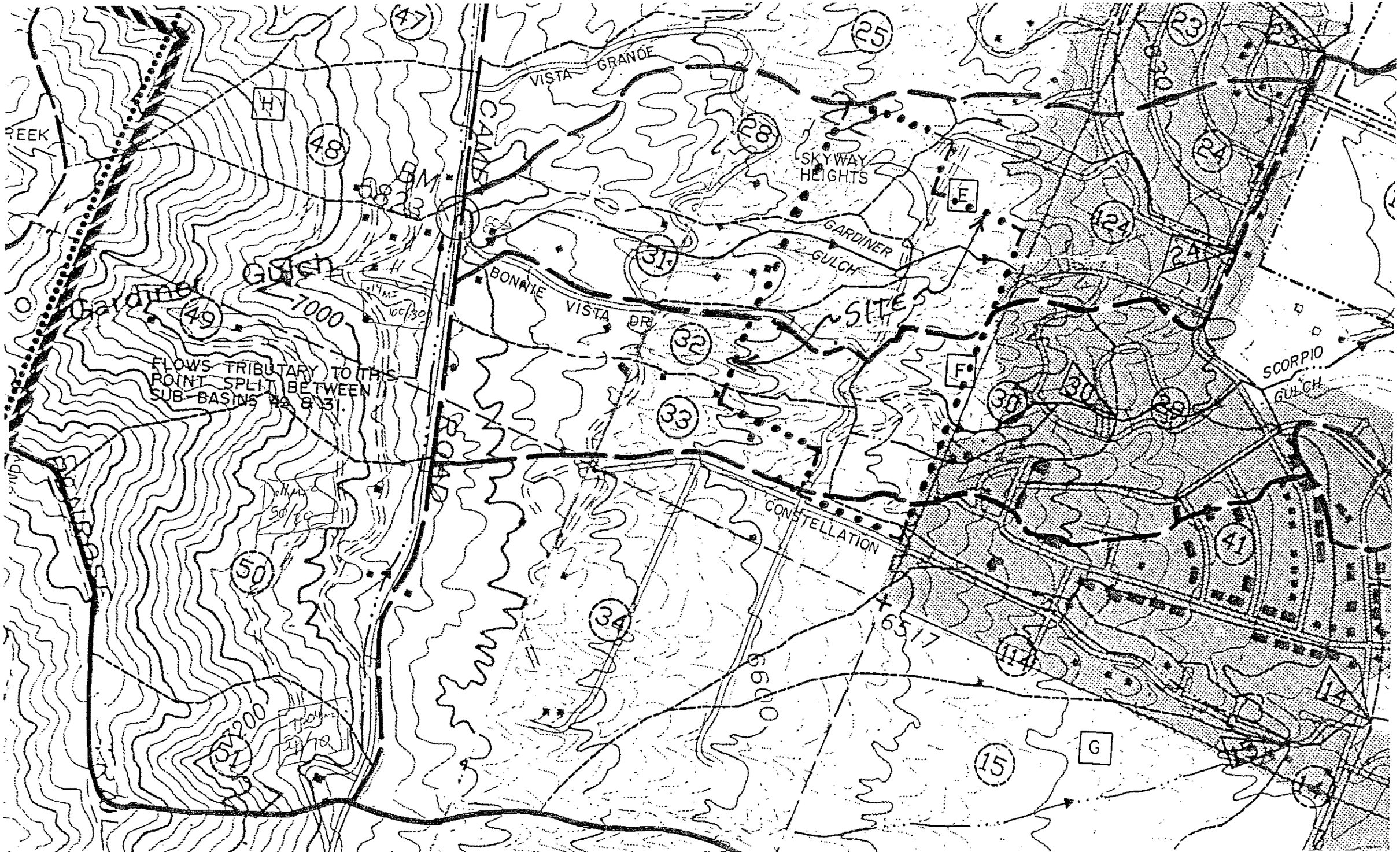
SUB-BASIN NO.	AREA SQ. MI	100 YR. 24 HR. (1 EXIST	100 YR. 24 HR. (1 FUTURE	100 YR. 2 HR. (2 EXIST	100 YR. 2 HR. (2 FUTURE	10 YR. 24 HR. (1 EXIST	10 YR. 24 HR. (1 FUTURE	10 YR. 2 HR.(2) EXIST	10 YR. 2 HR.(2) FUTURE
1	0.02	30	50	20	40	20	40	10	20
2	0.13	260	440	140	310	110	290	70	190
3	0.13	160	280	150	180	70	160	70	90
4	0.04	60	150	50	120	30	100	30	70
5	0.01	20	20	20	20	10	10	10	10
6	0.05	130	130	70	70	60	60	40	40
7	0.02	30	30	30	30	10	10	10	10
8	0.13	210	220	140	190	100	110	60	100
9	0.06	80	80	60	60	30	30	30	30
10	0.18	130	160	100	100	50	50	50	50
11	0.02	30	30	30	30	20	20	20	20
12	0.05	100	100	100	100	60	60	50	50
13	0.08	140	150	150	160	70	80	70	80
14	0.05	50	60	50	50	20	20	20	20
15	0.13	60	140	60	80	10	30	30	40
16	0.11	170	190	100	120	60	80	50	60
17	0.04	70	70	50	50	20	20	20	20
18	0.13	180	220	110	150	60	80	50	70
19	0.03	50	110	40	80	30	70	20	40
20	0.04	70	70	40	40	30	30	20	20
21	0.27	230	390	190	310	90	120	80	100
22	0.06	130	130	120	130	60	60	60	70
23	0.06	120	120	100	110	60	70	50	60
24	0.03	60	60	40	40	30	30	20	20
25	0.09	80	110	90	110	20	30	30	40
26	0.09	100	120	110	110	30	40	50	50
27	0.2	170	240	150	150	60	80	60	70
28	0.06	50	70	50	70	10	20	20	20
29	0.03	70	70	70	70	30	30	30	30
30	0.05	70	80	70	80	20	30	20	30
31	0.04	40	50	40	50	10	10	10	20
32	0.04	20	20	20	30	5	10	10	10
33	0.05	50	60	50	60	10	20	10	20
34	0.16	90	140	110	160	20	40	30	60
35	0.07	100	100	100	100	40	40	50	50
36	0.12	40	110	40	70	10	20	20	30
37	0.03	60	60	40	40	20	20	20	20
38	0.17	190	190	120	120	40	40	60	60
39	0.05	80	150	50	130	30	90	20	70
40	0.01	20	20	20	20	10	10	10	10
41	0.06	80	80	50	60	30	30	20	30
42	1.93	1210	1210	970	970	150	150	370	370
43	1.69	680	680	630	630	110	110	270	270
44	1.45	500	630	550	590	80	110	240	260
45	1.69	400	450	590	590	80	90	260	260
46	0.13	110	110	110	110	30	30	30	30

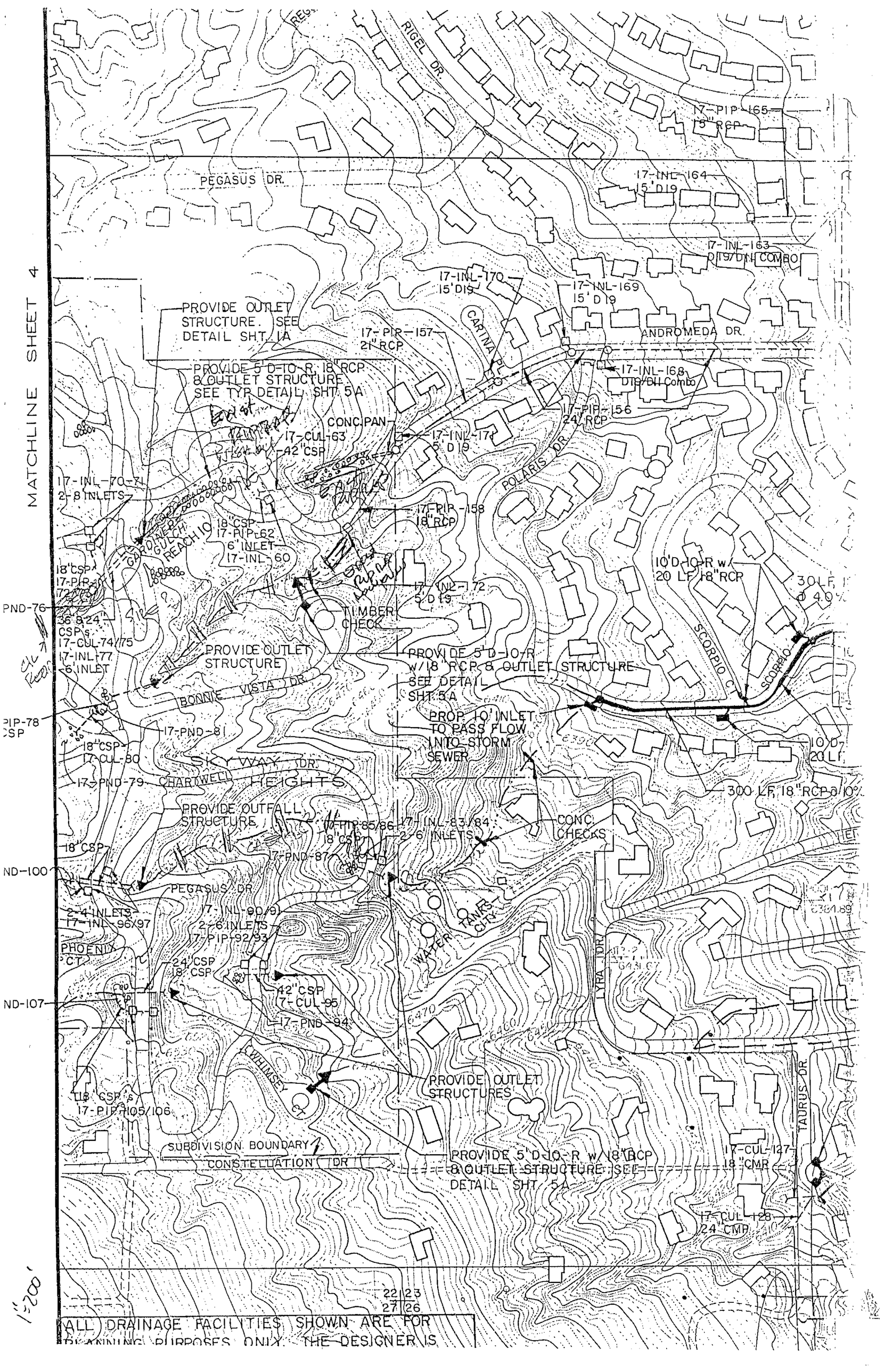
TABLE 6: SUMMARY OF PEAK FLOW RATES FOR SUBBASINS

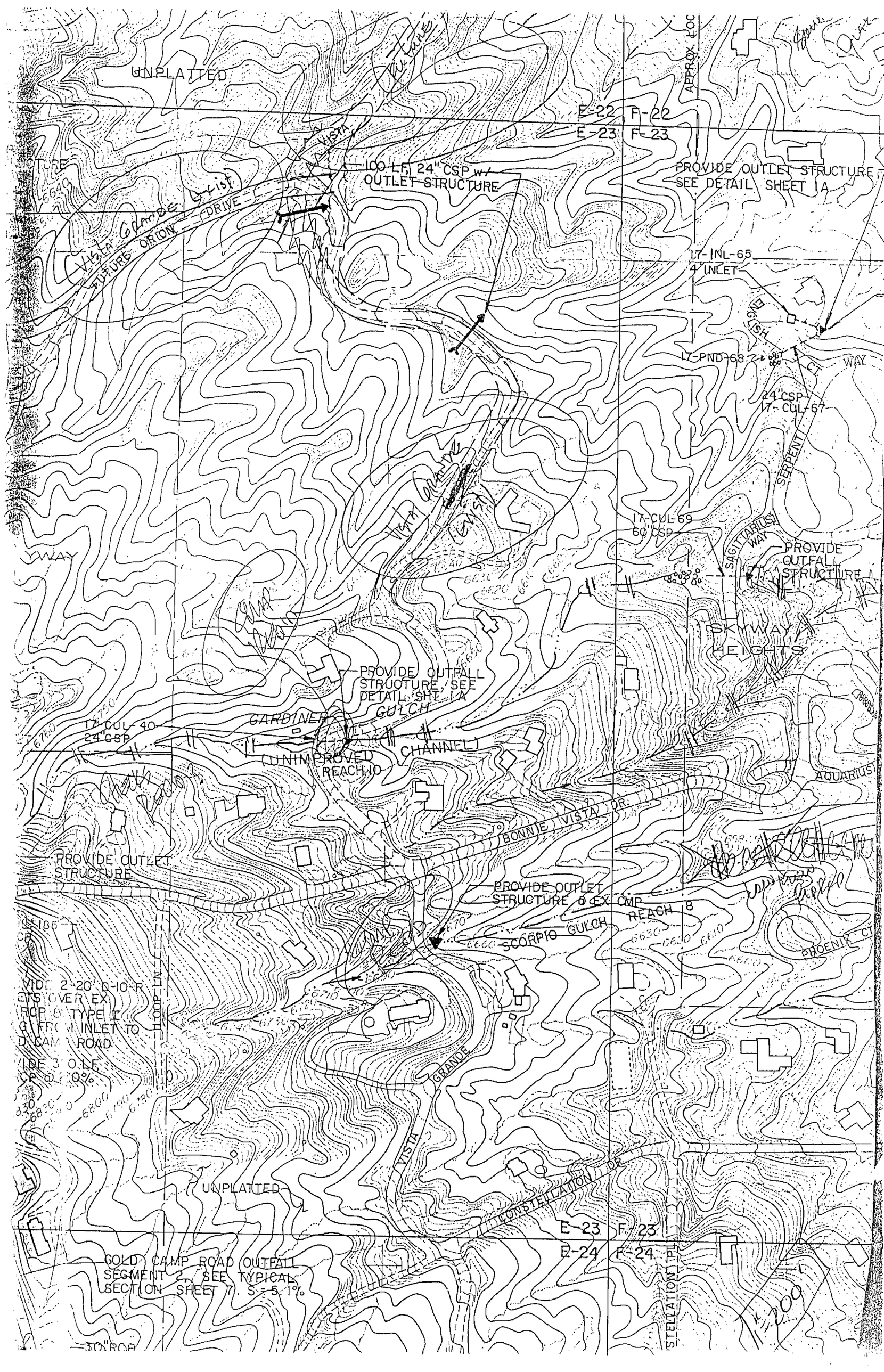
SUB-BASIN NO.	AREA SQ. MI	100 YR. 24 HR. (1 EXIST	100 YR. 24 HR. (1 FUTURE	100 YR. 2 HR. (2 EXIST	100 YR. 2 HR. (2 FUTURE	10 YR. 24 HR. (1 EXIST	10 YR. 24 HR. (1 FUTURE	10 YR. 2 HR.(2) EXIST	10 YR. 2 HR.(2) FUTURE
47	0.02	20	20	10	20	3	10	5	10
48	0.04	40	40	20	20	10	10	10	10
49	0.14	100	100	60	60	10	10	30	30
50	0.11	40	40	50	50	10	10	20	20
51	0.04	30	30	30	30	10	10	10	10
52	0.06	50	50	40	40	10	10	20	20
109	0.04	40	40	30	30	20	20	10	10
114	0.05	20	30	20	30	10	10	10	10
123	0.03	70	70	60	60	30	40	30	30
124	0.08	150	170	150	160	70	70	70	70

NOTES: (1) 24-HOUR DURATION STORM, ANTECEDENT MOISTURE CONDITION II (FOR DESIGN).

(2) 2-HOUR DURATION STORM, ANTECEDENT MOISTURE CONDITION III (FOR INFORMATION ONLY).


VISTA GRANDE
SKYWAY HEIGHTS
GARDINER GULCH
BONNIE VISTA DR.
SITE
SCORPIO GULCH
CONSTELLATION
Gardner Gulch
FLOWS TRIBUTARY TO THIS POINT SPLIT BETWEEN SUB-BASINS 32 & 31.
7000
6600
6317
H
F
G
47
48
49
50
51
25
28
31
32
33
34
23
24
30
41
14
15


MATCHLINE SHEET 4
RIGEL DR.
PEGASUS DR.
17-PIP-165
5" RCP
17-INL-164
15' D19
17-INL-163
D19/D11 COMBO
17-INL-170
15' D19
17-INL-169
15' D19
ANDROMEDA DR.
CARINA CT.
PROVIDE OUTLET STRUCTURE. SEE DETAIL SHT. 1A
17-PIP-157
21" RCP
PROVIDE 5' D-10-R 18" RCP & OUTLET STRUCTURE SEE TYP DETAIL SHT. 5A
17-INL-168
D19/D11 Combo
17-PIP-156
24" RCP
CONC PAN
17-CUL-63
42" CSP
17-INL-171
5' D19
POLARIS DR.
17-INL-70-71
2-8 INLETS
17-PIP-158
18" RCP
18" CSP
17-PIP-62
6" INLET
17-INL-60
GARDINER GULCH REACH 10
10'D-10-R w/ 20 LF 18" RCP
30 LF, I
@ 4.0%
18" CSP
17-PIP-72
17-INL-72
5' D19
PND-76
36 & 24" CSP's
17-CUL-74/75
17-INL-77
6' INLET
TIMBER CHECK
PROVIDE OUTLET STRUCTURE
PROVIDE 5' D-10-R w/18" RCP & OUTLET STRUCTURE SEE DETAIL SHT. 5A
SCORPIO CT.
SCORPIO
BONNIE VISTA DR.
PIP-78
CSP
17-PND-81
PROP. 10' INLET TO PASS FLOW INTO STORM SEWER
18" CSP
17-CUL-80
SKYWAY DR.
17-PND-79
CHARTWELL HEIGHTS
10'D-
20 LF,
300 LF, 18" RCP @ 10%
PROVIDE OUTFALL STRUCTURE
17-PIP-85/86
18" CSP
17-INL-83/84
2-6' INLETS
CONC. CHECKS
18" CSP
17-PND-87
ND-100
PEGASUS DR.
2-4' INLETS
17-INL-96/97
17-INL-90/91
2-6' INLETS
17-PIP-92/93
WATER TANK
LYRA DR.
PHOENIX CT.
24" CSP
18" CSP
42" CSP
17-CUL-95
ND-107
17-PND-94
WHIMSEY CT.
PROVIDE OUTLET STRUCTURES
18" CSP's
17-PIP-105/106
SUBDIVISION BOUNDARY
CONSTELLATION DR.
PROVIDE 5' D-10-R w/18" RCP & OUTLET STRUCTURE SEE DETAIL SHT. 5A
TAURUS DR.
17-CUL-127
18" CMP
17-CUL-128
24" CMP
1"=200'
22 23
27 26
ALL DRAINAGE FACILITIES SHOWN ARE FOR
PLANNING PURPOSES ONLY. THE DESIGNER IS


UNPLATTED
E-22 F-22
E-23 F-23
APPROX. LOC
100 LF, 24" CSP w/ OUTLET STRUCTURE
PROVIDE OUTLET STRUCTURE SEE DETAIL SHEET 1A
17-INL-65
4' INLET
17-POND-68
24" CSP
17-CUL-67
SERPENT
CT
WAY
17-CUL-69
60" CSP
SAGITTARIUS WAY
PROVIDE OUTFALL STRUCTURE
SKYWAY HEIGHTS
PROVIDE OUTFALL STRUCTURE, SEE DETAIL SHT 1A
GARDINER GULCH
17-CUL-40
24" CSP
UNIMPROVED CHANNEL
REACH 10
AQUARIUS
BONNIE VISTA DR.
PROVIDE OUTLET STRUCTURE
PROVIDE OUTLET STRUCTURE @ EX. CMP
REACH 8
SCORPIO GULCH
PHOENIX CT
VIDE 2-20' 8-10-R
ETS OVER EX
ROP TYPE II
G FR INLET TO
D CA ROAD
IDE 0.LF
CP @ 0%
GRANDE
VISTA
UNPLATTED
CONSTELLATION DR.
E-23 F-23
E-24 F-24
STELLATION PL
GOLD CAMP ROAD OUTFALL
SEGMENT 2, SEE TYPICAL
SECTION SHEET 7 S=5.1%
10" ROA

APPENDIX B

DETAILED HYDROLOGIC BASIN INFORMATION SUMMARIES

MAJOR BASIN	SUB BASIN	AREA		BASIN		Tc Min.	I	SOIL GROUP	DEV. TYPE	C	FLOW		RETURN PERIOD
		PLANIMETER READING	Ac.	LENGTH	HEIGHT						Q	q_p	
	OS-1		25.56	2600		23.4	3.2 / 4.7	A soil	3Ac Res.	.30 / .40		25 / 48	10 / 100
	OS-2		2.40	800		15.7	3.8 / 5.75					2.7 / 5.5	
	OS-3		1.43	500		13.7	4.1 / 6.2					1.8 / 3.5	
	OS-4		7.69	2300		21.5	3.3 / 5.0					7.6 / 15.4	
	OS-5		8.98	1550		21	3.3 / 5.0					9.0 / 18	
	OS-6			-			-						
	OS-7		4.04	8.00		15.9	3.8 / 5.7					4.6 / 9.2	
	OS-8		0.24	250		10.1	4.6 / 7.0					0.3 / 0.7	
	OS-9		19.65	2300		21.9	3.35 / 5.0					20 / 39	
	~~OS-10~~												
	OS-10		4.61	1200		16.7	3.8 / 5.7					5.3 / 10.5	
	OS-11		0.70	250		8.5	4.9 / 7.4					1.0 / 2.1	
	OS-12		3.16	800		13.3	4.1 / 6.2					3.9 / 7.8	
	OS-13		21.23	2350		21.7	3.25 / 4.9					21 / 42	

HYDROLOGIC COMPUTATION – BASIC DATA
RATIONAL METHOD Q=CIA

PAGE 1 of 1

KLH Engineering Consultants, Inc.
PROJECT: SKYWAY HEIGHTS

By: BJH
Date: 1-3-92

MAJOR BASIN	SUB BASIN	AREA		BASIN		Tc Min.	I	SOIL GROUP	DEV. TYPE	C	FLOW		RETURN PERIOD
		PLANIMETER READING	Ac.	LENGTH	HEIGHT						~~Q~~	q_p	
ON-SITE: MISCELLANEOUS											HISTORIC .30 .40	DEVELOPED	
	M1		0.25	100		7	5.2 / 8.0	A	UNDEV. E/OR ½ AC REQ.	.30 / .40	SAME	0.4 / 0.8	10 / 100
	M2		0.6	600		11.7	4.4 / 6.7			.39 / .48	1.5 / 2.9	1.0 / 1.9	
	M3		1.95	400		12	4.3 / 6.5			.35 / .45	4.3 / 8.5	2.9 / 5.7	
	M4		0.24	150		6.4	5.4 / 8.4			.30 / .40	SAME	0.4 / 0.8	
	M5		0.13	80		5.5	5.8 / 8.8			.33 / .43	SAME	0.3 / 0.5	
	M6		0.85	180		7.4	5.0 / 7.7			.32 / .42	1.5 / 3.1	1.4 / 2.7	
	M7		0.67	200		9.3	4.8 / 7.2			.36 / .46	1.2 / 2.3	1.2 / 2.2	
	M8		0.74	600		5.0	6.0 / 9.0			.64 / .71	0 / 0	2.8 / 4.7	
	M9		0.30	140		8.0	5.0 / 7.6			.35 / .44	SAME	0.5 / 1.0	
	M10		1.00	100		9.4	4.7 / 7.2			.38 / .48	2.7 / 5.6	1.8 / 3.5	
	M11		0.73	150		7.6	5.0 / 7.8			.30 / .40	4.3 / 8.5	1.1 / 2.3	
	M12		0.39	200		7.4	5.0 / 7.8			.34 / .43	SAME	0.7 / 1.3	

HYDROLOGIC COMPUTATION – BASIC DATA
RATIONAL METHOD Q=CIA

PAGE 1 of 1

KLH Engineering Consultants, Inc.
PROJECT: SKYWAY HEIGHTS

By: BJH
Date: 1-29-92

MAJOR BASIN	SUB BASIN	AREA		BASIN		Tc Min.	I	SOIL GROUP	DEV. TYPE	C	FLOW		RETURN PERIOD
		PLANIMETER READING	Ac.	LENGTH	HEIGHT						Q	q_p	
INLET	FLOWS: I1		0.70	610		5.0	6.0 / 9.0	A	MISC	.59 / .66		2.5 / 4.1	10 / 10
	I2		0.29			5.0	6.0 / 9.0			.66 / .73		1.1 / 1.9	
	I3		3.27			16.3	3.8 / 5.6			.37 / .46		4.6 / 8.4	
	I4		0.13			5.0	6.0 / 9.0			.67 / .74		0.5 / 0.9	
	I5		0.72			8.3	4.9 / 7.5			.47 / .56		1.7 / 3.0	
	I6		0.82			9.4	4.7 / 7.2			.61 / .69		2.4 / 4.1	
	I7		0.94			7.5	5.1 / 7.7			.51 / .59		2.4 / 4.3	
	I8		0.16			5.0	6.0 / 9.0			.90 / .95		0.9 / 1.4	
	I9		1.14			10.3	4.5 / 6.9			.53 / .61		2.7 / 4.8	
	I10		1.08			5.0	6.0 / 9.0			.74 / .79		4.7 / 7.7	
	I11		2.09			9.4	4.7 / 7.2			.54 / .62		5.3 / 9.3	
	I12		0.40			5.0	6.0 / 9.0			.39 / .48		0.9 / 1.7	
	I13		1.40			14.5	4.0 / 6.0			.51 / .59		2.9 / 5.0	
	I14		1.78			8.7	5.0 / 7.4			.50 / .58		4.5 / 7.6	
	I15		0.50			5.1	6.0 / 9.0			.54 / .62		1.6 / 2.8	

HYDROLOGIC COMPUTATION – BASIC DATA
RATIONAL METHOD Q=CIA

PAGE 1 of 2

KLH Engineering Consultants, Inc.
PROJECT: SKYWAY HEIGHTS

By: BJH
Date: 1-28-92

MAJOR BASIN	SUB BASIN	AREA		BASIN		Tc Min.	I	SOIL GROUP	DEV. TYPE	C	FLOW		RETURN PERIOD
		PLANIMETER READING	Ac.	LENGTH	HEIGHT						Q	q_p	
INLET	FLOWS, CONT'D:												
	I18		0.42			5	6.0 / 9.0	A	MISC	.76 / .82		1.9 / 3.1	10 / 100
	I19		0.24			5	6.0 / 9.0			.63 / .70		0.9 / 1.5	
	I20		0.36			5	6.0 / 9.0			.68 / .75		1.5 / 2.4	
	I21		1.02			5	6.0 / 9.0			.66 / .73		4.0 / 6.7	

HYDROLOGIC COMPUTATION – BASIC DATA
RATIONAL METHOD Q=CIA

PAGE 2 of 2

KLH Engineering Consultants, Inc.
PROJECT: SKYWAY HEIGHTS

By: BJH
Date: 1-28-92

PRIMARY DRAINAGEWAYS — WITHOUT DETENTION —

MAJOR BASIN	SUB BASIN	AREA: PLANIMETER READING	AREA: Ac.	BASIN: LENGTH	BASIN: HEIGHT	Tc Min.	I	SOIL GROUP	DEV. TYPE	C	FLOW: Qp	FLOW: Qp	RETURN PERIOD
									(DEER CREEK FLOW REDUCE)		HISTORIC .39 .40	DEV	
MAJOR ON-SITE CHANNELS:													
	DP 1		34.22			25	3.05 / 4.55			.31 / .41	31 / 62	32 / 64	10 / 100
	DP 1.1		33.42			24.1	3.1 / 4.6			.31 / .41		32 / 63	
	DP 1.2		33.21			24.1	3.1 / 4.6			.31 / .41		32 / 63	
	DP 1.3		31.49			23.4	3.2 / 4.7			.31 / .41		31 / 61	
	DP 1.4		31.21			23.4	3.2 / 4.7		10-20 / 50-60	.31 / .41		31 / 60	
	DP 1.5		4.95			18	3.55 / 5.40			.32 / .42		5.6 / 11.2	
	DP 2		32.07			25	3.05 / 4.55			.34 / .44	29 / 57	33 / 63	
	DP 2.1		31.47			25	3.05 / 4.55			.34 / .44		32 / 62	
	DP 2.2		28.09			25	3.05 / 4.55			.32 / .42		27 / 54	
	DP 2.3		23.73			23.3	3.2 / 4.7		5-10 / 20-30	.32 / .42		24 / 47	
	DP 2.4		23.60			23.3	3.2 / 4.7			.32 / .42		24 / 47	
	DP 2.5		20.33			23.3	3.2 / 4.7			.31 / .41		20 / 39	
	DP 2.6		16.67			21.5	3.3 / 5.0			.30 / .40		17 / 33	

HYDROLOGIC COMPUTATION – BASIC DATA
RATIONAL METHOD Q=CIA

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KLH Engineering Consultants, Inc.
PROJECT: SKYWAY HEIGHTS

By: BTH
Date: 1-28-92

PRIMARY DRAINAGEWAYS
— WITHOUT DETENTION —

MAJOR BASIN	SUB BASIN	AREA: PLANIMETER READING	AREA: Ac.	BASIN: LENGTH	BASIN: HEIGHT	Tc Min.	I	SOIL GROUP	DEV. TYPE	C	FLOW: Q	FLOW: q_p	RETURN PERIOD
MAJOR	ON-SITE CHANNELS: CONT'D								BEAR CREEK FLOW		HISTORIC .30 .40	DEV.	
	DP 3		2.61	640		9.8	4.7 / 7.1	A	MISC	.37 / .46	3.7 / 7.4	4.5 / 8.5	10 / 100
	DP 4	DP4.1 I14	8.35			11.9	4.3 / 6.6			.47 / .55	11 / 22	17 / 30	
	DP 4.1	DP4.2 I21	6.57			11.9	4.3 / 6.6			.46 / .54		13 / 23	
	DP 4.2		5.55			11.9	4.3 / 6.6			.41 / .50		9.8 / 18	
	DP 4.3		2.39			9.4	4.7 / 7.2			.48 / .56		5.4 / 9.6	
	DP 4.4		1.61			8.9	4.8 / 7.3			.50 / .58		3.9 / 6.8	
	DP 5.0	DP4.0 DP5.1	39.44			24.2	3.1 / 4.6			.35 / .45	37 / 73	43 / 82	
	DP 5.1		30.59			24.2	3.1 / 4.6			.32 / .42	28 / 56	30 / 59	
	DP 5.2		29.81			23.7	3.2 / 4.7			.32 / .42		31 / 59	
	DP 5.3		28.85			22.7	3.2 / 4.8		10-20 / 40-50	.32 / .42		30 / 58	
	DP 5.4		6.37			18.7	3.5 / 5.3			.32 / .42		7.1 / 14.2	
	DP 5.5		21.07			22.7	3.2 / 4.8			.31 / .41		21 / 41	

HYDROLOGIC COMPUTATION – BASIC DATA
RATIONAL METHOD Q=CIA

PAGE 2 of 3

KLH Engineering Consultants, Inc.
PROJECT: SKYWAY HEIGHTS

By: BTH
Date: 1-28-92

PRIMARY DRAINAGEWAYS
— WITHOUT DETENTION —

MAJOR BASIN	SUB BASIN	AREA: PLANIMETER READING	AREA: Ac.	BASIN: LENGTH	BASIN: HEIGHT	Tc Min.	I	SOIL GROUP	DEV. TYPE	C	FLOW: Q	FLOW: q_p	RETURN PERIOD
MAJOR ON-SITE CHANNELS:													
	DP6		9.14			16.5	3.8 / 5.7	A	MISC	.48 / .56		17 / 29	10 / 100
	DP6.1		7.42			15.5	3.8 / 5.8			.49 / .57		14 / 25	
	DP6.2		4.44			14.5	4.0 / 6.0			.51 / .59		9.1 / 15.7	
	DP7		7.88			19.2	3.4 / 5.2			.34 / .44	8 / 16	9.1 / 18	
	DP7.1		6.81			17.9	3.6 / 5.6			.34 / .44		8.3 / 16.7	
	DP7.2		5.87			17.9	3.6 / 5.6			.31 / .41		6.6 / 13.5	
	DP8		27.07			22.4	3.2 / 4.8			.30 / .40	26 / 52	26 / 52	
	DP8.1		4.97			14.2	4.0 / 6.0			.32 / .42		6.4 / 12.5	
	DP8.2		1.21			9.8	4.7 / 7.1			.34 / .44		1.9 / 3.8	
	DP678	DP 6 DP 7 DP 8	45.64			23	3.2 / 4.7		10-20 / 50-70	.34 / .44		50 / 94	

HYDROLOGIC COMPUTATION – BASIC DATA
RATIONAL METHOD Q=CIA

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KLH Engineering Consultants, Inc.
PROJECT: SKYWAY HEIGHTS

By: BJH
Date: 1-28-92

MAJOR BASIN	SUB BASIN	AREA		BASIN		Tc Min.	I	SOIL GROUP	DEV. TYPE	C	FLOW		RETURN PERIOD
		PLANIMETER READING	Ac.	LENGTH	HEIGHT						Q	q_p	
ON-SITE FLOWS:													
DP1	DEV		6.26			11.6	4.3 / 6.7	ASOIL		.36 / .46		9.7 / 19.3	10 / 100
	HIST		"			"	"			.30 / .40		8.1 / 16.8	
DP 2	DEV		13.37			11.6	4.3 / 6.7			.40 / .50		23 / 45	
	HIST		"			"	"			.30 / .40		17 / 36	
DP 3	DEV		2.61			9.8	4.7 / 7.1			.37 / .46		4.5 / 8.5	
	HIST		"			"	"			.30 / .40		3.7 / 7.4	
DP 4/5	DEV		15.71			11.6	4.3 / 6.7			.43 / .53		29 / 56	
	HIST		"			"	"			.30 / .40		20 / 42	
DP 6	DEV		8.90			16.5	3.8 / 5.7			.48 / .56		16 / 28	
	HIST	W/PEGASUS IN PLACE AS SHOWN	"			"	"			.30 / .40		10 / 20	
DP 7	DEV		3.27			8.9	4.8 / 7.3			.40 / .50		6.3 / 11.9	
	HIST		"			"	"			.30 / .40		4.7 / 9.5	
DP 8	DEV		1.88			7.5	5.1 / 7.7			.30 / .40		2.9 / 5.8	
	HIST		"			"	"			.30 / .40		2.9 / 5.8	
DP678	DEV / HIST		14.08			16.5	3.8 / 5.7			.44 / .53		2.1 / 16 / 4.3 / 32	

HYDROLOGIC COMPUTATION – BASIC DATA
RATIONAL METHOD Q=CIA

PAGE 1 of 1

KLH Engineering Consultants, Inc.
PROJECT: SKYWAY HEIGHTS

By: BTH
Date: 2-3-92

APPENDIX C

HYDROLOGIC AND HYDRAULIC DESIGN INFORMATION

March 20, 1992

Mr Dave Lethbridge
City Engineering Department
CITY OF COLORADO SPRINGS
P. O. Box 1575, Mail Code 435
Colorado Springs, CO 80901-1575

RE: Phasing Plan for Skyway Heights Subdivision #2

Dear Dave:

The final plat for Skyway Heights Subdivision #2 is submitted for review by the City. Our preliminary discussions included the feasibility of platting this in phases or platting the entire subdivision. We have decided to replat the entire parcel and develop the project in three phases of approximately 30 lots each. The boundaries of these phases is shown on the attached map.

We propose that an engineering plan be submitted which addresses the necessary public improvements, primarily drainage and erosion control that would be necessary for each phase. KLH Engineering, Inc. will also determine the cost of these improvements for each phase. Based upon mutual agreement of costs with your department, a financial assurance, approved by the City, will be put in place by ourselves before building permits are issued within that phase. The extent of the improvement for the first two phases will exceed the boundaries of that phase. However, we would only draw building permits on those lots within the approved phase. KLH Engineering, Inc. is finalizing the engineering report for the Phase I work and I am finalizing the escrow agreement covering the cost of the Phase I structures. Please review this with the appropriate City Departments. We would like to move forward with this at the earliest possible date.

Thanks again for all your cooperation in the redesign of the subdivision and working with us in reaching an equitable solution for the drainage problem that has surrounded this project. We hope

SCHUCK INTERESTS, INC.
1280 Holly Sugar Building • Palmer Center
Colorado Springs, CO 80903 • Phone (719) 633-4500 • FAX (719) 633-6258

MCI
91 559 00
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4/4/92

to start the actual drainage improvement the early part of this May.

Thanks again for your assistance.

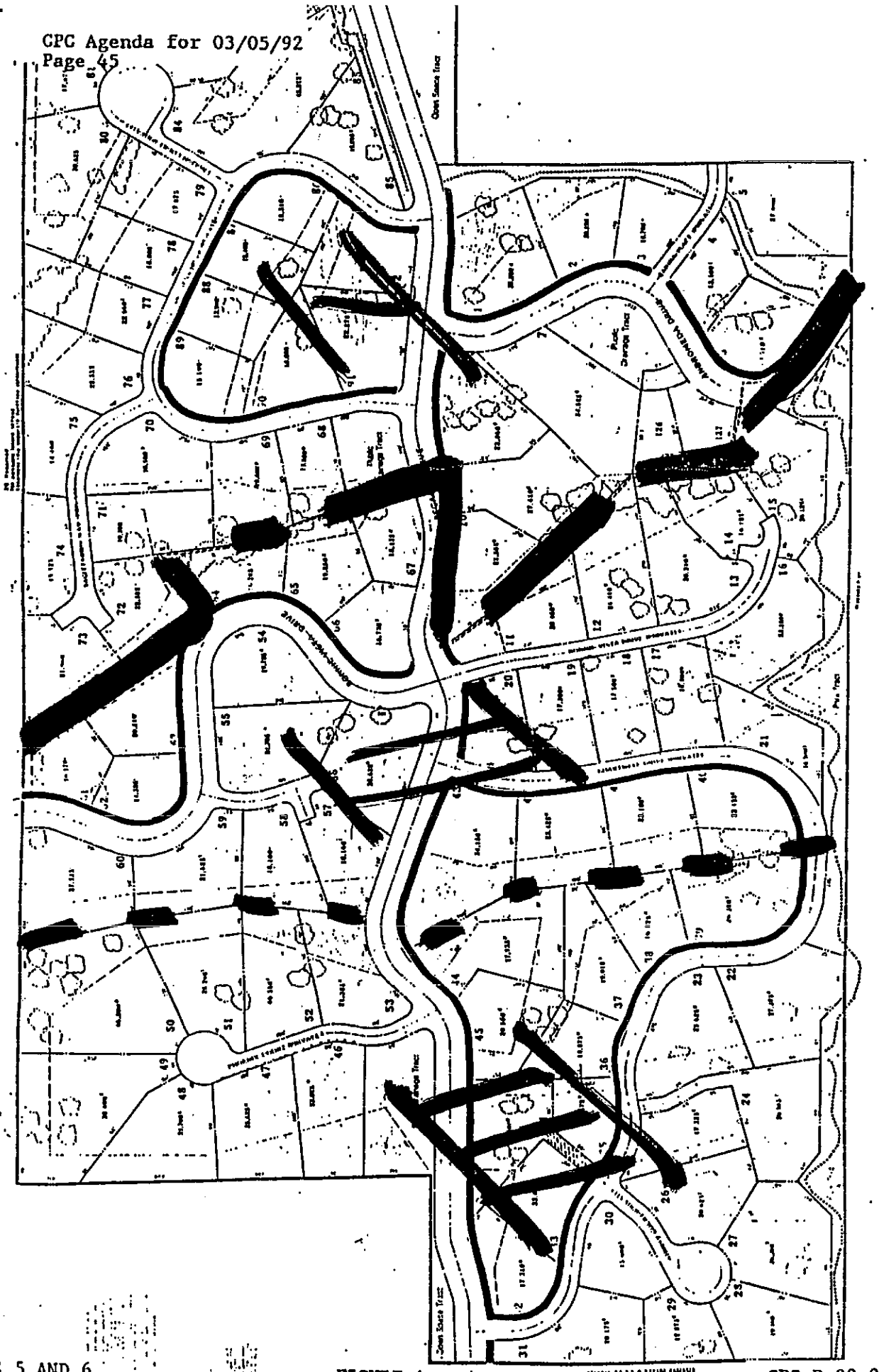
Best Regards,
SCHUCK INTERESTS, INC.

Terry E. Schooler
Vice President

TES/crw

Enc

cc: Bev Dustin
Kent Rockwell, KLH Engineering, Inc.



SKYWAY HEIGHTS

ITEMS 5 AND 6

FIGURE 4

CPC P 92-22
CPC DP 92-22-A1

SWH
1-92 BJH

HYDROLOGY:

RAINFALL: FOR HEC-1 MODEL

2YR 6HR = X_1 = 1.7 INCHES
2YR 24HR = X_2 = 2.1 INCHES
100YR 6HR = X_3 = 3.5 "
100 YR 24 HR = X_4 = 4.4

ELEVATION = 6700' Z = 6.7

2YR 1HR = Y_2 = $0.218 + 0.709\,[(x_1)\ x_1/x_2]$ = 1.2

100YR 1HR = Y_{100} = $1.897 + 0.439\,[X_3\ X_3/X_4] - .008Z$ = 3.1

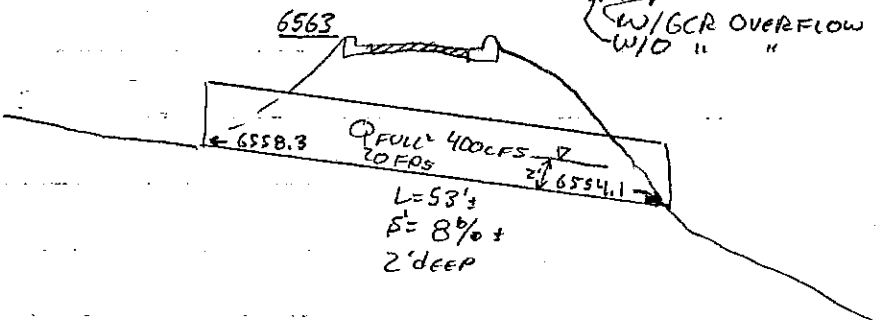
PLOT ⇒ 10YR 1HR = 1.97 ≈ (2.0)
10YR 2HR = 2.28 ≈ (2.3)
100YR 12HR = 3.58 ≈ (3.6)

SWH ○
1-31-92 BJH

HYDRAULICS:

CHECK CULVERT UNDER SAGITTARIUS PL:

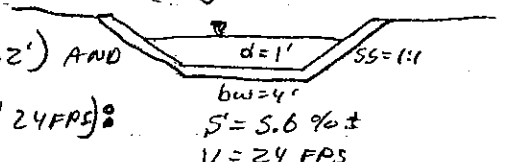
GARDINER GULCH: DPS.5 (±) Q_{10} = 21 Q_{100} = 41 / $121^{(Q_{100}-Q_{10})}$ = 112 ± CFS
W/GCR OVERFLOW
W/O " "



10 YEAR FLOW: Q_{10} = 21 CFS MANNINGS S_{MIN} = 0.02% OK
ENTRANCE COND: BELOW CHART ⇒ OK

100 YR FLOW: Q = 112 CFS MANNINGS S_{MIN} = 0.63% OK
ENTRANCE COND: STD HEADWALL H_W/d = 0.97 H_W = 4.9' OK

→ ACTUAL ENTRANCE HAS 30' LONG, 10:1 TAPERED CONCRETE ENTRANCE W/ 4' bw, SIDES TAPER FROM 4' & 7' WIDE TO 2' WIDE AT PIPE ENT. WITH A SMOOTH (10:1) TRANSITION &



SIMILAR FLOW DEPTHS (1' TO 2') AND SIMILAR VELOCITIES (20 & 24 FPS):

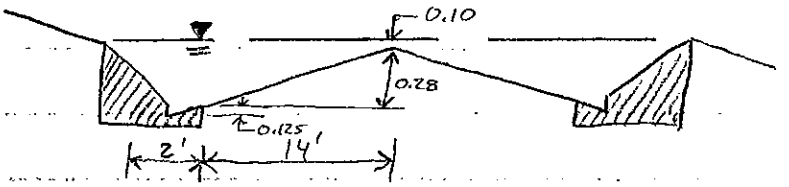
∴ THE 60" CMP SHOULD BE ADEQUATE FOR 121 CFS FLOW.

SWH
1-26-92 BTH

HYDRAULICS:

PUBLIC STREETS: TYPE "2" RAMP CURB

$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$ $N = .016$



½ STREET: $A = 3.36 + 0.875 = 4.235$

$P_W = 16.67'$

$HR = A/P_W = 0.2540$

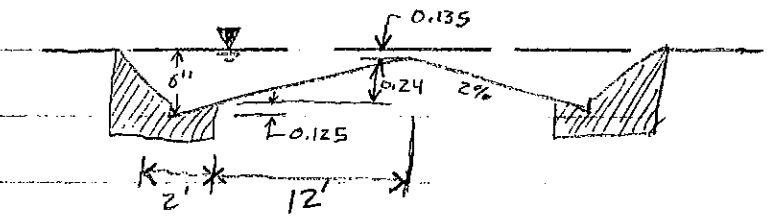
STREET FLOW: $Q = 157.77 \times S^{1/2}$

SLOPE FT/FT	½ ST FLOW CFS	FULL ST. FLOW CFS	VELOCITY
.01	15.8	31.6	3.7
.02	22.3	44.6	5.3
.03	27.3	54.6	6.4
.04	31.6	63.2	7.5
.05	35.3	70.6	8.3
.06	38.6	77.3	9.1
.07	41.7	83.4	9.8
.08	44.6	89.2	10.5
.09	47.3	94.6	11.2
.10	49.9	99.8	11.8
.11	52.3	104.6	12.4
.12	54.7	109.4	12.9

SWH
1-24-92 BTH

PRIVATE STREETS: TYPE "2", RAMP CURB

$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$ $\quad n = .016$



½ STREET: $A = 3.06_{SF} + 0.875 = 3.935_{SF}$

$P_w = 15'$

$HR = A/P_w = 0.2623$

STREET FLOW: $Q = 149.77 \times S^{1/2}$

SLOPE FT/FT	½ ST FLOW	FULL ST FLOW	VELOCITY
.01	15.0	30	3.8
.02	21.2	42.4	5.4
.03	25.9	51.8	6.6
.04	30.0	60	7.6
5	33.5	67	8.5
6	36.7	73.4	9.3
7	39.6	79.2	10.1
8	42.4	84.8	10.8
9	44.9	89.8	11.4
10	47.4	94.8	12
11	49.7	99.3	12.6
12	51.9	103.8	13.2

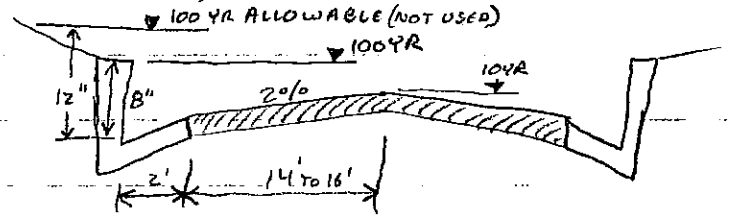
SWH 2-3-92 GTH

HYDRAULICS:

PUBLIC STREETS: PEGASUS & ANDROMEDA

6.7% - 9% 8% - 10%

TYPE 1: 8" VERT CURB, 2% X-SLOPE, 32' TO 36' WIDE



10YR FLOW CAPACITY: 32' ST. $Q = \frac{1.486}{n} A\, HR^{2/3} S^{1/2}$

$Q = 72.7857\, S^{1/2}$

SLOPE	FLOW CAPACITY ½ STREET	FULL STREET
4	14.6	29.2
5	16.3	32.6
6	17.8	35.6
7	19.3	38.6
8	20.6	41.2
9	21.8	43.6
10	23.6	47.2

100 YR FLOW CAPACITY: 32' ST, 8" DEEP $Q = 349.33\, S^{1/2}$

SLOPE	FLOW CAPACITY ½ STREET	FULL STREET
4	69.9	139.8
5	78.1	156.2
6	85.6	171.2
7	92.4	184.8
8	98.8	197.6
9	104.8	209.6
10	110.4	220.8

2-25-92 BTH

HYDRAULICS:

SIZE INLETS & PIPES FOR "INLET BASINS" W/O INLETS:

I 18: $Q_{10} = 1.9$ $Q_{100} = 3.1$ cfs

INLET: 4'd-10-R, SUMP $d_{10} = 0.29'$ $d_{100} = 0.41'$ OK

PIPE: 18" RCP @ 19% OK

I 19: NO INLET NECESSARY - "EYE BROW" DRIVE IS BEING REMOVED - LOT OWNERS TO PROVIDE DRAINAGE

I 20: (SAME AS I19 ABOVE)

I 21: $Q_{10} = 4.0$ $Q_{100} = 6.7$ cfs

INLET: 4'd-10-R, SUMP, $d_{10} = 0.48'$ $d_{100} = 0.68'$ OK

PIPE: 18" RCP @ 21% OK

SWH 1-23-92 GTH (1/1)

HYDRAULICS: INLETS-ON-GRADE

ANALYZE STREET CAPACITY & INLET CAPTURE:

→ ALLOWABLE ST. CAPACITY: TABLE 6-1, HILLSIDE RESIDENTIAL,

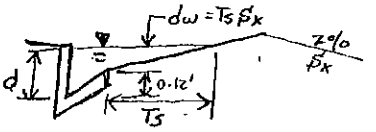
Q_{10} → TO TOP OF CURB OR TO 25 CFS

Q_{100} → < 12" @ FE

ASSUME CROSS SLOPE = 2%

STREET FLOW = $Q = \frac{0.56}{N} S_x S^{1/2} (T_s S_x)^{2.67}$

$N = .016$, $S_x = .02$, S = SLOPE FT/FT



$Q = 1750\, S^{1/2} (T_s \times .02)^{2.67}$

$\therefore T_s = \left(Q / 1750\, S^{1/2}\right)^{1/2.67} / .02$

4'D-10-R EXISTING INLET #5:

$Q_{10} = 1.7$ CFS | $Q_{100} = 3.0$ CFS | SLOPE = 0.05

$T_{s10} = 6.5'$ $dw_{10} = 0.13$ | $T_{s100} = 8.1'$ $dw_{100} = 0.16'$

$Q_i/Q_{10} = 0.30$ | $Q_i/Q_{100} = 0.24$

$\therefore Q_{i10} = 0.5$ CFS (1.2 CFS BY PASS) | $\therefore Q_{i100} = 0.7$ CFS (2.3 CFS BY PASS)

4'0-10-R EXISTING INLET #6:

$Q_{10} = 2.4$ CFS | $Q_{100} = 4.1$ CFS | SLOPE = .05

$T_{s10} = 7.4'$ $dw_{10} = 0.15$ | $T_{s100} = 9.1$ $dw_{100} = 0.18$

$Q_i/Q = 0.27$ | $Q_i/Q = .23$

$\therefore Q_{i10} = 0.6$ CFS | $\therefore Q_{i100} = 0.9$ CFS

→ SEE TABLE # 3 FOR INLET SUMMARY

SWH
1-31-92 BTH

HYDRAULICS:

CHECK OUTFALL CAPACITY OF ANDROMEDA DR.

1) FIND PIPE CAPACITY & ACTUAL FLOW: INLET #14

INLET #14, 10' DIOR, 10% SLOPE,

→ FRONT OF INLET: ±30% PICKUP Q_{10}=1.5 Q_{100}=2.1 CFS

→ REAR OF INLET: 3'x8" h OPENING W/ 8.5' LONG CONC. TRANSITION CHANNEL TO FUNNEL FLOW.

Q_{10} = 13 Q_{100} = 23 CFS. (DP 4.1)

ASSUME SLOPE = ±8% B_W = 6' TO 3' (USE) 1:1 SSLOPES

⇒ DEPTH = 0.4' OK VEL = 17 FPS OK FOR 100YR!

→ TOTAL FLOW ⇒ Q_{10} = 17 Q_{100} = 30 CFS (DP 4.0)

→ 18" RCP OUTLET PIPE: ENT. COND: H_W/D = 4/1.5 = 2.7

⇒ Q_{CAP} = 16 CFS BASED ON ENT. COND.

Q_{CAP} = 30 CFS BASED ON MANNINGS @ 8% SLOPE

→ REMAINING STREET FLOW:

Q_{10}: 10 CFS (DP 4.1-HEC) − (13 ~~-1.5~~) ⇒ = 3.0 CFS FLOW BY

Q_{100}: 18 CFS (" ") − 16 CFS = ~~2~~ CFS < 5.5 CFS FLOW BY

SWH
1-31-92 BJH

HYDRAULICS: CONT'D

2) FIND INLET/PIPE CAPACITY OF INLET #15:

→ 15' D-10-R, 10% SLOPE, FRONT & REAR OPENING,

→ FRONT OF INLET: ±60% PICKUP, Q_{10} = 1.0 Q_{100} = 1.6 CFS

→ REAR OF INLET: 8'w x 8"h OPENING W/ LONG CONC. TRANSITION CHANNEL TO DIRECT FLOW.

Q_{10}: 27 CFS (DETAINED FLOWS) Q_{100} = 59/(199 CFS) (INCLUDES GCR FLOW)

ASSUME SLOPE = 6% B_W = 8' SS = 1:1 Q = 99 CFS

⇒ DEPTH = 0.7' V_{EL} = 17 FPS OK FOR 100YR

→ TOTAL FLOW ⇒ Q_{10} = 35 Q_{100} = 108 CFS (COMB45-HEC1)

→ 21" RCP OUTLET PIPE: ENT. COND. $HW/D = \frac{5.2}{1.75} = 3.3$

⇒ Q_{CAP} = 26 CFS

⇒ Q_{CAP} = 37.7 CFS ACCORDING TO STMSEW DESIGN PLANS (HDR ENG.)

Q_{CAP} = 50 CFS BASED ON MANNINGS @ 10% SLOPE

1.0 0.6

→ REMAINING STREET FLOW:

Q_{10}: 35 CFS − (37.5 PIPE CAP.) < 0 ⇒ ADD "FLOW BYS"

→ Q_{10} = "FLOW BYS" = 3.0 (I14) + 0.6 (I19) = 3.6 CFS

Q_{100}: 108 CFS − 37.5 (PIPE CAP.) = 70.5 CFS

SCWH
2-3-91 BTH

HYDRAULICS:

CHECK OUTFALL ON PEGASUS DR.

1) FIND ACTUAL & ALLOWABLE ST. CAPACITY:

→ ALLOWABLE: RESIDENTIAL (≥32' WIDTH) 32' WIDE STREET $n=.016$ $S=6.7\%$ $S_x=2\%$ 8" VERT CURB

Q_{10} (to CROWN OF St) ⇒ $Q_{FULL} = 32.6$ CFS

Q_{100} 8" DEEP (12" ALLOW) ⇒ $Q_{FULL} = 180.8$ CFS

→ ACTUAL FLOW: (DP678) $Q_{10} = 50$ CFS NOT OK

$Q_{100} = 94$ CFS OK

→ CHECK ACTUAL ST. DEPTH FOR Q_{10}:

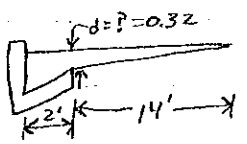
$$Q = 25 = \frac{1.486}{.016} \times A\, HR^{2/3} S^{1/2} \quad (\tfrac{1}{2} \text{ St. Section})$$

$$1.0399 = A\, HR^{2/3} = A\left(\frac{A}{P_W}\right)^{2/3} \qquad P_W = 16.5' \pm$$

$$= A^{3/3}\left(\frac{A}{16.5}\right)^{2/3} = A^{5/3}\left(\frac{1}{16.5}\right)^{2/3}$$

TRY $A = 3.1419$ SF

DEPTH @ CURB = 0.44'



→ NOTE: 15.6 ACRES OF THE TOTAL 45.6 ACRES TRIBUTARY TO PEGASUS IS FROM SKYWAY HEIGHTS (±34%).