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CITY OF RENO

HUFFAKER HILLS
STORM DRAIN RELIEF SYSTEM
ALTERNATIVE
INVESTIGATION

PROJECT NO. 150-056-864

SEA
ENGINEERS/PLANNERS

SEA incorporated
Consulting Engineers
950 INDUSTRIAL WAY
SPARKS, NEVADA 89431-6092
(702) 358-6931

December 9, 1986
Project No. 150-056-864

Millard G. Reed, P.E.
Public Works Director
CITY OF RENO
P. O. Box 1900
Reno, Nevada 89505

Attn: William N. Vann, Jr., P.E.

Re: Huffaker Drainage Relief System Alternative Study Summary Report

Dear Millard:

We are pleased to submit this summary report on our investigation of drainage problems and their solutions for the Huffaker Hills area.

The findings of the report recommend that Alternative C or C-1 be constructed within the City, and a cooperative City/County flood control project be implemented to route Thomas Creek flow easterly across Virginia Street south of the Huffaker Hills. In addition to this recommendation, various planning recommendations are provided for future development in the Huffaker Hills area.

Upon your review of this report, we will be more than happy to meet with you to discuss our recommendations. In the interim, if you have any questions, please call.

Thank you for you and your staffs' cooperation in this effort.

Sincerely,

SEA, INCORPORATED

Steve Varela

Steve Varela, P.E.

Joe W. Howard

Joe W. Howard, P.E.
Vice President

JWH:SV:jk

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EXHIBITS

APPENDICES

I. INTRODUCTION

Background

Authorization for this report was given by the City of Reno on March 18, 1986, for the purpose of providing the City with alternatives for relieving drainage problems within the study area which consists of the developed area bounded by the Cochran Ditch to the north, Huffaker Hills to the east, Longley Lane to the west, and the proposed U.S. 395 extension on the south.

The study area has experienced flooding on a frequent basis since the Huffaker Hills subdivision improvements began in the mid-1970's. Since 1980, there have been three occurrences of flooding which have contributed to flood damage in the study area, or have taxed City personnel and equipment resources to help relief inundation of city streets and private properties.

The first of these flood events occurred in January 1980 when a regional storm resulted in water ponding in Autumn Hills Drive to within one half foot of some homes adjacent to low point catch basins, water ponded in the vacant land to the east of the subdivision, the city park was flooded due to debris blocking catch basins, and storm water overtopping the culvert headwalls (F-21, G-15, Facility Map Exhibit A) at the upstream end of Huffaker Park. City maintenance personnel reported at least 12 hours of a 3 man sewer crew, and various heavy equipment were needed to unblock the area to help relieve the ponding water.

The storm of February 1986 caused similar flooding within Autumn Hills Drive, but did not back into the vacant lot nor flood the park. However, this storm event flooded over Offenhauser Drive as flow exceeded the capacity of the 48"x76" HEP crossing under it south of Craigmont Drive. Flow also left the ditch upstream of Offenhauser and flowed northerly down Armin Circle. Damage to the sidewalk caused by erosion and undermining, was apparent on the upstream side of Offenhauser. It should be noted that improvements were made to the two structures at the south end of Huffaker Park prior to the 1986 storm event as part of the Waterford Park Subdivision improvements.

City maintenance personnel described a storm that occurred sometime between the 1980 and 1986 storm that backed-up water at the east end of Huffaker Park at the split flow structure (G-15) due to debris clogging. This flood event caused damage to pavement on the existing cul-de-sac to the north. This street has not been repaired as yet.

The Phase IA - Preliminary Report for this study was completed and submitted to the City on June 23, 1986. The purpose of the preliminary report was to review the numerous drainage/hydrology studies relating to the study area, compare their results and recommend an appropriate hydrologic model for use in analyzing the drainage problems in the study area. Upon City review of the preliminary report, the City directed SEA on August 4, 1986 to utilize the 1980 Corps of Engineers report for runoff flow rates eminating from the Thomas Creek watershed (see Appendix).

Scope of Study

In order to identify and assess the flood problems within the study area, the following tasks were performed, and sources of information were used:

- A drainage facility map was prepared (Exhibit C) showing location, size, type and capacity of existing drainage improvements. As built drawings and field inventories were utilized.
- Interviews with City Engineering and Maintenance Department staff
- Field inspections of reported problem areas.
- NDOT 200 scale topographic maps and USGS 7.5 minute quadrangle maps.
- Flood routing utilizing Army Corps of Engineers HEC-2 computer program for 25-year and 100-year flows along Thomas Creek from the upstream split flow structure near Foothill Road to Virginia Street at Holcomb Lane, Exhibits B and C (see Appendix).
- Rating curves were developed for analyzing street flow capacities for Patriot Lane and Bluestone Drive utilizing the HYMO computer program (see Appendix).

- Local area hydology was prepared using the rational method within the study area. Five-year outflow from the proposed U.S. 395 detention pond was added (see Appendix).
- NDOT proposed plans for U.S. 395 and Hydrologic data for design of the interchange detention pond.

II. HYDROLOGIC ANALYSIS

Thomas Creek Watershed

Flood flows from the Thomas Creek watershed upstream of the study area were established by the City at the end of Phase IA and are summarized below:

Q_{100}	at Steamboat Ditch	=	2500 cfs
Q_{25}	at Steamboat Ditch	=	680 cfs
Q_{10}	at Steamboat Ditch	=	340 cfs
Q_{5}	at Steamboat Ditch	=	170 cfs

Flows from the 100-year and 25-year events were routed to and through the study area. The routing maps are shown in Exhibits B, C, D and E. Since plans for construction of U.S. 395 south of the study area have been completed, and are expected to be under construction in the near future, all routing conditions assumed the U.S. 395 improvements are in place. As shown, the total estimated 100-year storm flow entering the study area near South Virginia and Patriot, is 1100 cfs. The estimated 25-year storm flow entering the study area at the same location is 140 cfs.

NDOT U.S. 395 Hydrologic Design Criteria

The drainage improvements at the proposed U.S. 395 Interchange were designed to handle a 10-year frequency storm event, assuming that future flood improvements would divert Thomas Creek to the southeast across Virginia Street to the south of Huffaker Hills. The divertion assumption was accepted by the City of Reno for NDOT's design criteria in January 1976. The drainage area contributing to this runoff is 537 acres and is shown in Exhibit F. The detention pond is designed to receive the 10-year storm flow of 115 cfs and release it at a peak rate of 70 cfs. This flow will be diverted into an existing open ditch which eventually drains into a 65"x40" CMPA culvert under Patriot Lane.

N.D.O.T.

Local Area Hydrology

Hydrologic calculations were performed to determine peak discharge from a 5-year storm event within the study area. The 5-year flow of 50 cfs was added at the outfall of the U.S. 395 detention pond. A starting time of concentration (tc) of 2 hours was used for adding in local 5-year runoff by the rational method. Discharge rates and times of concentrations are shown on Exhibit G.

Calculations for determining the 2 hour starting time?

III ANALYSIS OF EXISTING SYSTEM

Methodology

By utilizing as-built plans and field inspections, sizes, slopes and capacities of the existing underground storm drain structures were listed on the Facility Map.

The major outfall lines serving the study area discharge into the Cochran Ditch at the northeast end of the Huffaker Subdivision. These lines collect runoff from a drainage ditch at the south side of Huffaker Park and flow down Wallsand Drive, Berry Hill Drive, and along back lot lines between Windmill and Wallsand Drive.

Assuming the conduits at full flow with a hydraulic grade line (HGL) equal to the conduit slope, capacities were calculated for the existing drainage network. This information is listed on the facility map. The exception to this is the 48"x76" culvert under Offenhauser, which was calculated utilizing an inlet control nomograph.

It should be noted that in most cases, the existing drainage system would handle more flow when the HGL rises above the crown of the conduit. In some cases, the system may have less capacity due to extreme angle points and potential debris clogging. On the average, the results provide a fair estimate of the existing capacities. Open ditch capacities were assumed to equal or exceed downstream closed system capacity.

Existing System Condition

As a result of field inspections and discussions with City Maintenance staff, a list of special problem areas was developed. The following items relate to the numbered areas shown on Exhibit H.

No. 1. Cochran ditch: This irrigation ditch is the drainage outlet for the study area. Primary problems associated with this ditch are:

a) City does not maintain this ditch.

b) It runs full with irrigation water during the months of April through November. Thereby its usefullness as an effective drainage outlet is little. During periods of heavy regional flooding, it may run full with overflow runoff from Dry Creek to the east. This effectively reduces the capacity of the storm drain lines into the ditch, causing water to backup and pond at low points in Autumn Hills Drive.

c) Its flat slope and earth lining tends to allow siltation buildup in connecting storm drain lines.

No. 2. ?This ditch provides the outlet channel for the 30-inch storm drain along Berry Hill Drive.

a) Poor maintenance access.
b) Subject to siltation. Outlet pipe was observed to be 40 percent blocked.
c) Backs up from water in Cochran ditch.

No. 3. This split flow structure is a favorite hideout for children to build forts, and for debris collection. Storm water has backed up over the structure and flowed to the north down the adjacent cul-de-sac and Wallsand Street.

No. 4. This recently constructed ditch has virtually no access for maintenance. At the south end of Armin Circle, it was noted that there is a low point in the ditch's north bank which overtops from backwater at the downstream culvert under Offenhauser Drive.

No. 5. The City maintenance personnel indicated that during storm events, debris is collected at these angle point manholes causing backup in the system.

Exhibit H also shows areas where sump conditions exist at drainage catch basins. The low point within Patriot Lane, when overtaxed by stormwater, has no overflow outlet because of block walls constructed between apartment complexes. Within this area, the potential to backup water into private yards and flood the apartment structures exists. Flow ponding in the low points shown within Autumn Hills Drive when backed up high enough will eventually flow to the north into the Cochran Ditch and the vacant field through dead end streets or side yard before wetting the first floor of adjacent houses. The fact that there has been no record of water damage to houses in this area leads to support this claim.

Existing System Capacity Related to Assumed Design Storm Runoff

The 5-year local area storm, the 25-year and the 100-year Thomas Creek watershed storms were routed through the study area, assuming the U.S. 395 Interchange is in place. Since this interchange involves construction of detention basin which has the effect of reducing peak flows for the 10-year and less frequency storms, only the 5-year event was effectively reduced.

The drainage area used for the 5-year local storm event is shown on Exhibit G and follows the same assumption that was used for the design of the U.S. 395 improvements, which is the flow from the upstream Thomas Creek watershed will be diverted south of Huffaker Hills. Due to the time of concentration and natural divertions upstream of Virginia Street, it is safe to assume the 5-year runoff from the full Thomas Creek watershed would not be substantially greater than the 5-year local event.

The peak inflow rate to the detention structure for a 24-hour 5-year Type II rainstorm using the City's IDF curves and isopleth maps is 70 cfs. The Tc for this peak is 2 hours. The peak outflow from the detention basin is 50 cfs. As a conservative estimate, 50 cfs was assumed as the Q5 out of the basin. A Tc of 2 hours was used as the initial Tc for calculating local inflow from catch basins within the Huffaker Subdivision. This flow was added to the initial 50 cfs. Exhibit G shows the flow at various points routed through the study area. The existing system has a capacity of 26 cfs gravity flow along each line down Wallsand, Berry Hill, and between Windmill and Offenhauser. The 5-year flows along these lines are estimated at 33 cfs. Allowing head to build up in the system, the 5-year flow should be adequately handled, assuming a free outlet condition were existing. Since the Cochran Ditch prevents the free outlet condition, water would pond within the low points in Autumn Hill Drive.

The 25-year and 100-year Thomas Creek watershed storm was routed through the study area assuming that the existing drainage system will be flowing at capacity due to local runoff, therefore, this flow would be routed overland in streets, and between buildings where grading allows. Low points such as that shown in Patriot Drive would pond, and eventually flood adjacent apartment buildings. There is also the possibility that during storms approaching the 100-year event, water may not be able to escape to the north fast enough within Autumn Hill Drive, and flood homes in this area.

IV ALTERNATIVE RELIEF SYSTEMS

Design Criteria/Levels of Service

Three scenarios for design storms and/or levels of service were assumed. They include 100-year and 25-year Thomas Creek watershed storm protection and 5-year local area storm protection. The five alternatives investigated will provide varying degrees of protection from the three design storm scenarios. A summary of costs for each of these alternatives is shown on Plate 1. As discussed earlier, one scenario assumes that future improvements within Washoe County in the upstream Thomas Creek watershed would divert the main flow of Thomas Creek south around Huffaker Hills. Alternative C assumes this scenario, although as discussed earlier, the increase in the 5-year flow for the full Thomas Creek watershed should not be substantially greater than if Thomas Creek is diverted southerly.

Alternative A

Objective: Provide capacity to carry the 100-year frequency Thomas Creek watershed storm flow (1100 cfs) plus local drainage without significant street flooding.

Description: This system will route the storm water south of Patriot Lane easterly, south of the existing tennis courts, thence parallel to and adjacent to Portmann Avenue to the southwest corner of the Portmann/Offenhauser Drive intersection. The flow will then be routed underground (approx. 750') to the existing open ditch on the east side of Offenhauser. The flow will then be routed to the southwest corner of Huffaker Park (at existing structure F-21) were it will be taken underground to the north through the park, thence, along Offenhauser Drive north, terminating at the Cochran Ditch were it will discharge into an open channel and be carried northerly within the existing sanitary sewer easement to McCarran Boulevard. The sizes, lengths and types of the proposed drainage improvements are shown in Exhibit A. In order to accommodate the new drainage channel, the existing easement would need to be widened by approximately 33 feet and renegotiated for use as a combined storm drain and sanitary sewer easement. In addition, we have included the piping of the ditch between structure E-1 and

M-2 to allow maintenance access and avoid backwater escaping to the north at the low side of the ditch. Flow through the system from structure E-9 to E-1 will be perpetuated by extending a 60" x 30" Horizontal Eliptical Pipe southerly to the proposed U.S. 395 detension basin outlet. This alternative would avoid flooding due to backup from Cochran Ditch.

Other routes for routing the 100-year Thomas Creek flow around the study area were investigated but were determined to have greater costs.

Total Estimated Costs: $3,140,000

Alternative B

Objective: Provide capacity to carry the 25-year frequency Thomas Creek watershed storm flow (140 cfs) plus local drainage without significant street flooding.

Description: This system will route the 25-year storm flow along the alignment described in Alternate A. The easement for the outfall ditch to McCarran will be widened by an estimated 23 feet and renegotiated to allow for combined use as a storm drain and sanitary sewer easement. Improvements to the ditch between E-1 and M-2 is also included. As in Alternate A, flows of up to 76 cfs will be allowed to pass through structures E-9 to E-1 (see Exhibit B).

Total Estimated Costs: $1,266,000

Alternative C

Objective: Provide capacity to carry the 5-year frequency storm flow through the study area without significant street flooding.

Description: This system will collect the 5-year storm flow at the downstream ends of Wallsand, Berry Hill and between Offenhauser and Windmill, in a closed pipe system within Autumn Hills, and discharge into a new open ditch at the downstream end of Offenhauser Drive. As in the other alternatives, this ditch will be separated from irrigation flow to allow for a free drainage outflow and be carried northerly within an existing sanitary sewer easement. This easement would need to be widened by an

Agenda Item # ___________

Date: October 23, 1990

To: MAYOR AND CITY COUNCIL

Thru: Harold L. Schilling, City Manager

From: Glen B. Daily, P.E., Associate Civil Engineer

Via: Steve Varela P.E., City Engineer

Date: October 10, 1990

Re: Plumas Moana Storm Drain
Construction Contract No. 688

SUMMARY:

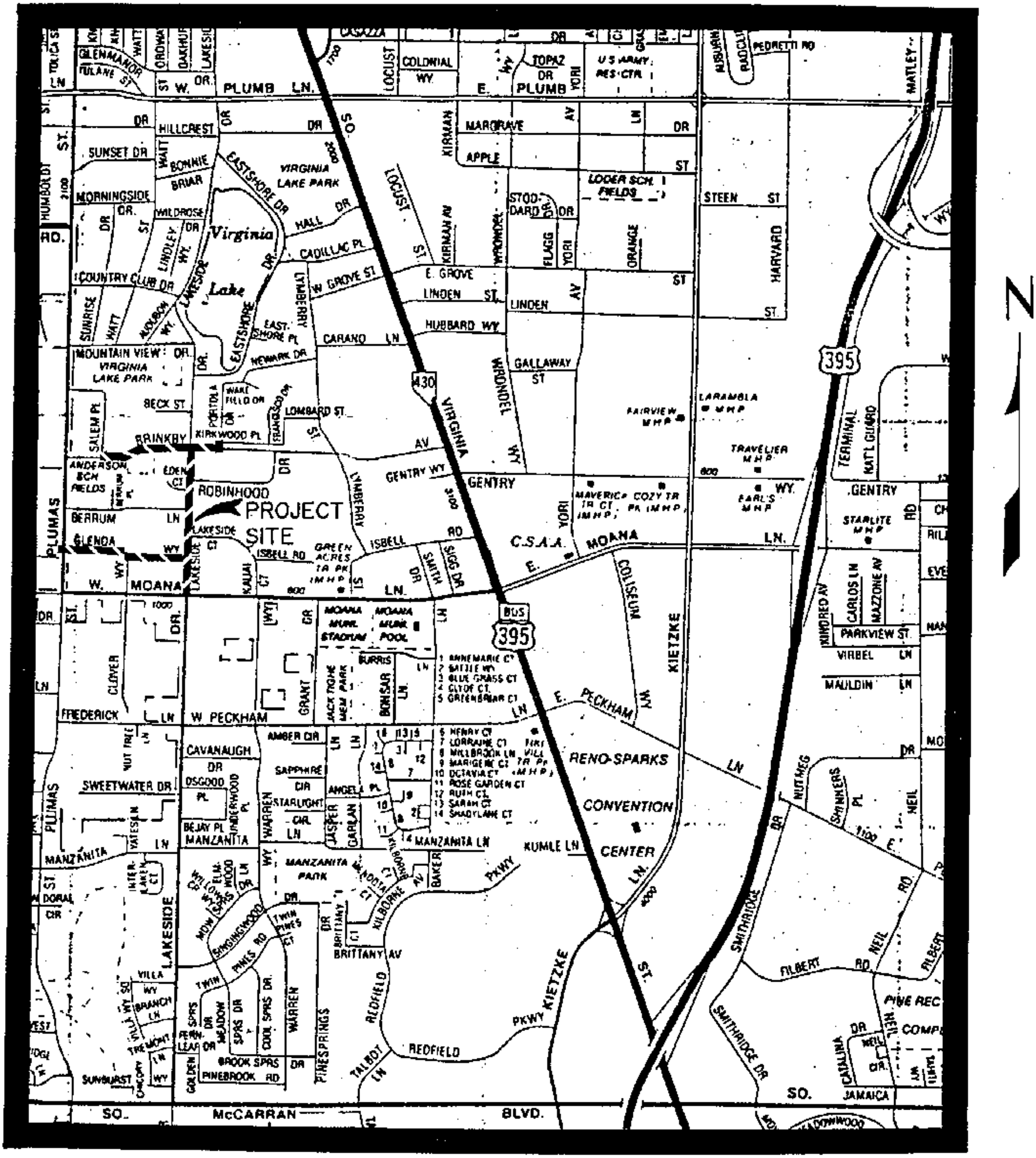
Presented for your consideration are bids for the Plumas Moana Storm Drain. Nine bids were received and opened on October 10, 1990, for Contract No. 688, and the low bidder is Robert L. Helms Construction Co. of Reno, Nevada. The low bid is in the amount of $1,585,915.95 which is below the Engineer's estimate of $1,588,099.15.

PREVIOUS COUNCIL ACTIONS:

Approval of 1985 Bond Fund.

BACKGROUND:

The Plumas Moana Storm Drain is designed to alleviate severe and recurrent flooding problems within the Moana Lane-Lakeside Drive area through which the lower end of the Plumas Moana tributary drainage basin flows. This project will greatly improve facilities within the area which are designed to collect and transmit storm water runoff into the Virginia Lake and protect adjacent properties from flooding. The reconstruction of Lakeside Drive from Moana Lane to Brinkby Avenue is included as part of the project to be performed subsequent to construction of the storm drainage and flood control improvements.



SITE LOCATION
PLUMAS-MOANA STORM DRAIN
CONTRACT NO. 688

TABULATION OF BIDS 10:00 A.M., OCTOBER 10, 1990
FOR: PLUMAS MOANA STORM DRAIN

PROJECT NO: 22005
CONTRACT NO: 688
DATE: OCTOBER 10, 1990

CITY OF RENO

DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION

LOW BIDDER: ROBERT L. HELMS CONSTRUCTION CO.

LOW BID AMOUN $1,585,915.95

ITEM	QTY	UNIT	ITEM	ENGINEER'S ESTIMATE UNIT PRICE	ENGINEER'S ESTIMATE TOTAL	BIDDER NO.1 ROBERT L. HELMS CONSTRUCTION CO. UNIT PRICE	BIDDER NO.1 TOTAL	BIDDER NO.2 JOE SUTER CONSTRUCTION COMPANY, INC. UNIT PRICE	BIDDER NO.2 TOTAL	BIDDER NO.3 CONTRI CONSTRUCTION COMPANY UNIT PRICE	BIDDER NO.3 TOTAL	BIDDER NO.4 M. M. BYARS CONSTRUCTION COMPANY UNIT PRICE	BIDDER NO.4 TOTAL	BIDDER NO.5 GERHARDT & BERRY CONSTRUCTION, INC. UNIT PRICE	BIDDER NO.5 TOTAL
301a	1350	L.F.	REMOVE CURB & GUTTER	$2.00	$2,700.00	$4.50	$6,075.00	$2.50	$3,375.00	$1.50	$2,025.00	$2.00	$2,700.00	$2.00	$2,700.00
301b	6815	SQ FT	REMOVE SIDEWALK	$0.75	$5,111.25	$1.40	$9,541.00	$1.00	$6,815.00	$1.00	$6,815.00	$0.50	$3,407.50	$0.50	$3,407.50
301c	300	SQ FT	REMOVE DRIVEWAY APRON	$2.50	$750.00	$1.40	$420.00	$1.50	$450.00	$1.00	$300.00	$1.00	$300.00	$0.50	$150.00
301d	4	EA	REMOVE MANHOLE	$200.00	$800.00	$350.00	$1,400.00	$300.00	$1,200.00	$400.00	$1,600.00	$300.00	$1,200.00	$100.00	$400.00
301e	3	EA	REMOVE CATCH BASIN	$200.00	$600.00	$175.00	$525.00	$200.00	$600.00	$200.00	$600.00	$300.00	$900.00	$50.00	$150.00
301f	50	L.F.	REMOVE 6' CHAIN LINK FENCE	$2.00	$100.00	$6.50	$325.00	$3.00	$150.00	$3.00	$150.00	$5.00	$250.00	$2.50	$125.00
302	350	CU YD	EXCAVATION OF UNSUITABLE MATERIAL	$6.00	$2,100.00	$10.00	$3,500.00	$8.00	$2,800.00	$10.00	$3,500.00	$10.00	$3,500.00	$4.50	$1,575.00
303	5460	CU YD	UNCLASSIFIED EXCAVATION	$8.00	$43,680.00	$7.50	$40,950.00	$8.00	$43,680.00	$7.00	$38,220.00	$10.00	$54,600.00	$5.50	$30,030.00
304a	350	CU YD	UNCLASSIFIED FILL	$8.00	$2,800.00	$3.50	$1,225.00	$8.00	$2,800.00	$13.00	$4,550.00	$10.00	$3,500.00	$6.00	$2,100.00
304b	750	SQ FT	10" HEAVY RIP-RAP	$5.00	$3,750.00	$1.50	$1,125.00	$5.00	$3,750.00	$3.00	$2,250.00	$5.00	$3,750.00	$3.15	$2,362.50
305	50	CU YD	IMPORTED FRENCH BACKFILL	$8.00	$400.00	$12.00	$600.00	$10.00	$500.00	$10.00	$500.00	$20.00	$1,000.00	$12.00	$600.00
306a	627	L.F.	66" STORM DRAIN PIPE	$185.00	$115,995.00	$192.00	$120,384.00	$200.00	$125,400.00	$302.00	$189,354.00	$200.00	$125,400.00	$237.50	$148,912.50
306b	715	L.F.	60" STORM DRAIN PIPE	$165.00	$117,975.00	$156.00	$111,540.00	$190.00	$135,850.00	$160.00	$114,400.00	$160.00	$114,400.00	$224.50	$160,517.50
306c	84	L.F.	54" STORM DRAIN PIPE (furnished by Owner)	$100.00	$8,400.00	$400.00	$33,600.00	$560.00	$47,040.00	$380.00	$31,920.00	$500.00	$42,000.00	$540.00	$45,360.00
306d	13	L.F.	54" STORM DRAIN PIPE (furnished by Contractor)	$150.00	$1,950.00	$540.00	$7,020.00	$750.00	$9,750.00	$518.00	$6,734.00	$650.00	$8,450.00	$685.00	$8,905.00
306e	730	L.F.	48" STORM DRAIN PIPE	$130.00	$94,900.00	$118.00	$86,140.00	$160.00	$116,800.00	$128.00	$93,440.00	$140.00	$102,200.00	$164.55	$120,121.50
306f	25	L.F.	42" STORM DRAIN PIPE (re-install)	$100.00	$2,500.00	$125.00	$3,125.00	$150.00	$3,750.00	$149.00	$3,725.00	$200.00	$5,000.00	$235.40	$5,885.00
306g	664	L.F.	36" STORM DRAIN PIPE	$90.00	$59,760.00	$94.50	$62,748.00	$100.00	$66,400.00	$157.00	$104,248.00	$75.00	$49,800.00	$116.05	$77,057.20
306h	20	L.F.	30" STORM DRAIN PIPE	$85.00	$1,700.00	$165.00	$3,300.00	$90.00	$1,800.00	$56.00	$1,120.00	$170.00	$3,400.00	$108.90	$2,178.00
306i	123	L.F.	24" STORM DRAIN PIPE	$60.00	$7,380.00	$78.00	$9,594.00	$65.00	$7,995.00	$57.00	$7,011.00	$60.00	$7,380.00	$99.20	$12,201.60
306j	211	L.F.	18" STORM DRAIN PIPE	$45.00	$9,495.00	$54.00	$11,394.00	$55.00	$11,605.00	$54.00	$11,394.00	$50.00	$10,550.00	$95.30	$20,108.30
306k	442	L.F.	15" STORM DRAIN PIPE	$35.00	$15,470.00	$50.00	$22,100.00	$45.00	$19,890.00	$42.00	$18,564.00	$40.00	$17,680.00	$94.55	$41,791.10
306l	159	L.F.	12" STORM DRAIN PIPE	$30.00	$4,770.00	$30.00	$4,770.00	$40.00	$6,360.00	$40.00	$6,360.00	$30.00	$4,770.00	$93.15	$14,810.85
306m	250	L.F.	4" SANITARY SEWER LATERAL	$20.00	$5,000.00	$16.50	$4,125.00	$25.00	$6,250.00	$21.00	$5,250.00	$20.00	$5,000.00	$28.00	$7,000.00
307a	2	EA	RELOCATE FIRE HYDRANT	$750.00	$1,500.00	$750.00	$1,500.00	$600.00	$1,200.00	$640.00	$1,280.00	$800.00	$1,600.00	$400.00	$800.00
307b	50	L.F.	6" FIRE HYDRANT SERVICE	$25.00	$1,250.00	$16.50	$825.00	$25.00	$1,250.00	$28.00	$1,400.00	$30.00	$1,500.00	$22.50	$1,125.00
308a	3586	TON	TYPE 2 CLASS B AGGREGATE BASE	$12.00	$43,032.00	$8.90	$31,915.40	$15.00	$53,790.00	$8.22	$29,476.92	$11.00	$39,446.00	$12.35	$44,287.10
308b	3586	TON	PITRUN SUBBASE	$10.00	$35,860.00	$6.10	$21,874.60	$11.00	$39,446.00	$5.95	$21,336.70	$7.00	$25,102.00	$9.25	$33,170.50
311a	1	L.S.	6' X 8' RCB HEADWALL AND CHANNEL TRANSITION STRUCTURE - STA. "R" 5 + 56.75	$20,000.00	$20,000.00	$24,860.00	$24,860.00	$17,000.00	$17,000.00	$80,000.00	$80,000.00	$27,500.00	$27,500.00	$22,665.00	$22,665.00
311b	1	L.S.	66" RCP by 6' X 8' RCB JUNCTION VAULT STRUCTURE- STA. "R" 12 + 96	$15,000.00	$15,000.00	$14,640.00	$14,640.00	$8,000.00	$8,000.00	$9,500.00	$9,500.00	$22,000.00	$22,000.00	$11,024.00	$11,024.00
311c	1	L.S.	66" RCP by 6' X 8' RCB JUNCTION VAULT STRUCTURE - STA. "R" 24 + 45.5	$12,000.00	$12,000.00	$13,460.00	$13,460.00	$8,000.00	$8,000.00	$9,000.00	$9,000.00	$21,000.00	$21,000.00	$10,440.00	$10,440.00
311d	1	L.S.	48" RCP by 5' X 5' RCB JUNCTION VAULT STRUCTURE - STA. "G" 13 + 65	$7,000.00	$7,000.00	$12,100.00	$12,100.00	$8,000.00	$8,000.00	$7,000.00	$7,000.00	$19,000.00	$19,000.00	$8,700.00	$8,700.00
312e	1	L.S.	5' X 5' RCB HEADWALL & TRASH RACK STRUCTURE	$5,500.00	$5,500.00	$7,370.00	$7,370.00	$9,000.00	$9,000.00	$12,000.00	$12,000.00	$9,500.00	$9,500.00	$5,485.00	$5,485.00
311f	6	EA	TYPE IA (48") MANHOLE	$1,500.00	$9,000.00	$1,950.00	$11,700.00	$1,500.00	$9,000.00	$700.00	$4,200.00	$1,300.00	$7,800.00	$1,562.00	$9,372.00
311g	2	EA	TYPE II (60") MANHOLE	$1,800.00	$3,600.00	$3,950.00	$7,900.00	$3,000.00	$6,000.00	$3,500.00	$7,000.00	$3,100.00	$6,200.00	$1,728.00	$3,456.00
311h	11	EA	TYPE IV (60") MODIFIED MANHOLE	$2,500.00	$27,500.00	$3,190.00	$35,090.00	$4,000.00	$44,000.00	$3,500.00	$38,500.00	$3,500.00	$38,500.00	$2,050.00	$22,550.00
311i	2	EA	TYPE I CATCH BASIN	$600.00	$1,200.00	$575.00	$1,150.00	$600.00	$1,200.00	$690.00	$1,380.00	$800.00	$1,600.00	$337.00	$674.00
311j	5	EA	TYPE I (MODIFIED) CATCH BASIN	$3,000.00	$15,000.00	$2,365.00	$11,825.00	$600.00	$3,000.00	$2,500.00	$12,500.00	$4,500.00	$22,500.00	$4,610.00	$23,050.00
311k	16	EA	TYPE 4-R (MODIFIED) CATCH BASIN	$1,250.00	$20,000.00	$1,200.00	$19,200.00	$1,200.00	$19,200.00	$1,000.00	$16,000.00	$1,400.00	$22,400.00	$712.00	$11,392.00
312a	850	L.F.	TYPE I P.C.C. CURB & GUTTER	$12.00	$10,200.00	$9.65	$8,202.50	$16.00	$13,600.00	$8.00	$6,800.00	$12.00	$10,200.00	$10.00	$8,500.00
312b	500	L.F.	TYPE I-A P.C.C. CURB & GUTTER	$13.50	$6,750.00	$9.65	$4,825.00	$20.00	$10,000.00	$8.50	$4,250.00	$12.00	$6,000.00	$10.50	$5,250.00
312c	25	L.F.	TYPE II P.C.C. MEDIAN CURB	$10.00	$250.00	$9.50	$237.50	$15.00	$375.00	$25.00	$625.00	$20.00	$500.00	$18.00	$450.00
312d	6815	SQ FT	P.C.C. SIDEWALK	$2.50	$17,037.50	$2.25	$15,333.75	$3.00	$20,445.00	$2.00	$13,630.00	$3.00	$20,445.00	$2.40	$16,356.00
312e	300	SQ FT	P.C.C. DRIVEWAY APRON	$3.50	$1,050.00	$3.35	$1,005.00	$3.00	$900.00	$2.50	$750.00	$4.00	$1,200.00	$2.90	$870.00
312f	2000	SQ FT	P.C.C. VALLEY GUTTER	$3.75	$7,500.00	$3.40	$6,800.00	$4.00	$8,000.00	$2.50	$5,000.00	$3.50	$7,000.00	$2.90	$5,800.00
312g	1500	SQ FT	P.C.C. HANDICAP RAMP	$4.85	$7,275.00	$12.50	$18,750.00	$5.00	$7,500.00	$2.50	$3,750.00	$3.50	$5,250.00	$3.25	$4,875.00
319a	315	TON	AR-4000 ASPHALTIC CEMENT	$200.00	$63,000.00	$28.30	$8,914.50	$210.00	$66,150.00	$200.00	$63,000.00	$220.00	$69,300.00	$200.00	$63,000.00
319b	4170	TON	PLANTMIX BITUMINOUS SURFACE AGGREGATE	$20.00	$83,400.00	$28.30	$118,011.00	$35.00	$145,950.00	$31.00	$129,270.00	$33.00	$137,610.00	$30.45	$126,976.50
319c	10647	SQ FT	4-1/2" A.C. PAVEMENT REPLACEMENT W/ 6" AGGR. BASE	$2.20	$23,423.40	$3.60	$38,329.20	$2.30	$24,488.10	$0.50	$5,323.50	$3.00	$31,941.00	$2.20	$23,423.40
319d	8159	SQ FT	4" A.C. PAVEMENT REPLACEMENT W/ 15" AGGR. BASE	$2.50	$20,397.50	$4.50	$36,715.50	$2.60	$21,213.40	$0.50	$4,079.50	$3.50	$28,556.50	$2.00	$16,318.00
319e	550	SQ FT	6" A.C. PAVEMENT REPLACEMENT W/ 12" AGGR. BASE	$2.75	$1,512.50	$5.10	$2,805.00	$2.70	$1,485.00	$2.80	$1,540.00	$5.00	$2,750.00	$2.75	$1,512.50
319f	3000	SF-IN	ADDITIONAL 1" PAVEMENT REPLACEMENT	$0.30	$900.00	$0.28	$840.00	$0.50	$1,500.00	$0.30	$900.00	$0.40	$1,200.00	$0.27	$810.00
321a	1	EA	ABANDON MANHOLE	$350.00	$350.00	$300.00	$300.00	$500.00	$500.00	$255.00	$255.00	$600.00	$600.00	$170.00	$170.00
321b	14	EA	ADJUST MANHOLE TO GRADE	$150.00	$2,100.00	$235.00	$3,290.00	$250.00	$3,500.00	$113.00	$1,582.00	$180.00	$2,520.00	$150.00	$2,100.00
321c	32	EA	ADJUST VALVE TO GRADE	$75.00	$2,400.00	$110.00	$3,520.00	$150.00	$4,800.00	$42.00	$1,344.00	$100.00	$3,200.00	$60.00	$1,920.00
325a	50	L.F.	6' CHAIN LINK FENCE	$12.00	$600.00	$9.50	$475.00	$20.00	$1,000.00	$25.00	$1,250.00	$20.00	$1,000.00	$10.00	$500.00
332	6	EA	RECONSTRUCT MONUMENT	$150.00	$900.00	$135.00	$810.00	$400.00	$2,400.00	$200.00	$1,200.00	$300.00	$1,800.00	$75.00	$450.00
349	1	L.S.	TRAFFIC CONTROL	$35,000.00	$35,000.00	$129,450.00	$129,450.00	$1,000.00	$1,000.00	$1,000.00	$1,000.00	$25,000.00	$25,000.00	$15,000.00	$15,000.00
350a	10	EA	REPLACE TRAFFIC LOOP	$275.00	$2,750.00	$275.00	$2,750.00	$290.00	$2,900.00	$225.00	$2,250.00	$300.00	$3,000.00	$225.00	$2,250.00
350b	3	EA	RELOCATE PULL BOX	$200.00	$600.00	$150.00	$450.00	$175.00	$525.00	$175.00	$525.00	$200.00	$600.00	$120.00	$360.00
350c	150	L.F.	REPLACE 2" TRAFFIC CONDUIT	$10.00	$1,500.00	$12.00	$1,800.00	$10.00	$1,500.00	$9.00	$1,350.00	$10.00	$1,500.00	$9.50	$1,425.00
350d	250	L.F.	REPLACE 3" TRAFFIC CONDUIT	$12.00	$3,000.00	$13.50	$3,375.00	$11.00	$2,750.00	$11.00	$2,750.00	$11.00	$2,750.00	$10.50	$2,625.00
353a	1148	L.F.	6' X 6' PRECAST REINFORCED CONCRETE BOX (RCB)	$400.00	$459,200.00	$267.00	$306,516.00	$280.00	$321,440.00	$341.00	$391,468.00	$310.00	$355,880.00	$315.45	$362,136.60
353b	51	L.F.	5' X 5' PRECAST REINFORCED CONCRETE BOX (RCB)	$225.00	$11,475.00	$225.00	$11,475.00	$240.00	$12,240.00	$300.00	$15,300.00	$250.00	$12,750.00	$278.45	$14,200.95
399	1	F.A.	MISCELLANEOUS WORK		$100,000.00		$100,000.00		$100,000.00		$100,000.00		$100,000.00		$100,000.00
			*** TOTAL BID PRICE ***		$1,580,099.15		$1,585,915.95		$1,629,257.80 *		$1,664,595.42		$1,669,358.00		$1,693,918.10

* Total corrected from $1,620,257.50

ATTACHMENT "B"

TABULATION OF BIDS 10:00 A.M., OCTOBER 10, 1990
FOR: PLUMAS MONNA STORM DRAIN

PROJECT NO: 22005
CONTRACT NO: 1680
DATE: OCTOBER 10, 1990

CITY OF RENO

DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION

LOW BIDDER: ROBERT L. HELMS CONSTRUCTION CO.

LOW BID AMOUN $1,595,915.95

ITEM	QTY	UNIT	ITEM	ENGINEER'S ESTIMATE UNIT PRICE	ENGINEER'S ESTIMATE TOTAL	BIDDER NO.6 T. W. CONSTRUCTION CO., INC. UNIT PRICE	BIDDER NO.6 TOTAL
301a	1350	L.F.	REMOVE CURB & GUTTER	$2.00	$2,700.00	2.50	$3,375.00
301b	6815	SQ FT	REMOVE SIDEWALK	$0.75	$5,111.25	$0.50	$3,407.50
301c	300	SQ FT	REMOVE DRIVEWAY APRON	$2.50	$750.00	$0.50	$150.00
301d	4	EA	REMOVE MANHOLE	$200.00	$800.00	$450.00	$1,800.00
301e	3	EA	REMOVE CATCH BASIN	$200.00	$600.00	$220.00	$660.00
301f	50	L.F.	REMOVE 6' CHAIN LINK FENCE	$2.00	$100.00	$6.00	$300.00
302	350	CU YD	EXCAVATION OF UNSUITABLE MATERIAL	$6.00	$2,100.00	$15.00	$5,250.00
303	5460	CU YD	UNCLASSIFIED EXCAVATION	$8.00	$43,680.00	$10.00	$54,600.00
304a	350	CU YD	UNCLASSIFIED FILL	$8.00	$2,800.00	$20.00	$7,000.00
304b	750	SQ FT	18" HEAVY RIP-RAP	$5.00	$3,750.00	$3.50	$2,625.00
305	50	CU YD	IMPORTED TRENCH BACKFILL	$8.00	$400.00	$20.00	$1,000.00
306a	627	L.F.	66" STORM DRAIN PIPE	$185.00	$115,995.00	$236.00	$147,972.00
306b	715	L.F.	60" STORM DRAIN PIPE	$165.00	$117,975.00	$220.00	$157,300.00
306c	84	L.F.	54" STORM DRAIN PIPE (furnished by Owner)	$100.00	$8,400.00	$236.00	$19,824.00
306d	13	L.F.	54" STORM DRAIN PIPE (furnished by Contractor)	$150.00	$1,950.00	$476.00	$6,188.00
306e	730	L.F.	48" STORM DRAIN PIPE	$130.00	$94,900.00	$166.00	$121,180.00
306f	25	L.F.	42" STORM DRAIN PIPE (re-install)	$100.00	$2,500.00	$156.00	$3,900.00
306g	664	L.F.	36" STORM DRAIN PIPE	$90.00	$59,760.00	$106.00	$70,384.00
306h	20	L.F.	30" STORM DRAIN PIPE	$85.00	$1,700.00	$106.00	$2,120.00
306i	123	L.F.	24" STORM DRAIN PIPE	$60.00	$7,380.00	$68.00	$8,364.00
306j	211	L.F.	18" STORM DRAIN PIPE	$45.00	$9,495.00	$50.00	$10,550.00
306k	442	L.F.	15" STORM DRAIN PIPE	$35.00	$15,470.00	$36.00	$15,912.00
306l	159	L.F.	12" STORM DRAIN PIPE	$30.00	$4,770.00	$34.00	$5,406.00
306m	250	L.F.	4" SANITARY SEWER LATERAL	$20.00	$5,000.00	$15.00	$3,750.00
307a	2	EA	RELOCATE FIRE HYDRANT	$750.00	$1,500.00	$800.00	$1,600.00
307b	50	L.F.	6" FIRE HYDRANT SERVICE	$25.00	$1,250.00	$20.00	$1,000.00
308a	3586	TON	TYPE 2 CLASS B AGGREGATE BASE	$12.00	$43,032.00	$11.00	$39,446.00
308b	3586	TON	PITRUN SUBBASE	$10.00	$35,860.00	$9.00	$32,274.00
311a	1	L.S.	6' X 8' RCB HEADWALL AND CHANNEL TRANSITION STRUCTURE - STA. "A" 3 + 96.75	$20,000.00	$20,000.00	$47,000.00	$47,000.00
311b	1	L.S.	66" RCP by 6' X 8' RCB JUNCTION VAULT STRUCTURE- STA. "A" 12 + 96	$15,000.00	$15,000.00	$27,000.00	$27,000.00
311c	1	L.S.	66" RCP by 6' X 8' RCB JUNCTION VAULT STRUCTURE - STA. "A" 24 + 43.5	$12,000.00	$12,000.00	$27,000.00	$27,000.00
311d	1	L.S.	48" RCP by 5' X 5' RCB JUNCTION VAULT STRUCTURE - STA. "D" 13 + 15	$7,000.00	$7,000.00	$28,000.00	$28,000.00
311e	1	L.S.	5' X 5' RCB HEADWALL & TRASH RACK STRUCTURE	$5,500.00	$5,500.00	$10,000.00	$10,000.00
311f	6	EA	TYPE IA (48") MANHOLE	$1,500.00	$9,000.00	$1,000.00	$6,000.00
311g	2	EA	TYPE II (60") MANHOLE	$1,800.00	$3,600.00	$6,400.00	$12,800.00
311h	11	EA	TYPE IV (60") MODIFIED MANHOLE	$2,500.00	$27,500.00	$5,100.00	$56,100.00
311i	2	EA	TYPE I CATCH BASIN	$600.00	$1,200.00	$600.00	$1,200.00
311j	5	EA	TYPE 2 (MODIFIED) CATCH BASIN	$3,000.00	$15,000.00	$4,900.00	$24,500.00
311k	16	EA	TYPE 4-R (MODIFIED) CATCH BASIN	$1,250.00	$20,000.00	$2,000.00	$32,000.00
312a	850	L.F.	TYPE I P.C.C. CURB & GUTTER	$12.00	$10,200.00	$10.00	$8,500.00
312b	500	L.F.	TYPE I-A P.C.C. CURB & GUTTER	$13.50	$6,750.00	$10.00	$5,000.00
312c	25	L.F.	TYPE I P.C.C. MEDIAN CURB	$10.00	$250.00	$28.00	$700.00
312d	6815	SQ FT	P.C.C. SIDEWALK	$2.50	$17,037.50	$3.00	$20,445.00
312e	300	SQ FT	P.C.C. DRIVEWAY APRON	$3.50	$1,050.00	$4.00	$1,200.00
312f	2000	SQ FT	P.C.C. VALLEY GUTTER	$3.75	$7,500.00	$4.00	$8,000.00
312g	1500	SQ FT	P.C.C. HANDICAP RAMP	$4.65	$6,975.00	$4.00	$6,000.00
319a	315	TON	AR-4000 ASPHALTIC CEMENT	$200.00	$63,000.00	$33.00	$10,395.00
319b	4170	TON	PLANTMIX BITUMINOUS SURFACE AGGREGATE	$20.00	$83,400.00	$33.00	$137,610.00
319c	10647	SQ FT	4-1/2" A.C. PAVEMENT REPLACEMENT W/ 8" AGGR. BASE	$2.20	$23,423.40	$4.00	$42,588.00
319d	8159	SQ FT	4" A.C. PAVEMENT REPLACEMENT W/ 15" AGGR. BASE	$2.50	$20,397.50	$4.00	$32,636.00
319e	550	SQ FT	6" A.C. PAVEMENT REPLACEMENT W/ 12" AGGR. BASE	$2.75	$1,512.50	$5.00	$2,750.00
319f	3000	SF-IN	ADDITIONAL 1" PAVEMENT REPLACEMENT	$0.30	$900.00	$0.25	$750.00
321a	1	EA	ABANDON MANHOLE	$350.00	$350.00	$250.00	$250.00
321b	14	EA	ADJUST MANHOLE TO GRADE	$150.00	$2,100.00	$150.00	$2,100.00
321c	32	EA	ADJUST VALVE TO GRADE	$75.00	$2,400.00	$110.00	$3,520.00
325a	50	L.F.	6' CHAIN LINK FENCE	$12.00	$600.00	$20.00	$1,000.00
332	6	EA	RECONSTRUCT MONUMENT	$150.00	$900.00	$100.00	$600.00
349	1	L.S.	TRAFFIC CONTROL	$35,000.00	$35,000.00	$5,100.00	$5,100.00
350a	10	EA	REPLACE TRAFFIC LOOP	$275.00	$2,750.00	$270.00	$2,700.00
350b	3	EA	RELOCATE PULL BOX	$200.00	$600.00	$120.00	$360.00
350c	150	L.F.	REPLACE 2" TRAFFIC CONDUIT	$10.00	$1,500.00	$6.00	$900.00
350d	250	L.F.	REPLACE 3" TRAFFIC CONDUIT	$12.00	$3,000.00	$7.00	$1,750.00
353a	1148	L.F.	8' X 6' PRECAST REINFORCED CONCRETE BOX (RCB)	$400.00	$459,200.00	$340.00	$390,320.00
353b	51	L.F.	5' X 5' PRECAST REINFORCED CONCRETE BOX (RCB)	$225.00	$11,475.00	$230.00	$11,730.00
399	1	F.A.	MISCELLANEOUS WORK		$100,000.00		$100,000.00
			*** TOTAL BID PRICE ***		$1,508,059.15		$1,795,841.50

ITEM	BIDDER NO. 7 IMS VEGAS PAVING CORPORATION UNIT PRICE	BIDDER NO. 7 TOTAL	BIDDER NO. 8 A & K EARTHMOVERS, INC. UNIT PRICE	BIDDER NO. 8 TOTAL	BIDDER NO. 9 W.E.S. CONSTRUCTION COMPANY, INC. UNIT PRICE	BIDDER NO. 9 TOTAL	UNIT PRICE	TOTAL
301a	$2.00	$2,700.00	$2.00	$2,700.00	$5.00	$6,750.00		
301b	$1.00	$6,815.00	$0.50	$3,407.50	$1.00	$6,815.00		
301c	$1.25	$375.00	$2.00	$600.00	$3.00	$900.00		
301d	$500.00	$2,000.00	$296.00	$1,184.00	$2,500.00	$10,000.00		
301e	$500.00	$1,500.00	$361.00	$1,083.00	$300.00	$900.00		
301f	$5.00	$250.00	$5.00	$250.00	$10.00	$500.00		
302	$9.00	$3,150.00	$10.50	$3,675.00	$20.00	$7,000.00		
303	$5.00	$27,300.00	$16.00	$87,360.00	$10.00	$54,600.00		
304a	$15.00	$5,250.00	$25.50	$8,925.00	$12.00	$4,200.00		
304b	$5.00	$3,750.00	$2.00	$1,500.00	$4.00	$3,000.00		
305	$15.00	$750.00	$23.40	$1,170.00	$20.00	$1,000.00		
306a	$223.00	$139,821.00	$236.00	$147,972.00	$146.00	$91,542.00		
306b	$200.00	$143,000.00	$200.00	$143,000.00	$130.00	$92,950.00		
306c	$580.00	$48,720.00	$300.00	$25,200.00	$300.00	$25,200.00		
306d	$725.00	$9,425.00	$400.00	$5,200.00	$450.00	$5,850.00		
306e	$168.00	$122,640.00	$134.50	$98,185.00	$110.00	$80,300.00		
306f	$130.00	$3,250.00	$117.00	$2,925.00	$150.00	$3,750.00		
306g	$112.00	$74,368.00	$82.00	$54,448.00	$90.00	$59,760.00		
306h	$110.00	$2,200.00	$82.00	$1,640.00	$90.00	$1,800.00		
306i	$71.00	$8,733.00	$54.50	$6,703.50	$70.00	$8,610.00		
306j	$69.00	$14,559.00	$40.45	$8,534.95	$65.00	$13,715.00		
306k	$58.00	$25,636.00	$60.00	$26,520.00	$65.00	$28,730.00		
306l	$56.00	$8,904.00	$35.00	$5,565.00	$65.00	$10,335.00		
306m	$15.00	$3,750.00	$15.00	$3,750.00	$50.00	$12,500.00		
307a	$1,000.00	$2,000.00	$1,200.00	$2,400.00	$2,000.00	$4,000.00		
307b	$25.00	$1,250.00	$43.00	$2,150.00	$50.00	$2,500.00		
308a	$14.25	$51,100.50	$15.00	$53,790.00	$16.00	$57,376.00		
308b	$12.00	$43,032.00	$11.50	$41,239.00	$13.00	$46,618.00		
311a	$29,000.00	$29,000.00	$33,700.00	$33,700.00	$12,000.00	$12,000.00		
311b	$16,200.00	$16,200.00	$20,500.00	$20,500.00	$12,200.00	$12,200.00		
311c	$16,200.00	$16,200.00	$18,400.00	$18,400.00	$11,500.00	$11,500.00		
311d	$11,700.00	$11,700.00	$17,850.00	$17,850.00	$8,700.00	$8,700.00		
311e	$8,800.00	$8,800.00	$10,700.00	$10,700.00	$7,000.00	$7,000.00		
311f	$1,000.00	$6,000.00	$1,500.00	$9,000.00	$2,500.00	$15,000.00		
311g	$3,700.00	$7,400.00	$4,500.00	$9,000.00	$4,000.00	$8,000.00		
311h	$3,700.00	$40,700.00	$4,650.00	$51,150.00	$4,500.00	$49,500.00		
311i	$1,000.00	$2,000.00	$1,275.00	$2,550.00	$750.00	$1,500.00		
311j	$4,100.00	$20,500.00	$3,450.00	$17,250.00	$1,200.00	$6,000.00		
311k	$1,300.00	$20,800.00	$1,500.00	$24,000.00	$2,000.00	$32,000.00		
312a	$10.00	$8,500.00	$14.00	$11,900.00	$12.00	$10,200.00		
312b	$11.00	$5,500.00	$20.50	$10,250.00	$14.00	$7,000.00		
312c	$30.00	$750.00	$20.00	$500.00	$15.00	$375.00		
312d	$3.00	$20,445.00	$3.25	$22,148.75	$3.00	$20,445.00		
312e	$3.50	$1,050.00	$6.50	$1,950.00	$6.00	$1,800.00		
312f	$3.50	$7,000.00	$4.00	$8,000.00	$5.00	$10,000.00		
312g	$3.50	$5,250.00	$4.00	$6,000.00	$5.00	$7,500.00		
319a	$36.00	$11,340.00	$1.00	$315.00	$240.00	$75,600.00		
319b	$36.00	$150,120.00	$45.00	$187,650.00	$35.00	$145,950.00		
319c	$4.50	$47,911.50	$2.90	$30,876.30	$3.20	$34,070.40		
319d	$4.25	$34,675.75	$3.50	$28,556.50	$3.50	$28,556.50		
319e	$6.00	$3,300.00	$4.50	$2,475.00	$3.50	$1,925.00		
319f	$0.50	$1,500.00	$0.35	$1,050.00	$0.50	$1,500.00		
321a	$1,000.00	$1,000.00	$625.00	$625.00	$900.00	$900.00		
321b	$300.00	$4,200.00	$385.00	$5,390.00	$250.00	$3,500.00		
321c	$200.00	$6,400.00	$120.00	$3,840.00	$100.00	$3,200.00		
325a	$20.00	$1,000.00	$50.00	$2,500.00	$15.00	$750.00		
332	$250.00	$1,500.00	$175.00	$1,050.00	$250.00	$1,500.00		
349	$70,000.00	$70,000.00	$122,028.00	$122,028.00	**********	$200,000.00		
350a	$300.00	$3,000.00	$350.00	$3,500.00	$400.00	$4,000.00		
350b	$250.00	$750.00	$275.00	$825.00	$400.00	$1,200.00		
350c	$11.00	$1,650.00	$12.00	$1,800.00	$8.00	$1,200.00		
350d	$13.00	$3,250.00	$16.25	$4,062.50	$9.00	$2,250.00		
353a	$361.00	$414,428.00	$375.00	$430,500.00	$420.00	$482,160.00		
353b	$330.00	$16,830.00	$400.00	$20,400.00	$350.00	$17,850.00		
399		$100,000.00		$100,000.00		$100,000.00		
*** TOTAL BID PRICE ***		$1,854,878.75		$1,963,369.00		$1,968,032.90		

estimated 20 feet and renegotiated to allow for combined use as a storm drain and sanitary sewer easement.

In addition to the above improvements, this alternative will provide improvements which call for the ditch between structures E-1 and M-2 to be piped, the structures G-4, G-10, G-12 and G-13 to be reconstructed to eliminate excessive angle points, and the split flow structure G-15 to be improved to alleviate debris clogging (see Exhibit C).

Total Estimated Costs: <u>$774,000</u>

Alternative C-1

Objective: Same as Alternative C

Description: Same as Alternative C except the outfall ditch to McCarran would be replaced by a 60-inch RCP installed completely within the existing 25 foot sanitary sewer easement. Renegotiation of the easement to allow use as a storm drain and sanitary sewer easement may be necessary.

Total Estimated Costs: <u>$755,000</u>

Alternative D

Objective: Save Dollars

Description: Do nothing

Total Estimated Costs: <u>$0.00</u>

Alternative Comparisons

Plate 2 provides a summary for comparison purposes of costs, objectives and comments related to level of service, benefits and negative consequences related to the construction of these alternatives.

01-Dec-86
HUFFAKER HILLS
COST ESTIMATE

ALTERNATIVE A (100 YR. STORM)

#	ITEM DESCRIPTION	UNIT	QUANT.	COST/UNIT	TOTAL COST
1	OPEN CHANNEL 9,100 LF	CY	76,000	$3.00	$228,000.00
2	12x5 RCB DOUBLE BARREL	LF	2,100	$660.00	$1,386,000.00
3	PAV./BASE REMOVAL & REPLACE	SF	32,000	$1.75	$56,000.00
4	COCHRAN DITCH SIPHON	LS	1	$8,000.00	$8,000.00
5	71"x47" CMP ARCH 14 ga	LF	400	$50.00	$20,000.00
6	38"x60" RCP HE	LF	300	$85.00	$25,500.00
7	UTILITY RELOCATION	LS	1	$40,000.00	$40,000.00
	SUB TOTAL				$1,763,500.00
	ENGINEERING & CONTINGENCIES 25%				$440,875.00
	R/W AQUISITION				$935,700.00
	TOTAL				$3,140,075.00
				SAY	$3,140,000.00

ALTERNATIVE B (25 YR STORM)

#	ITEM DESCRIPTION	UNIT	QUANT.	COST/UNIT	TOTAL COST
1	OPEN CHANNEL 9,100 LF	CY	53,000	$3.00	$159,000.00
2	66" RCP	LF	2,100	$86.00	$180,600.00
3	PAV./BASE REMOVAL & REPLACE	SF	32,000	$1.75	$56,000.00
4	COCHRAN DITCH SIPHON	LS	1	$7,000.00	$7,000.00
5	71"x47" CMP ARCH 14 ga	LF	400	$50.00	$20,000.00
6	38"x60" RCP HE	LF	300	$85.00	$25,500.00
7	UTILITY RELOCATION	LS	1	$15,000.00	$15,000.00
	SUB TOTAL				$463,100.00
	ENGINEERING & CONTINGENCIES 25%				$115,775.00
	R/W AQUISITION				$686,700.00
	TOTAL				$1,265,575.00
				SAY	$1,266,000.00

01-Dec-86
HUFFAKER HILLS
COST ESTIMATE

ALTERNATIVE C (5 YR STORM)

#	ITEM DESCRIPTION	UNIT	QUANT.	COST/UNIT	TOTAL COST
1	OPEN CHANNEL 6,400 LF	CY	36,800	$3.00	$110,400.00
2	36" RCP	LF	800	$42.00	$33,600.00
3	48" RCP	LF	400	$65.00	$26,000.00
4	60" RCP	LF	250	$79.00	$19,750.00
5	PAV./BASE REMOVAL & REPLACE	SF	15,000	$1.75	$26,250.00
6	COCHRAN DITCH SIPHON	LS	1	$7,000.00	$7,000.00
7	71"x47" CMP ARCH 14 ga	LF	400	$50.00	$20,000.00
8	MANHOLE RECONSTRUCTION	EA	4	$2,000.00	$8,000.00
9	UTILITY RELOCATION	LS	1	$15,000.00	$15,000.00
	SUB TOTAL				$266,000.00
	ENGINEERING & CONTINGENCIES 25%				$66,500.00
	R/W AQUISITION				$441,600.00
	TOTAL				$774,100.00
				SAY	$774,000.00

ALTERNATIVE C-1 (5 YR STORM)

#	ITEM DESCRIPTION	UNIT	QUANT.	COST/UNIT	TOTAL COST
1	60" RCP	LF	6,400	$70.00	$448,000.00
2	36" RCP	LF	800	$42.00	$33,600.00
3	48" RCP	LF	400	$65.00	$26,000.00
4	60" RCP	LF	250	$79.00	$19,750.00
5	PAV./BASE REMOVAL & REPLACE	SF	15,000	$1.75	$26,250.00
6	COCHRAN DITCH SIPHON	LS	1	$7,000.00	$7,000.00
7	71"x47" CMP ARCH 14 ga	LF	400	$50.00	$20,000.00
8	MANHOLE RECONSTRUCTION	EA	4	$2,000.00	$8,000.00
9	UTILITY RELOCATION	LS	1	$15,000.00	$15,000.00
	SUB TOTAL				$603,600.00
	ENGINEERING & CONTINGENCIES 25%				$150,900.00
	TOTAL				$754,500.00
				SAY	$755,000.00

SEA ENGINEERS / PLANNERS PROJECT No. 0150-056-864

01-Dec-86
HUFFAKER HILLS
COST ESTIMATE

THOMAS CREEK DIVERSION AND CULVERTS

#	ITEM DESCRIPTION	UNIT	QUANT.	COST/UNIT	TOTAL COST
1	12x7 DBL BARREL RCB (CROSSING SIERRA MANOR DRIVE)	LF	30	$700.00	$21,000.00
2	15x7 CONCRETE LINED CHANNEL	LF	800	$234.00	$187,200.00
3	12x7 DBL BARREL RCB (CREEK CROSSING)	LF	30	$700.00	$21,000.00
4	12x7 DBL BARREL RCB (CROSSING VIRGINIA STREET)	LF	130	$700.00	$91,000.00
5	EXCAV. CHANNEL TO MAYS LN.	CY	4500	$3.00	$13,500.00
	SUB TOTAL				$333,700.00
	ENGINEERING & CONTINGENCIES 25%				$83,425.00
	TOTAL				$417,125.00
				SAY	$417,000.00

Alternative	Total Est. Cost($1,000)	Objective	Comments
A	$3,140	Provide 100-year Thomas Creek flood flow protection without substantial street flooding	Costs extremely high. Will alleviate flooding and damage to private property up to 100-year storm flows. Disruption of neighborhood during construction is substantial. May require improvements to drainage system downstream of McCarran to allow continuation of flood flows. Will not resolve flooding along Virginia Street and Longley Lane from Thomas Creek flows.
B	$1,266	Provide capacity for 25-year Thomas Creek flood flow without substantial street flooding	High costs. For flood flows above the 25-year event there is potential for damage to the apartment complexes adjacent to the low point in Patriot Lane. Flows escaping down other streets should be routed to the north without damage to private structures. Disruption of neighborhood also a problem, but not as severe as Alternative A. Will not resolve flooding along Virginia Street and Longley Lane from Thomas Creek flows.
*C C-1	$774 $755	Provide capacity for 6-year flood flows without substantial street flooding	For flood flows between the 5-year and 10 year event, there still should not be substantial street flooding. The culvert under Patriot can handle up to 76 cfs out of the proposed NDOT detention structure. This would handle the 10-year local storm, therefore, somewhere close to the 10-year regional storm. According to street routing analysis, those flows that are routed away from Patriot can escape to the north via streets without damage to private structures. Damage may occur at flows above the 25 year event at the north end of Huffaker subdivision in Autumn Hills Drive.
D	$0.00	No Cost	Continued street flooding will occur on a frequent basis (approx. once in every 3 to 5 years). Cost associated with City maintenance crews, etc. will continue to be incurred. Potential for private property and structural damage during high flows is high.

* The costs to divert the 100-year Thomas Creek flows within the County to south of Huffaker Hills is estimated at $417,000.00 (This cost may be shared by the County and City.) Therefore, the cost to provide flood protection to the study area for the 100-year Thomas Creek storm flows and the local area 6-year storm flows would be $755,000 + $417,000 = $1,172,000 (See exhibit L).

sea ENGINEERS/PLANNERS SPARKS NEVADA LAS VEGAS NEVADA

ALTERNATIVE COST COMPARISON
HUFAKER HILLS DRAINAGE RELIEF SYSTEM

PROJECT NO 150-056-8
PLATE 2

V. RECOMMENDATIONS

In light of the City's desire to resolve the drainage related problems which have occurred since 1980 within the study area and which were described in the body of this report, the following alternative and actions are recommended for implementation by the City:

1. That further development of vacant lands within the study area be required to provide escapeways for drainage which may overtax the normal design requirements for 5-year subsurface drainage improvements. The City should carefully review drainage plans to avoid low points without overland escapeways.

2. The City should ask the Mountain Shadows Apartment Complex owners to provide openings within their perimeter walls to allow for drainage to escape in the event of catch basin plugging or excessive runoff. This will help prevent possible flood damage to apartment buildings.

3. The City should start immediately to discuss with Washoe County an implementation plan to divert the 100-year Thomas Creek storm flow of 2,500 cfs easterly south of Huffaker Hills. This flow would be discharged across Virginia Street, and eventually follow Mays Lane to the proposed Double Diamond Ranch Development. This plan would be consistent with the Preliminary Flood Control and Drainage Report prepared by Collins and Ryder, Consulting Engineers, in January 1981.

4. The City should begin plans to implement Alternative C or C-1. The costs for this alternative may be partially borne by the Developers of the proposed Park 2001 development if it can be shown to be practical and beneficial to their project.

EXHIBITS

FACILITY MAP

HUFFAKER HILLS DRAINAGE RELIEF STUDY

CITY OF RENO

RENO | WASHOE COUNTY | NEVADA

SPARKS, NEVADA
LAS VEGAS, NEVADA

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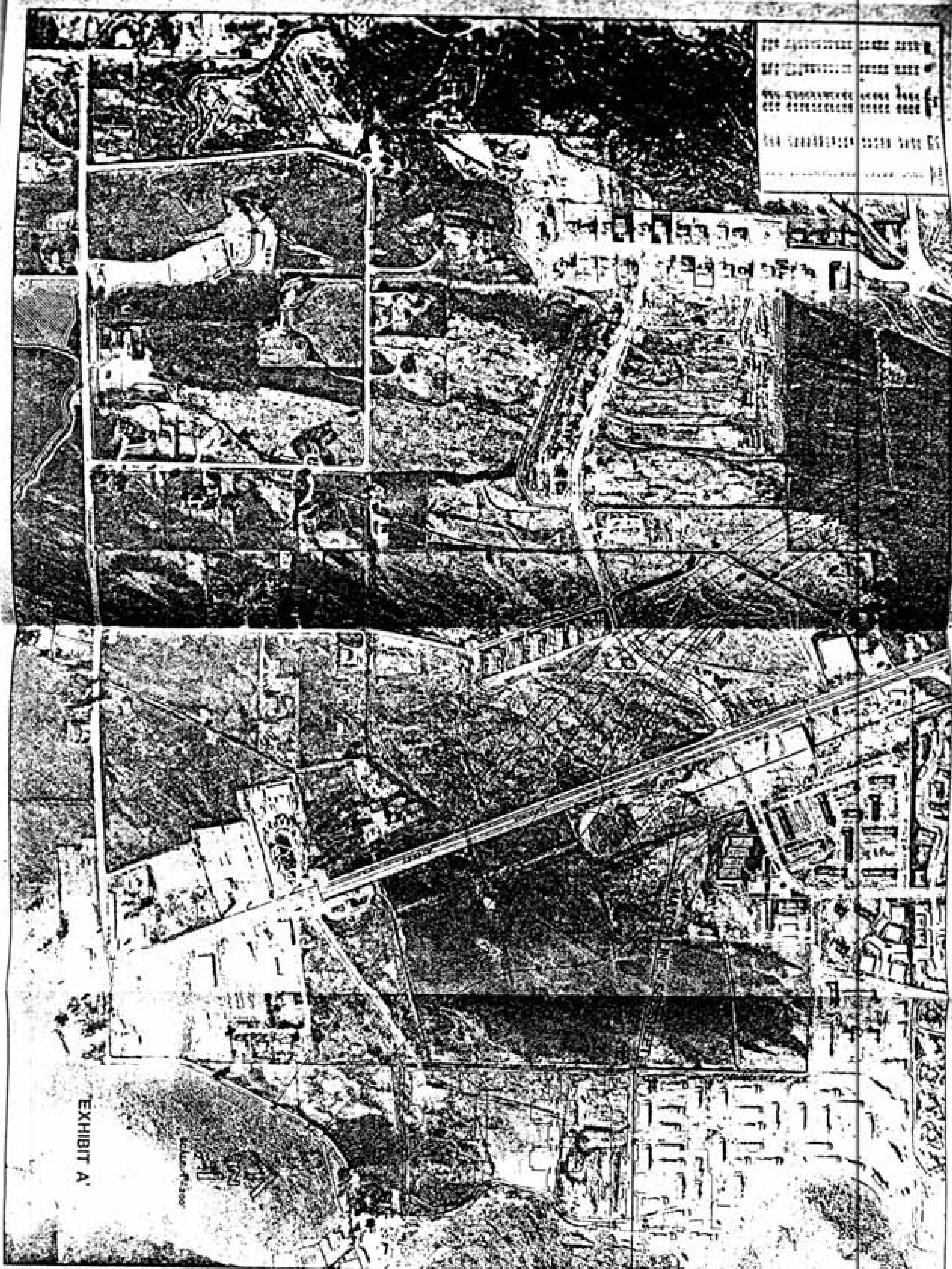

FACILITY MAP
HUFFAKER HILLS DRAINAGE RELIEF STUDY
CITY OF RENO

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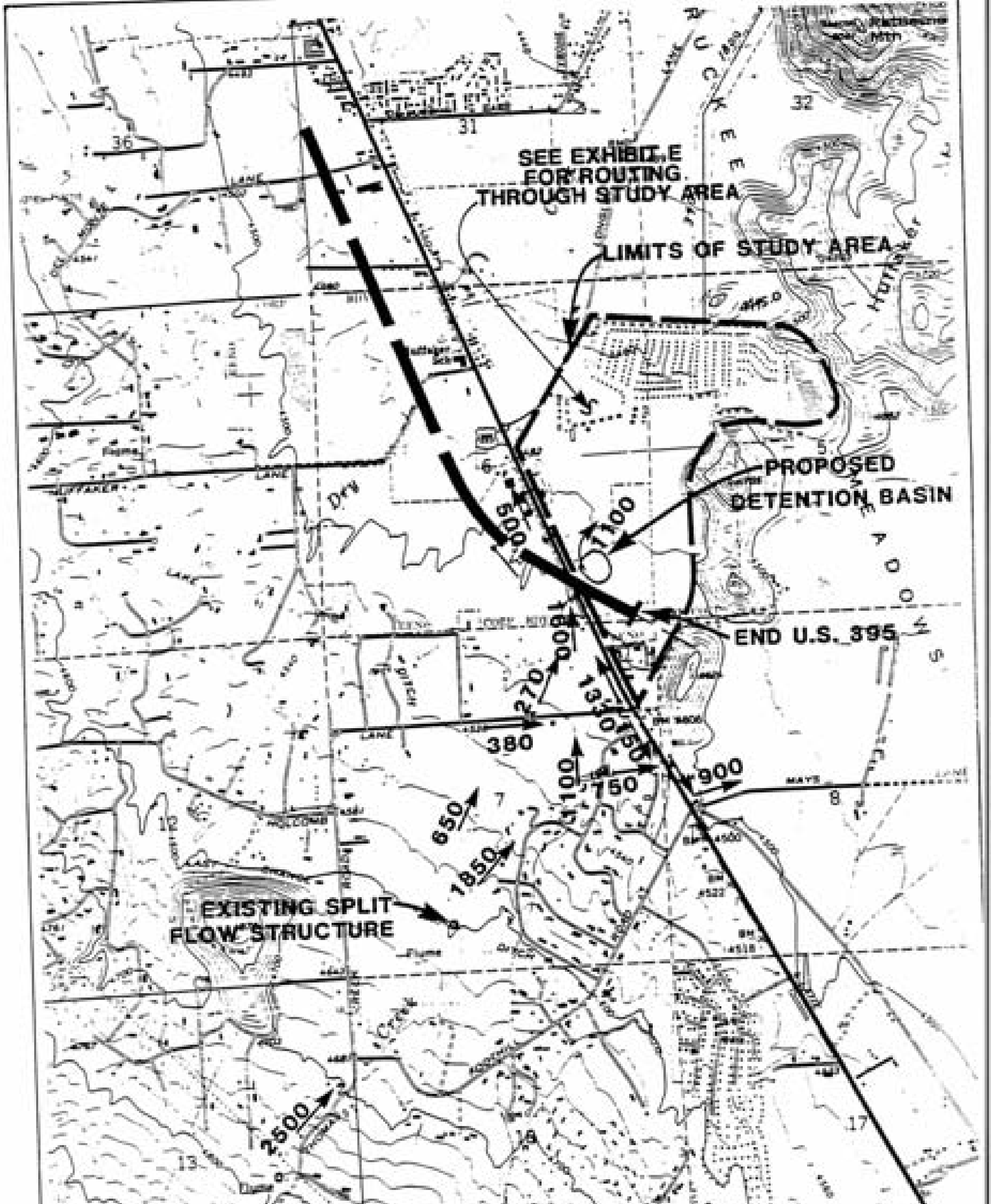
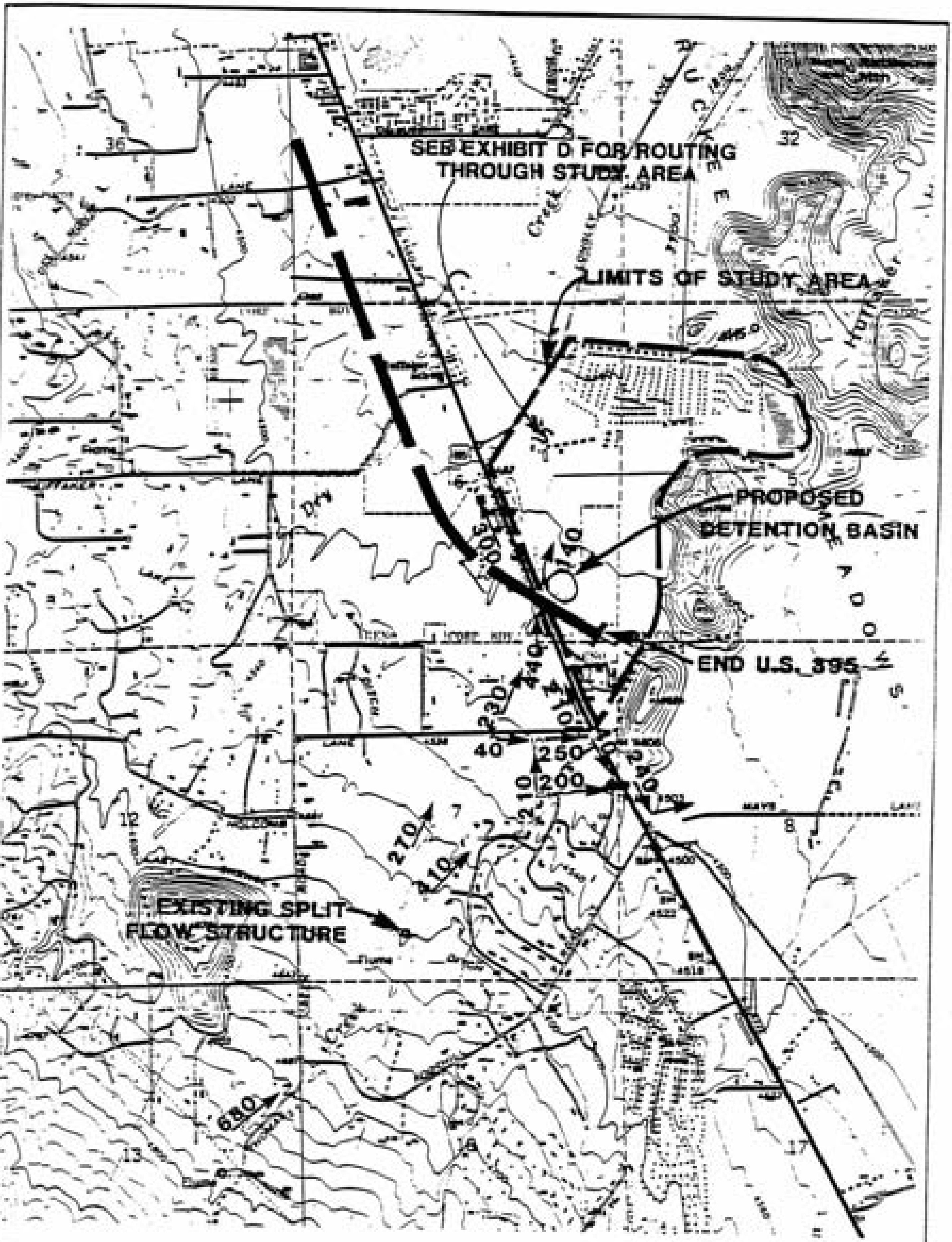


HUFFAKER HILLS
DRAINAGE RELIEF SYSTEM
100-YR THOMAS CREEK FLOOD ROUTING
TO STUDY AREA

sea — SPARKS, NEVADA — LAS VEGAS, NEVADA — ENGINEERS/PLANNERS

PROJECT NO. 150-056-86-
EXHIBIT C
PAGE



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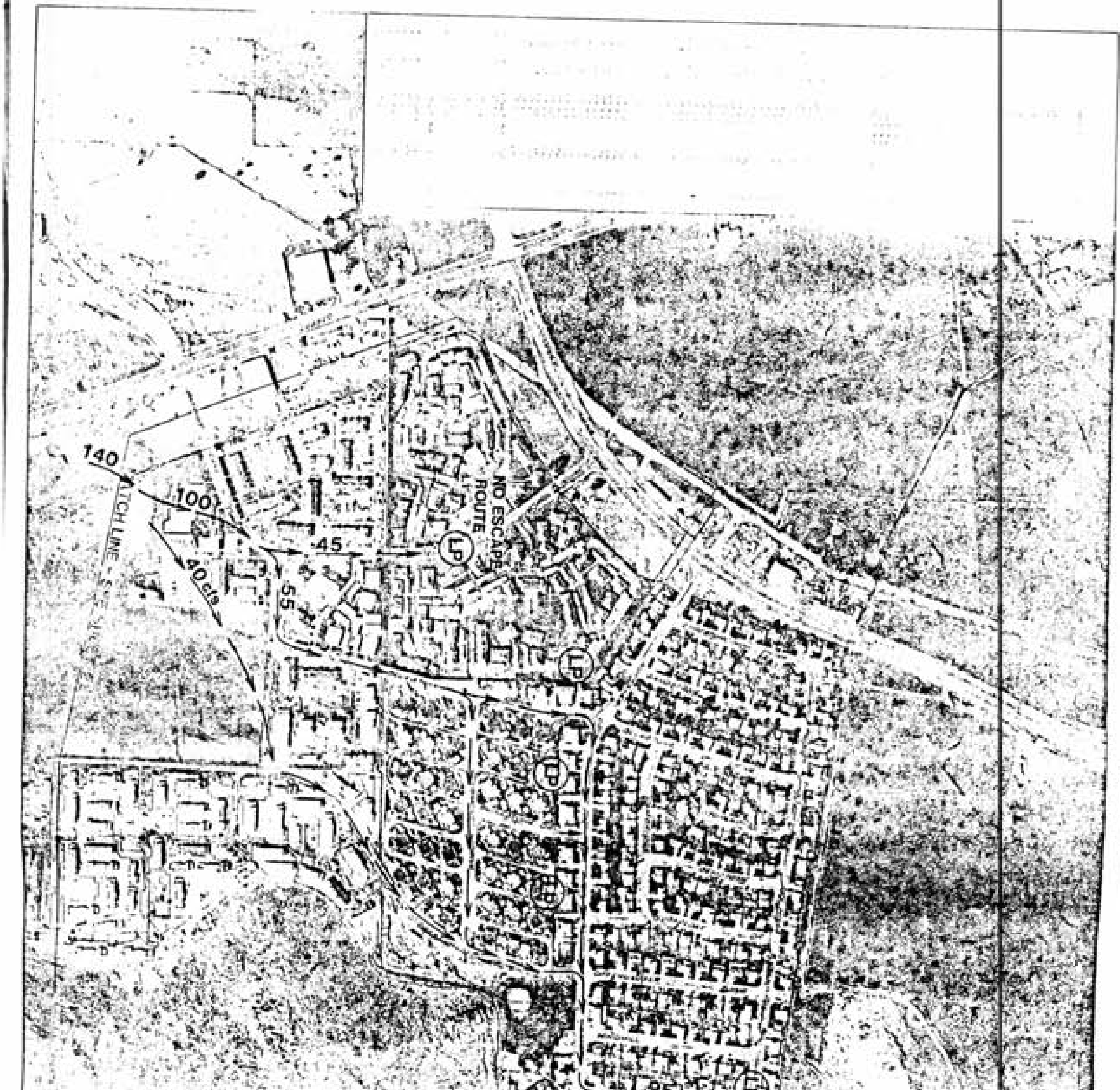
HUFFAKER HILLS
DRAINAGE RELIEF SYSTEM
25-YR THOMAS CREEK FLOOD ROUTING
TO STUDY AREA

PROJECT NO. 150-056-564
EXHIBIT B



FACILITY MAP
HUFFAKER HILLS
DRAINAGE RELIEF STUDY
CITY OF RENO
WASHOE COUNTY
RENO NEVADA

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LAS VEGAS, NEVADA

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FACILITY MAP
HUFFAKER HILLS
DRAINAGE RELIEF STUDY
CITY OF RENO
RENO | WASHOE COUNTY | NEVADA

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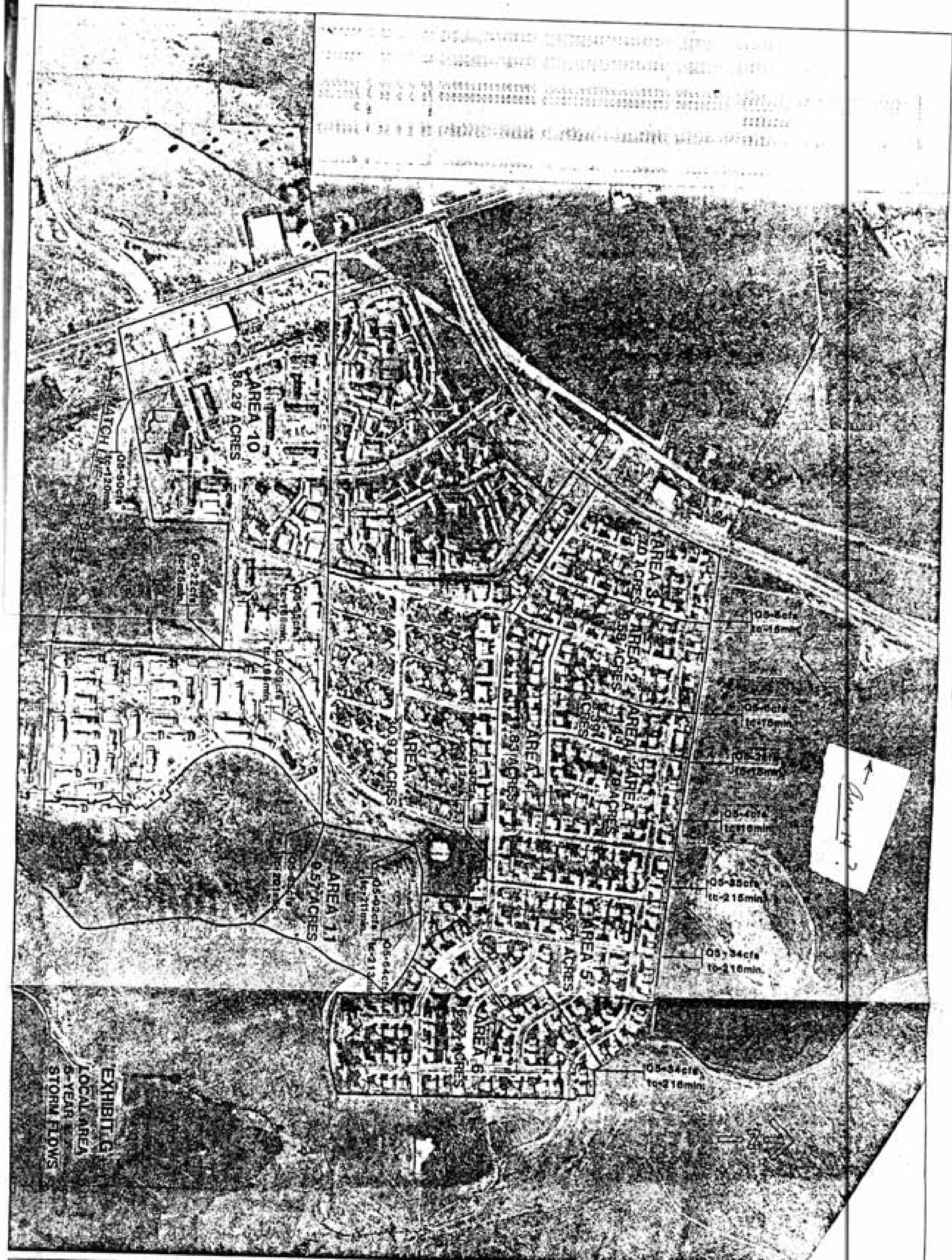

HUFFAKER HILLS
DRAINAGE RELIEF STUDY
CITY OF RENO
WASHOE COUNTY

RENO NEVADA

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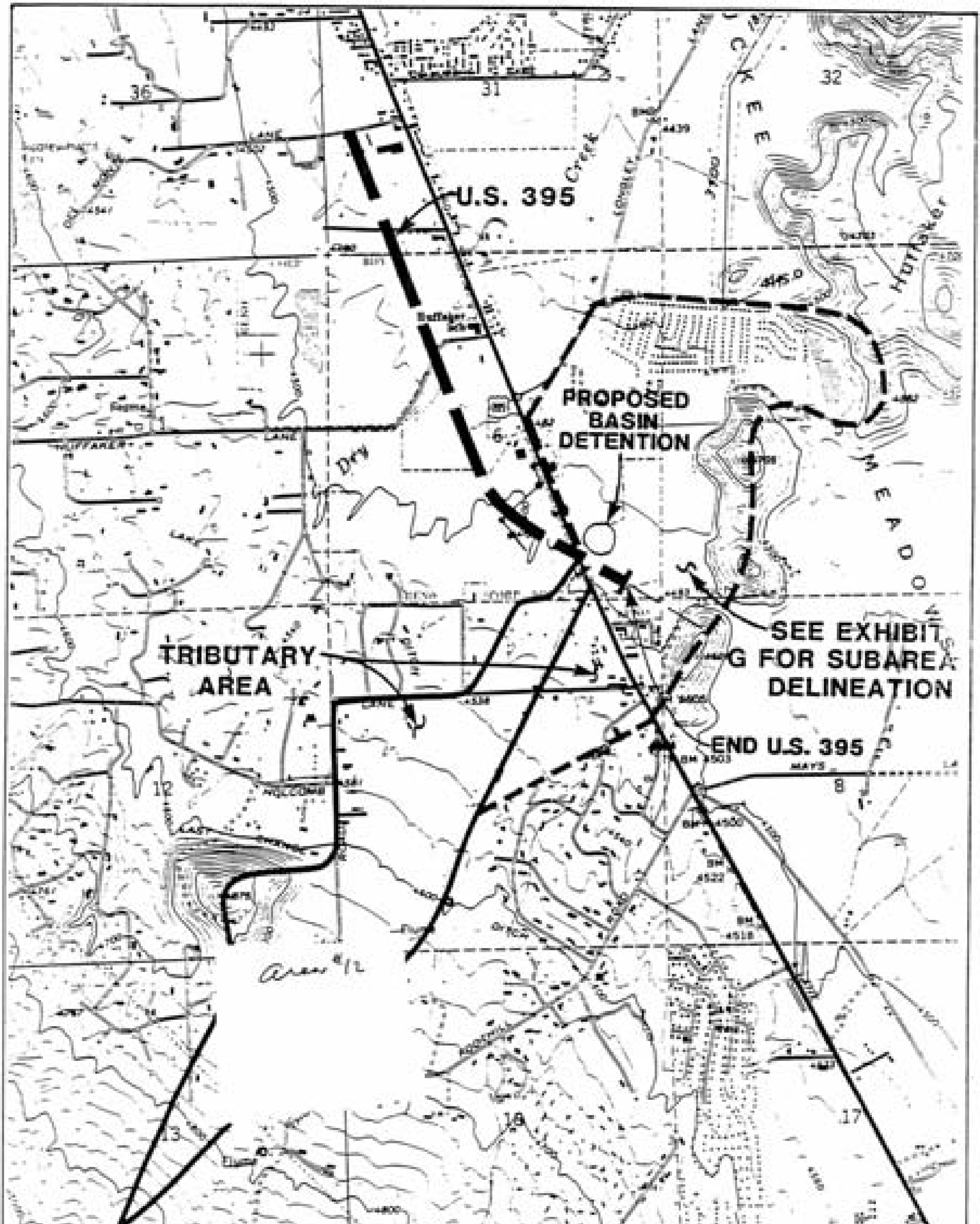

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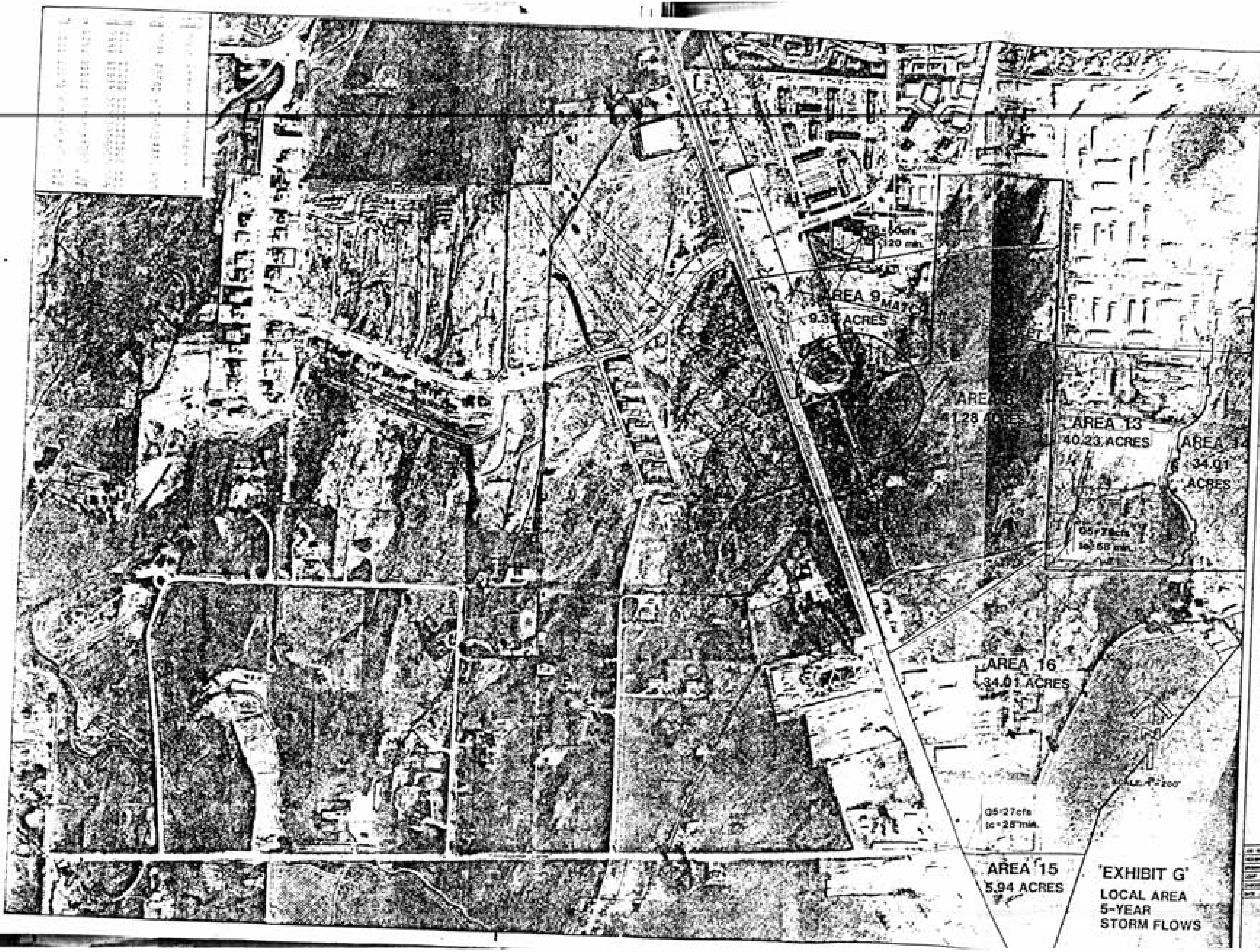
NDOT U.S. 395 AND
LOCAL AREA DRAINAGE MAP

PROJECT NO. 150-066-664
EXHIBIT F
PAGE



HUFFAKER HILLS
DRAINAGE RELIEF STUDY
CITY OF RENO
WASHOE COUNTY
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HUFFAKER HILLS DRAINAGE RELIEF STUDY

CITY OF RENO

WASHOE COUNTY

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HUFFAKER HILLS
DRAINAGE RELIEF STUDY
CITY OF RENO
WASHOE COUNTY
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HUFFAKER HILLS DRAINAGE RELIEF STUDY

CITY OF RENO

RENO WASHOE COUNTY NEVADA

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HUFFAKER HILLS DRAINAGE RELIEF STUDY

CITY OF RENO

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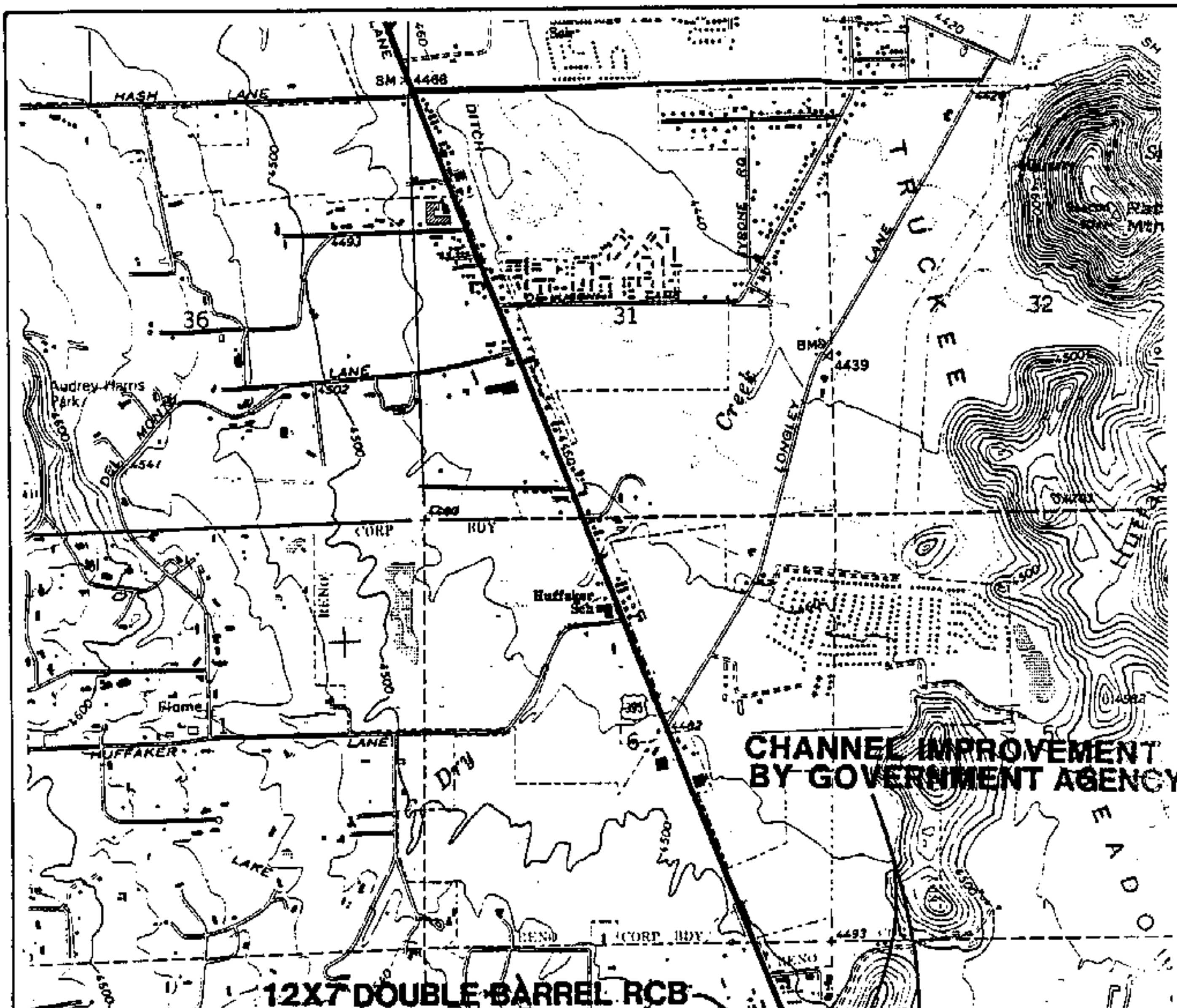
LAS VEGAS, NEVADA



SPARKS, NEVADA
LAS VEGAS, NEVADA

ENGINEERS/PLANNERS

THOMAS CREEK DIVERSION EASTERLY AND SOUTH OF HUFFAKER HILLS

PROJECT NO.
EXHIBIT L
PAGE

DATAPRINT N68358

APPENDICES

- Letter to City Regarding Results of Phase 1A
- Phase 1A Report
- HEC 2, Flood Routing Upstream of Virginia Street Computer Runs
- Street Flow Rating Capacity Calculations
- 5-Year Local Area Hydrology Analysis
- NDOT U.S. 395 Hydrology Calculations
- Alternative Cross Sections from Cochran Ditch to McCarran Boulevard

August 6, 1986
Project No. 150-056-863

sea incorporated
Consulting Engineers

Bill Vann, Jr., P.E.
CITY OF RENO
Engineering Division
P.O. Box 1900
Reno, Nevada 89505

Re: Huffaker Hills - Drainage Relief System

Dear Bill:

This letter will serve to document our meeting on August 4, 1986. Discussion was mainly concerned with the Phase IA - Preliminary Report submitted by this office on June 23, 1986.

In our report we indicated that the 100-year peak flows given in the 1980 SCS study and the 1980 Corps of Engineers study (Ref. #4 and #5) were probably the most representative of the actual flows compared to the other studies reviewed. We also pointed out in the report that there was a range of 5-year peak flows among the various studies, but that we would recommend further hydrologic analysis before accepting any one as being accurate. The City's position is to accept the 1980 Corps of Engineers study results without further hydrologic analysis unless the 5-year flow (170 cfs) was considered unacceptable by this office. We replied that we did not have any strong feelings either way without further study. The recent flood of February 1986 was then brought up, the magnitude of which was gaged by the USGS to be 400 cfs on Thomas Creek above Steamboat Ditch. It was not agreed as to what return frequency had been determined for the flood-producing rainfall event, but 50-year to 100-year was the range discussed. It was pointed out that a flood of this magnitude could be expected to reoccur at a greater frequency than once every 50 to 100 years when considering all events (winter storms, snowmelt and cloudburst storms). The 1980 Corps of Engineers study gives a 10-year return frequency peak flow of 340 cfs, so 400 cfs would be expected at a 13-year return frequency according to this study. After further consideration, we feel that this is probably reasonable. However, it would be prudent to research the various agencies that may have enough flow data to put the recent flood into perspective.

As a result of this meeting, we will proceed with the study as follows:

1. Research historical flows to verify the magnitude of the expected 5-year and 10-year return frequency peak flows.

2. Use the 1980 Corps of Engineers study results for Thomas Creek as verified above.

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Consulting Engineers
950 INDUSTRIAL WAY
SPARKS, NEVADA 89431-6092
(702) 358-6931

3. Route the peak flows only to appropriate routing points and divide the flow where necessary using appropriate percentages to be determined from topo map and field data.

We propose to translate the peak flows determined at Steamboat Ditch to the routing points in light of the following assumptions and observations:

1. The contributing drainage areas for each reach below Steamboat Ditch have sufficient area and lag time to maintain channel storage volume that would otherwise reduce the peak flow, yet not so large as to increase the peak.

2. Reach lengths are only about one (1) mile long each.

3. Verification would require development of hydrographs, which is beyond the selected scope of work.

If our findings differ significantly from what we have discussed, we will contact you for further direction. Please let us know if anything in this letter is contrary to what you recall or if our proposed action is unacceptable to you.

We also pointed out in the meeting that an erroneous statement was discovered in our report concerning the effect of lag time on peak flow. The page containing this statement was subsequently amended and three copies are enclosed for insertion into your copies of the report. Please remove and discard the page that it replaces.

Sincerely,

S E & A, INC.

Guy A. Sharp, P.E.

GAS:jk

Encl.

HUFFAKER HILLS

DRAINAGE RELIEF SYSTEM
for
CITY OF RENO

Phase IA - Preliminary Report

JUNE 1986

Proj. No. 150-056-861

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Consulting Engineers

950 INDUSTRIAL WAY
SPARKS, NEVADA 89431-6092
(702) 358-6931

June 23, 1986
Project No. 150-056-861

Millard G. Reed, P.E.
City Engineer
CITY OF RENO
P. O. Box 1900
Reno, Nevada 89505

ATTN: William N. Vann, Jr., P.E.

Re: Huffaker Hills Drainage Relief System
Phase I - Existing Basin Hydrology Review
and Recommendations

Dear Millard:

We are pleased to submit this summary report on our review of the various existing hydrologic studies within the Thomas Creek Watershed. This summary report will complete Phase I, Part A of our contract.

The findings of the report recommend that a hydrologic model utilizing the most representative and up-to-date information be used to develop runoff values in the Thomas Creek Watershed for various frequency storms. These runoff values will then be used for evaluation of the Huffaker Hills flooding problems.

Upon your review and approval of this recommendation, we will proceed with Phase II of the study and prepare the hydrologic model to develop design storm flows.

Thank you for you and your staff's cooperation in this effort. We look forward to the successful completion of the next phases of this project.

Sincerely,

S E & A, INC.

Joe W. Howard, P.E.
Vice President

JWH:SV:jk

TABLE OF CONTENTS

HUFFAKER HILLS DRAINAGE DEFICIENCY STUDY
THOMAS CREEK BASIN

I. INTRODUCTION

The purpose of this preliminary report is to:

a. Review the various existing drainage/hydrology studies relevant to the Thomas Creek watershed.

b. Compare the methologies and results of these studies and rate them for use in analyzing the existing Huffaker Hills drainage system.

c. Recommend the use of a particular study for the system analysis or recommend additional hydrologic analysis of the watershed.

II. DESCRIPTION OF STUDY AREA

The study area consists of the developed area bounded by the Huffaker Hills to the east and Longley Lane to the west. The main channel of Dry Creek comes within 1/4 mile west by the study area, and the main channel of Thomas Creek passes of the study area. However, irrigation facilities and sheet flow at flood stage can contribute portions of the Thomas Creek basin runoff to the study area. It is anticipated and assumed that only runoff from the Thomas Creek basin contributes to flooding in the study area.

III. ANALYSIS OF PREVIOUS STUDIES

A summary of the studies reviewed along with the peak flows for selected return frequency events are tabulated in Table 1. Those studies that qualified for detailed analysis are discussed in detail below. The remainder are either irrelevant, are superceded by another study, or they use the results of another study. Analysis was confined to the Thomas Creek basin.

1. Hydrologic Analysis of the City of Reno's Major Drainage Basins, October 1985, Summit Engineering Corp.

Methodology. This study utilizes a computer program similar to TR20 and uses the SCS unit hydrograph. Rainfall data was taken from the Winzler and Kelly report referenced herein at

TABLE 1
SUMMARY OF SELECTED PEAK FLOWS FROM PREVIOUS STUDIES
THOMAS CREEK

Title of Study	Location of Computation Point	Peak Flows (cfs) Return Period 5-yr.	10-yr.	25-yr.	50-yr.	100-yr.	Comments
							Winzler & Kelly Rainfall Data
1.) Hydrologic Analysis of the City of Reno's Major Drainage Basins Oct. 1985, Summit Engineering Corp.	Steamboat Ditch	1874	-	3648	4949	5561	24 hr. winter storm
	" "	438	-	910	1221	1884	6 hr. cloudburst storm
	" "	243	-	615	900	1298	3 hr. cloudburst storm
	S. Virginia St.	1912	-	3688	5005	5625	24 hr. winter storm
	" " "	436	-	908	1220	1884	6 hr. cloudburst storm
	" " "	235	-	598	881	1274	3 hr. cloudburst storm
							NOAA Atlas No. 2 Rainfall Data
	Steamboat Ditch	480	-	753	1189	1292	24 hr. winter storm
	" "	126	-	217	477	619	6 hr. cloudburst storm
	" "	65	-	172	238	362	3 hr. cloudburst storm
	S. Virginia St.	496	-	781	1221	1329	24 hr. winter storm
	" " "	128	-	221	482	627	6 hr. cloudburst storm
	" " "	63	-	167	233	354	3 hr. cloudburst storm
3.) Flood Insurance Study - City of Reno, Nevada, July 1983, FEMA	S. Virginia St.	-	290	-	921	1451	regional frequency analysis of gaged basins
4.) Stormwater Hydrology and Conservation Treatments in Southwest Reno Feb. 1980, SCS	S. Virginia St.	230	470	950	-	2340	3 hr. storm, NOAA Atlas
	" " "	410	780	1500	-	3400	6 hr. storm, NOAA Atlas
*5.) Truckee River, Calif. and Nevada Hydrology, Feb. 1980, Corps of Engineers	Steamboat Ditch	170	340	680	1350	2500	3 hr. cloudburst storm
6.) Flood Plain Information - Southwest Foothill Streams (Evans, Thomas, & Whites Creeks & Skyline Wash) Reno, Nevada, June 1974, Corps of Engineers	Steamboat Ditch	-	-	-	-	3500	This study is superceded by the Feb. 1980 study done by the Corps of Engineers (see #5)
7.) Flood Control and Drainage Report for Double Diamond Development Washoe County, Nevada, Jan. 1981, Collins & Ryder Consulting Engrs.	*	*	*	*	*	*	*This study uses the peak flows developed by the Feb. 1980 study done by the Corps of Engineers.

the request of the City of Reno, the SCS Type II rainfall distribution was used, and areal reduction factors found in the NOAA Atlas 2, Vol. VII, Nevada, were used. Values for 3-hr. and 6-hr. duration storms were taken from the dry season isopleth map, and values for 24-hr. duration storms were taken from the wet season isopleth map. For comparison purposes, Summit reran the computations using rainfall data from NOAA Atlas 2, Vol. VII, Nevada.

Analysis. The runoff values for the 24-hr. duration storm appear to be very high using the Winzler and Kelly data. The following assumptions could be made that would effectively reduce the peak runoff values:

a. Assume that the higher elevations will receive precipitation as snowfall and will not contribute to runoff from a winter (wet season) event.

b. Assume that the SCS Type II rainfall distribution generates intensities higher than would be expected during a winter event.

c. Assume that a 3-hr. duration cloudburst storm will produce the peak flows in this basin, as did the Corps of Engineers. This duration would be consistent with accepted limits of storm duration relative to basin time of concentration.

The lag time for computation point #42 is listed as 4.01 hrs. A check of this calculation was made using the same equation and basin data that Summit used, and a lag time of 1.04 hrs. was calculated. Reducing the lag time will increase the peak flow due to the higher average rainfall intensity that would result over the basin.

Unit hydrographs have been developed for the Reno area which should be more accurate than the SCS unit hydrograph. It is not known whether this change would increase or reduce peak runoff values.

The areal reduction factors developed for semi-arid regions in NWS Hydro-40 are currently being used by local SCS hydrologists, and may be more applicable to dry season events than the NOAA factors. Substitution of these factors would reduce peak runoff values.

2. Reno Drainage Study - Preliminary Report : Analysis of Drainage Deficiency Areas Within the City Limits, Dec. 1984, Winzler and Kelly.

Methodology. The relevant portion of this study was development of new intensity-duration-frequency curves for the Reno area. A set of curves was developed based upon rainfall data from the NWS gauge at the Reno-Canon Airport, and two isopleth maps were developed to be used in conjunction with the curves.

A frequency analysis was made of rainfall intensities of various durations, and a weighted average of three distributions was used to develop the I-D-F curves. The data base used was 1952 through 1983.

Monthly and daily maximum rainfall amounts at each of 8 rain gauges in the Reno area were averaged to develop a ratio of rainfall relative to the Reno-Canon Airport gage. Isopleth contours were then mapped using the trend surface analysis technique.

Analysis. The data base used in this study was limited, though there may have been justifiable cause to omit the rainfall data recorded between 1875 and 1952. The number of gages and rainfall records used to develop the isopleth maps also appears limited. However, the analysis is thorough and provides a better tool for study purposes than did the old I-D-F curves without the isopleth maps.

Comparison of the isopleth maps to the NOAA isopluvial maps shows that they produce similar depths near the valley floor while the isopleth maps will produce depths twice that of the NOAA isopluvial maps at high elevations.

3. Flood Insurance Study - City of Reno, Nevada, July 1983, FEMA.

Methodology. Flood discharge-frequency relationships were developed using records from 18 stream gauging stations, four of which are in the Reno area. This data was transferred to the ungauged basins using the multiple regression technique and mapping the standard deviation, which reflected the increased probability of thunderstorms in the basins west of Reno.

Analysis. The results of this study are low compared to the other studies using gaged data to calibrate their results. Though there is insufficient data presented in this study to adequately analyze the results, it appears that the data from basins outside of the immediate area caused the averaged discharge-frequency curve to be less "steep" than those in like studies.

4. Stormwater Hydrology and Conservation Treatments in Southwest Reno, Feb. 1980, USDA, Soil Conservation Service, Reno, NV.

Methodology. This study used the SCS TR-20 computer program to perform hydrologic modeling of the basins. The discharge-frequency curves thus obtained were then calibrated to the Galena Creek stream gage by holding the 10-year peak flow of each basin constant and then adjusting the remaining flows (25-year, 50-year, etc.) to match the "slope" of the Galena Creek discharge-frequency "curve" (i.e., the ratios of 25-year flows to 10-year flows; 50-year flows to 10-year flows, etc.) Rainfall data from the NOAA Atlas was used with storm durations of 3 and 6 hours.

Analysis. The results for the 6-hr event appear to be high, but the 3-hr. event results seem reasonable. Calibrating the results to a gaged basin that is similar in physical characteristics, exposure, location, etc. is desirable, but the data base is limited (18 years of record for only one gage) in this case.

PMP?

5. Truckee River, California and Nevada-Hydrology, Feb. 1980, Dept. of the Army, Corps of Engineers.

Methodology. This study used the HEC-1 hydrologic modeling program to calculate Standard Project Flood (SPF) flows for the foothill basins. Precipitation used was 35% of the PMP for a 3-hr. duration "cloudburst" event. Dry antecedant moisture conditions was assumed, with 0.30-inch initial abstraction used. A 0.16-inch per hour constant loss rate was used thereafter. A unit hydrograph developed in a previous study using a modification of the Los Angeles "S" curve method was chosen.

The SPF flows thus obtained were then factored by a set of ratios to obtain the discharge-frequency curves for the foothill basins. These ratios were averaged from curves for the gaged basins in the area (Galena, Hunter and Steamboat Creeks).

Analysis. The methods used by the Corps in this study are very thorough and incorporate data tailored to the basins in question. The regional frequency analysis of the local gaged basins appears to be the most reasonable approach to developing discharge-frequency curves for basins where cloudburst storms produce the highest peak flows.

IV. CONCLUSIONS AND RECOMMENDATIONS

As can be seen from Table 1, the peak flows for a 100-year return frequency cloudburst storm varies from 1451 cfs to 3400 cfs for the current studies evaluated. Historically, the peak flows recorded for the foothill basins have been cloudburst events that have produced flows in this range, as shown in the following table:

HISTORICAL CLOUDBURST FLOODS

Stream	Drainage Area (sq. mi.)	Date	Peak Flow (cfs)
Galena Creek near Steamboat	8.5	20 Jul '56	4730
		15 Aug '65	3670
Whites Creek near Steamboat	8.02	15 Aug '65	2280

To determine which study, if any, has peak flow values that accurately represent the 100-year return period is difficult because of the limited data base of gaged streams. However, the order of magnitude of the historical peak flows listed above should be an indication of whether or not the 100-year peak flows from a given study are reasonable. Also, the fact that all of the peak flows occurred during the summer indicates that a cloudburst event should be used for the design storm. The recent flood-producing winter storm of Feb. 1986 generated a peak flow of about 400 cfs in Thomas Creek, much less than the potential cloudburst flood flow.

Because Whites Creek is immediately adjacent to Thomas Creek and the drainage areas at the canyon mouths are almost identical, it would be expected that the peak flows for a given return frequency would be of the same magnitude for these basins. Two of the studies reviewed (Ref. #4 and #6) support this premise. Assuming that the 100-year return period peak flow for Thomas Creek would be similar in magnitude to the recorded peak flow on Whites Creek (2280 cfs), it would appear that the 1980 Corps of Engineers study (Ref. #5) and the 1980 SCS study (Ref. #4) come the closest with 3-hr. storm peak flow values of 2500 cfs and 2340 cfs, respectively. In light of these observations and assumptions, we believe these 100-year storm values to be the most representative of the actual 100-year event.

For reasons discussed in the study evaluation above, the winter storm peak flows in the Oct. 1985 Summit Engineering Corp. study should be rejected for consideration in the study area drainage system analysis.

The most often used peak flow values for sizing local storm drainage facilities are those for the 5-year return frequency events. The three studies reviewed that utilized gaged data to develop discharge-frequency ratios for the various return periods have 5-year return period, 3-hr. storm peak flows ranging from 145 cfs (extrapolated) to 230 cfs. The Oct. 1985 Summit Engineering Corp. study, which has a 100-year peak flow that is relatively low, has a 5-year, 3-hr. storm peak flow of 243 cfs, the largest flow of the reviewed studies. Though the range of flows is not extremely wide, arbitrary acceptance of the highest flows would not be justified for economic reasons.

In light of the evaluations made, we recommend that a hydrologic model of the Thomas Creek basin be established utilizing the following criteria for the various frequencies of occurrence (5, 10, 25, 50 & 100 -yr.).

1. HEC 1 computer model

2. 3-hr. cloudburst storm event

3. Winzler & Kelly I-D-F curves and isopleth maps be utilized for calculating average intensities in the basin.

4. The SCS Type II rainfall distribution curve.

5. The NWS Hydro-40 areal reduction factors be used.

6. a) Unit hydrograph for mountain cloudburst storm, modified L.A. "S" curve method (Ref. #5 & #6).

b) SCS unit hydrograph.

7. Loss rates using SCS curve number method.

The purpose of this model will be to reconcile the differences in discharge-frequency curves among the studies analyzed by using the methods and data currently being utilized by the local agencies and consultants.

REFERENCES

1. Hydrologic Analysis of the City of Reno's Major Drainage Basins, Oct. 1985, Summit Engineering Corp.

2. Reno Drainage Study - Preliminary Report : Analysis of Drainage Deficiency Areas Within The City Limits, Dec. 1984, Winzler and Kelly

3. Flood Insurance Study - City of Reno, Nevada, July 1983, FEMA

4. Stormwater Hydrology and Conservation Treatments in Southwest Reno, Feb. 1980, SCS

5. Truckee River, Calif, and Nevada Hydrology, Feb. 1980, Corps of Engineers

6. Flood Plain Information - Southwest Foothill Streams (Evans, Thomas & Whites Creeks & Skyline Wash) Reno, Nevada, June 1984, Corps of Engineers

7. Flood Control and Drainage Report for Double Diamond Development, Washoe County, Nevada, Jan. 1981, Collins & Ryder Consulting Engrs.

HUFFAKER HILLS DRAINAGE RELIEF SYSTEM

HEC-2

FLOOD ROUTING UPSTREAM OF VIRGINIA STREET

Q_{100} = 1480 cfs

SEA Engineers
PROJECT NO.: 150-056-864

THIS RUN EXECUTED 10/20/06   10:37:42

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**********************************************
 HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
 ERROR CORR -  01,02,03,04,05,06
 MODIFICATION -  50,51,52,53,54,55,56
 IBM-PC-XT VERSION APRIL 1985
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SPLIT FLOW BEING PERFORMED

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SF            SPLIT FLOW OPTION STA 5+00 TO 9+53 LEFT - WIER METHOD


TW                  STA 5+00 TO 5+34
WS     2     500      534       -1     3.05
WC     0   50.12       34    49.35

TW                  STA 5+34 TO 6+00
WS     2     534      600        1     3.05
WC     0   49.35       66     49.8

TW                  STA 6+00 TO 7+20.5
WS     2     600    720.5       -1     3.05
WC     0    49.8    120.5    51.11

TW                  STA 7+20.5 TO 8+22
WS     2   720.5      822        1     3.05
WC     0   51.11     93.5       52

TW                  STA 8+22 TO 9+53
WS     2     822      953        1     3.05
WC     0      52      131    53.33
```

T1 HUFFAKER HILLS 0150-056-864
T2 HOLCOMB LANE / SO. VIRGINIA ST. INTERSECTION
T3 THOMAS CREEK OVERFLOW Q=1400 CFS 100 YEAR FLOW

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.	0.	0.	0.	.003000	.00	.0	1400.	49.700	.000

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	.000	.000	.000	.000	.000	.000	-1.000	.000	.000	.000

NC	.030	.035	.020	.100	.300	.000	.000	.000	.000	.000
X1	100.000	6.000	24.000	40.000	.000	.000	.000	.000	.000	.000
GR	49.800	.000	48.270	24.000	47.370	29.000	48.140	33.000	48.910	40.000
GR	50.820	100.000	.000	.000	.000	.000	.000	.000	.000	.000
X1	200.000	9.000	31.000	76.000	100.000	100.000	100.000	.000	.000	.000
GR	49.800	.000	48.390	31.000	48.010	33.000	48.900	36.000	49.860	46.000
GR	49.340	56.000	49.050	76.000	50.660	103.000	53.660	200.000	.000	.000
NC	.020	.020	.030	.000	.000	.000	.000	.000	.000	.000
X1	250.000	6.000	.000	150.000	50.000	50.000	50.000	.000	.000	.000
GR	49.940	.000	49.460	14.000	49.640	50.000	50.200	100.000	50.790	150.000
GR	53.790	300.000	.000	.000	.000	.000	.000	.000	.000	.000
X1	286.000	7.000	.000	67.000	36.000	36.000	36.000	.000	.000	.000
GR	50.010	.000	48.090	28.000	48.150	38.000	48.850	46.000	49.600	67.000
GR	50.160	84.000	53.160	230.000	.000	.000	.000	.000	.000	.000
X1	350.000	9.000	.000	83.000	64.000	64.000	64.000	.000	.000	.000
GR	50.170	.000	49.150	22.000	48.690	32.000	48.860	43.000	49.020	53.000
GR	49.390	63.000	49.600	83.000	49.400	100.000	52.400	120.000	.000	.000
NC	.000	.000	.020	.000	.000	.000	.000	.000	.000	.000
X1	400.000	7.000	.000	70.000	50.000	50.000	50.000	.000	.000	.000
GR	50.170	.000	49.810	5.000	49.520	13.000	48.970	30.000	49.230	43.000
GR	49.600	90.000	52.500	110.000	.000	.000	.000	.000	.000	.000
X1	450.000	7.000	6.000	40.000	50.000	50.000	50.000	.000	.000	.000
GR	50.200	.000	49.820	6.000	49.500	23.000	49.030	40.000	49.400	60.000
GR	49.650	87.000	52.650	87.000	.000	.000	.000	.000	.000	.000
X1	500.000	7.000	25.000	56.000	50.000	12.000	32.000	.000	.000	.000
GR	50.120	.000	49.400	25.000	49.350	32.000	49.150	42.000	49.120	56.000
GR	49.650	100.000	52.650	100.000	.000	.000	.000	.000	.000	.000
X1	534.000	6.000	8.000	33.000	34.000	5.000	15.000	.000	.000	.000
GR	49.350	.000	49.190	8.000	49.180	20.000	49.250	33.000	49.650	71.000
GR	52.650	71.000	.000	.000	.000	.000	.000	.000	.000	.000

X1	600.000	7.000	10.000	30.000	66.000	26.000	57.000	.000	.000	.000
GR	49.800	.000	49.800	10.000	49.490	20.000	49.620	30.000	49.910	50.000
GR	50.320	70.000	53.320	70.000	.000	.000	.000	.000	.000	.000
NC	.000	.035	.030	.000	.000	.000	.000	.000	.000	.000
X1	720.500	9.000	10.000	33.000	128.500	128.500	128.500	.000	.000	.000
GR	51.110	.000	50.920	10.000	50.290	17.000	50.270	22.000	50.410	33.000
GR	50.190	50.000	50.890	66.000	50.950	100.000	53.950	120.000	.000	.000
X1	822.000	11.000	10.000	37.000	93.500	93.500	93.500	.000	.000	.000
GR	52.000	.000	51.820	10.000	51.650	15.000	51.000	22.000	49.790	26.000
GR	48.830	29.000	50.480	32.000	51.270	37.000	51.210	50.000	51.870	100.000
GR	54.870	120.000	.000	.000	.000	.000	.000	.000	.000	.000
X1	953.000	11.000	10.000	35.000	131.000	131.000	131.000	.000	.000	.000
GR	53.330	.000	53.190	10.000	52.690	17.000	51.980	23.000	50.690	26.000
GR	49.850	30.000	51.190	32.000	52.130	35.000	52.240	50.000	52.920	100.000
GR	55.920	120.000	.000	.000	.000	.000	.000	.000	.000	.000
CI	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV= .100 CEHV= .300

*SECNO 100.000

100.00	2.16	49.53	49.41	49.70	49.85	.33	.00	.00	48.27
146.	25.	115.	6.	12.	23.	6.	0.	0.	48.91
.00	1.99	5.08	1.06	.030	.020	.035	.000	47.37	4.28
.002995	0.	0.	0.	0	12	7	.00	55.09	59.38

*SECNO 200.000

3280 CROSS SECTION 200.00 EXTENDED .24 FEET

200.00	2.04	50.05	49.74	.00	50.15	.10	.27	.02	48.39
146.	69.	77.	0.	29.	29.	1.	0.	0.	49.85
.01	2.34	2.69	.44	.030	.020	.035	.000	48.01	.00
.002422	100.	100.	100.	2	16	0	.00	82.49	82.49

*SECNO 250.000

3280 CROSS SECTION 250.00 EXTENDED .29 FEET

250.00	.70	50.24	50.15	.00	50.38	.14	.22	.01	49.94
146.	0.	146.	0.	0.	48.	0.	0.	0.	50.79
.02	.00	3.05	.00	.020	.030	.020	.000	49.46	.00
.010520	50.	50.	50.	3	22	0	.00	102.95	102.95

*SECNO 286.000

3280 CROSS SECTION 286.00 EXTENDED .41 FEET

286.00	2.27	50.42	49.58	.00	50.46	.04	.07	.01	50.01
146.	0.	139.	7.	0.	86.	7.	0.	0.	49.60
.02	.00	1.60	1.12	.020	.030	.020	.000	48.15	.00
.000753	36.	36.	36.	3	17	0	.00	83.16	83.16

*SECNO 350.000

3280 CROSS SECTION 350.00 EXTENDED .30 FEET

350.00	1.78	50.47	49.69	.00	50.50	.02	.04	.00	50.17
146.	0.	117.	29.	0.	100.	20.	0.	0.	49.60
.04	.00	1.17	1.44	.020	.030	.020	.000	48.69	.00
.000442	64.	64.	64.	2	13	0	.00	107.14	107.14

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 400.000
3280 CROSS SECTION 400.00 EXTENDED .31 FEET

400.00	1.52	50.49	49.80	.00	50.52	.03	.02	.00	50.17
146.	0.	0.	146.	0.	0.	101.	1.	1.	100.17
.05	.00	.00	1.44	.020	.020	.020	.000	48.97	.00
.000331	50.	50.	50.	2	14	0	.00	96.10	96.10

*SECNO 450.000
3280 CROSS SECTION 450.00 EXTENDED .30 FEET

450.00	1.47	50.50	49.09	.00	50.54	.04	.02	.00	49.82
146.	3.	56.	87.	3.	35.	52.	1.	1.	49.03
.05	.94	1.60	1.67	.020	.020	.020	.000	49.03	.00
.000443	50.	50.	50.	2	11	0	.00	87.00	87.00

*SECNO 500.000
3280 CROSS SECTION 500.00 EXTENDED .40 FEET

500.00	1.40	50.52	49.81	.00	50.55	.03	.01	.00	49.40
146.	20.	59.	67.	19.	40.	50.	1.	1.	49.12
.06	1.03	1.48	1.34	.020	.020	.020	.000	49.12	.00
.000283	50.	32.	12.	2	14	0	.00	100.00	100.00

*SECNO 534.000
3280 CROSS SECTION 534.00 EXTENDED 1.12 FEET

534.00	1.29	50.47	50.01	.00	50.58	.12	.01	.03	49.19
216.	25.	94.	97.	10.	32.	39.	1.	1.	49.25
.06	2.61	2.96	2.52	.020	.020	.020	.000	49.18	.00
.001158	34.	15.	5.	2	14	0	.00	71.00	71.00

*SECNO 600.000
3280 CROSS SECTION 600.00 EXTENDED 1.13 FEET

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

600.00	1.44	50.93	50.93	.00	51.48	.55	.13	.13	49.80
455.	62.	176.	217.	11.	27.	40.	1.	1.	49.62
.06	5.52	6.61	5.40	.020	.020	.020	.000	49.49	.00
.005414	66.	57.	26.	0	0	0	.00	70.00	70.00

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 728.500
3280 CROSS SECTION 728.50 EXTENDED .88 FEET

728.50	1.80	51.99	51.96	.00	52.62	.62	1.12	.02	50.92
851.	73.	266.	512.	10.	36.	92.	1.	1.	50.41
.07	7.51	7.30	5.56	.020	.030	.035	.000	50.19	.00
.011793	129.	129.	129.	1	11	0	.00	106.94	106.94

*SECNO 822.000
3280 CROSS SECTION 822.00 EXTENDED .93 FEET

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

822.00	4.10	52.93	52.93	.00	53.72	.79	1.05	.05	51.82
1097.	75.	492.	530.	10.	58.	95.	1.	1.	51.27
.07	7.38	8.43	5.57	.020	.030	.035	.000	48.83	.00
.010820	94.	94.	94.	0	17	0	.00	107.06	107.06

*SECNO 953.000
3280 CROSS SECTION 953.00 EXTENDED 1.01 FEET

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

953.00	4.49	54.34	54.34	.00	55.26	.92	1.10	.04	53.19
1480.	82.	577.	821.	11.	63.	127.	2.	2.	52.13
.08	7.55	9.18	6.45	.020	.030	.035	.000	49.85	.00
.010560	131.	131.	131.	0	8	0	.00	109.49	109.49

TW STA 5+00 TO 5+34

ASO	OCOMP	ERRAC	TASO	TCO	TABER	NITER	OSWS	USWS	OSSNO	USSNO
70.29	70.36	.10	70.29	70.36	.10	11	50.520	50.166	500.000	534.000

TW STA 5+34 TO 6+00

ASO	OCOMP	ERRAC	TASO	TCO	TABER	NITER	OSWS	USWS	OSSNO	USSNO
238.73	239.50	.32	309.03	309.86	.27	11	50.166	50.929	534.000	600.000

TW STA 6+00 TO 7+28.5

ASO	OCOMP	ERRAC	TASO	TCO	TABER	NITER	OSWS	USWS	OSSNO	USSNO
396.23	396.21	.00	705.25	706.07	.12	11	50.929	51.993	600.000	728.500

TW STA 7+28.5 TO 8+22

ASO	OCOMP	ERRAC	TASO	TCO	TABER	NITER	OSWS	USWS	OSSNO	USSNO
246.04	246.02	.01	951.29	952.09	.08	11	51.993	52.930	728.500	822.000

TW STA 8+22 TO 9+53

ASO	OCOMP	ERRAC	TASO	TCO	TABER	NITER	OSWS	USWS	OSSNO	USSNO
382.72	382.71	.00	1334.01	1334.80	.06	11	52.930	54.343	822.000	953.000

HUFFAKER HILLS DRAINAGE RELIEF SYSTEM
HEC-2
FLOOD ROUTING UPSTREAM OF VIRGINIA STREET

$Q_{25} = 250$

SEA Engineers
PROJECT NO.: 150-056-864

THIS RUN EXECUTED 12/09/86 16:00:05

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**********************************************
 HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984
 ERROR CORR - 01,02,03,04,05,06
 MODIFICATION - 50,51,52,53,54,55,56
 IBM-PC-XT VERSION APRIL 1985
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SPLIT FLOW BEING PERFORMED

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SF            SPLIT FLOW OPTION STA 5+00 TO 9+53 LEFT - WIER METHOD

TW             STA 5+00 TO 5+34
WS    2    500    534    -1    3.05
WC    0  50.12     34  49.35

TW             STA 5+34 TO 6+00
WS    2    534    600    -1    3.05
WC    0  49.35     66   49.8

TW             STA 6+00 TO 7+28.5
WS    2    600  728.5    -1    3.05
WC    0   49.8  128.5  51.11

TW             STA 7+28.5 TO 8+22
WS    2  728.5    822    -1    3.05
WC    0  51.11   93.5     52

TW             STA 8+22 TO 9+53
WS    2    822    953    -1    3.05
WC    0     52    131  53.33
```

T1 HUFFAKER HILLS 0150-056-864
T2 HOLCOMB LANE / SO. VIRGINIA ST. INTERSECTION
T3 THOMAS CREEK OVERFLOW Q=250 CFS 25 YEAR FLOW

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.	0.	0.	0.	.003000	.00	.0	250.	49.700	.000

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	.000	.000	.000	.000	.000	.000	-1.000	.000	.000	.000

NC	.030	.035	.020	.100	.300	.000	.000	.000	.000	.000
X1	100.000	6.000	24.000	40.000	.000	.000	.000	.000	.000	.000
GR	49.800	.000	48.270	24.000	47.370	29.000	48.140	33.000	48.910	40.000
GR	50.820	100.000	.000	.000	.000	.000	.000	.000	.000	.000
X1	200.000	9.000	31.000	76.000	100.000	100.000	100.000	.000	.000	.000
GR	49.800	.000	48.390	31.000	48.010	33.000	48.900	36.000	49.860	46.000
GR	49.340	56.000	49.850	76.000	50.660	103.000	53.660	200.000	.000	.000
NC	.020	.020	.030	.000	.000	.000	.000	.000	.000	.000
X1	250.000	6.000	.000	150.000	50.000	50.000	50.000	.000	.000	.000
GR	49.940	.000	49.460	14.000	49.640	50.000	50.200	100.000	50.790	150.000
GR	53.790	300.000	.000	.000	.000	.000	.000	.000	.000	.000
X1	286.000	7.000	.000	67.000	36.000	36.000	36.000	.000	.000	.000
GR	50.010	.000	48.890	28.000	48.150	38.000	48.850	46.000	49.600	67.000
GR	50.460	84.000	53.460	230.000	.000	.000	.000	.000	.000	.000
X1	350.000	9.000	.000	83.000	64.000	64.000	64.000	.000	.000	.000
GR	50.170	.000	49.150	22.000	48.690	32.000	48.860	43.000	49.020	53.000
GR	49.390	63.000	49.600	83.000	49.400	100.000	52.400	120.000	.000	.000
NC	.000	.000	.020	.000	.000	.000	.000	.000	.000	.000
X1	400.000	7.000	.000	70.000	50.000	50.000	50.000	.000	.000	.000
GR	50.170	.000	49.810	5.000	49.520	13.000	48.970	30.000	49.230	43.000
GR	49.600	90.000	52.500	110.000	.000	.000	.000	.000	.000	.000
X1	450.000	7.000	6.000	40.000	50.000	50.000	50.000	.000	.000	.000
GR	50.200	.000	49.820	6.000	49.500	23.000	49.030	40.000	49.400	60.000
GR	49.650	87.000	52.650	87.000	.000	.000	.000	.000	.000	.000
X1	500.000	7.000	25.000	56.000	50.000	12.000	32.000	.000	.000	.000
GR	50.120	.000	49.400	25.000	49.350	32.000	49.150	42.000	49.120	56.000
GR	49.650	100.000	52.650	100.000	.000	.000	.000	.000	.000	.000
X1	534.000	6.000	8.000	33.000	34.000	5.000	15.000	.000	.000	.000
GR	49.350	.000	49.190	8.000	49.180	20.000	49.250	33.000	49.650	71.000
GR	52.650	71.000	.000	.000	.000	.000	.000	.000	.000	.000

X1	600.000	7.000	10.000	30.000	66.000	26.000	57.000	.000	.000	.000
GR	49.800	.000	49.800	10.000	49.490	20.000	49.620	30.000	49.910	50.000
GR	50.320	70.000	53.320	70.000	.000	.000	.000	.000	.000	.000
NC	.000	.035	.030	.000	.000	.000	.000	.000	.000	.000
X1	728.500	9.000	10.000	33.000	128.500	128.500	128.500	.000	.000	.000
GR	51.110	.000	50.920	10.000	50.290	17.000	50.270	22.000	50.410	33.000
GR	50.190	50.000	50.890	66.000	50.950	100.000	53.950	120.000	.000	.000
X1	822.000	11.000	10.000	37.000	93.500	93.500	93.500	.000	.000	.000
GR	52.000	.000	51.820	10.000	51.650	15.000	51.000	22.000	49.790	26.000
GR	48.830	29.000	50.480	32.000	51.270	37.000	51.210	50.000	51.870	100.000
GR	54.870	120.000	.000	.000	.000	.000	.000	.000	.000	.000
X1	953.000	11.000	10.000	35.000	131.000	131.000	131.000	.000	.000	.000
GR	53.330	.000	53.190	10.000	52.690	17.000	51.980	23.000	50.690	26.000
GR	49.850	30.000	51.190	32.000	52.130	35.000	52.240	50.000	52.920	100.000
GR	55.920	120.000	.000	.000	.000	.000	.000	.000	.000	.000
F1	000	000	.000	.000	.000	.000	.000	.000	.000	.000

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV= .100 CEHV= .300

*SECNO 100.000

100.00	1.39	48.76	48.59	49.70	48.92	.15	.00	.00	48.27
36.	2.	34.	0.	2.	11.	0.	0.	0.	48.91
.00	1.06	3.22	.00	.030	.020	.035	.000	47.37	16.28
.002981	0.	0.	0.	0	11	10	.00	22.38	38.66

*SECNO 200.000

7185 MINIMUM SPECIFIC ENERGY

3720 CRITICAL DEPTH ASSUMED

200.00	1.17	49.18	49.18	.00	49.38	.21	.45	.02	48.39
36.	16.	20.	0.	7.	5.	0.	0.	0.	49.85
.01	2.32	4.41	.00	.030	.020	.035	.000	48.01	13.68
.007634	100.	100.	100.	0	17	0	.00	25.21	38.89

*SECNO 250.000

250.00	.39	49.85	49.83	.00	49.93	.09	.54	.01	49.94
36.	0.	36.	0.	0.	15.	0.	0.	0.	50.79
.01	.00	2.35	.00	.020	.030	.020	.000	49.46	2.51
.016084	50.	50.	50.	3	17	0	.00	66.58	69.10

*SECNO 286.000

286.00	1.81	49.96	49.03	.00	49.96	.01	.02	.01	50.01
36.	0.	35.	0.	0.	56.	1.	0.	0.	49.60
.03	.00	.64	.34	.020	.030	.020	.000	48.15	1.34
.000207	36.	36.	36.	4	20	0	.00	72.70	74.04

*SECNO 350.000

350.00	1.28	49.97	49.22	.00	49.98	.00	.01	.00	50.17
36.	0.	31.	5.	0.	58.	9.	0.	0.	49.60
.06	.00	.53	.56	.020	.030	.020	.000	48.69	4.33
.000169	64.	64.	64.	2	17	0	.00	99.47	103.80

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 400.000

400.00	1.01	49.98	49.49	.00	49.98	.01	.01	.00	50.17
36.	0.	0.	36.	0.	0.	53.	0.	0.	100.17
.08	.00	.00	.67	.020	.020	.020	.000	48.97	2.69
.000147	50.	50.	50.	2	18	0	.00	89.90	92.59

*SECNO 450.000

450.00	.95	49.98	49.55	.00	49.99	.01	.01	.00	49.02
36.	0.	13.	23.	0.	18.	28.	0.	0.	49.03
.10	.21	.73	.82	.020	.020	.020	.000	49.03	3.41
.000231	50.	50.	50.	2	11	0	.00	83.59	87.00

*SECNO 500.000

500.00	.87	49.99	49.48	.00	50.00	.01	.00	.00	49.40
36.	2.	17.	16.	6.	24.	27.	0.	1.	49.12
.11	.38	.72	.62	.020	.020	.020	.000	49.12	4.48
.000135	50.	32.	12.	2	18	0	.00	95.52	100.00

*SECNO 534.000

3280 CROSS SECTION 534.00 EXTENDED .63 FEET

534.00	.80	49.98	49.61	.00	50.01	.02	.00	.00	49.19
53.	7.	26.	21.	6.	20.	20.	0.	1.	49.25
.11	1.18	1.32	1.02	.020	.020	.020	.000	49.18	.00
.000439	34.	15.	5.	2	9	0	.00	71.00	71.00

*SECNO 600.000

3280 CROSS SECTION 600.00 EXTENDED .54 FEET

7185 MINIMUM SPECIFIC ENERGY

3720 CRITICAL DEPTH ASSUMED

600.00	.85	50.34	50.34	.00	50.60	.26	.09	.07	49.80
144.	20.	69.	55.	5.	15.	16.	0.	1.	49.62
.12	3.65	4.66	3.42	.020	.020	.020	.000	49.49	.00
.005858	66.	57.	26.	0	8	0	.00	70.00	70.00

*SECNO 720.500

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3280 CROSS SECTION 728.50 EXTENDED .22 FEET

728.50	1.19	51.33	51.22	.00	51.53	.20	.92	.01	50.92
238.	9.	89.	139.	3.	21.	44.	1.	1.	50.41
.13	3.04	4.23	3.13	.020	.030	.035	.000	50.19	.00
.008154	129.	129.	129.	3	11	0	.00	102.51	102.51

*SECNO 822.000
3280 CROSS SECTION 822.00 EXTENDED .01 FEET

822.00	3.18	52.01	51.98	.00	52.29	.28	.74	.02	51.82
250.	1.	164.	84.	1.	33.	34.	1.	1.	51.27
.13	1.41	4.91	2.51	.020	.030	.035	.000	48.83	.00
.007668	94.	94.	94.	1	18	0	.00	100.94	100.94

*SECNO 953.000

953.00	3.17	53.02	52.99	.00	53.33	.31	1.03	.01	53.19
250.	0.	158.	92.	0.	30.	35.	1.	1.	52.13
.14	.00	5.25	2.65	.020	.030	.035	.000	49.85	12.34
.008130	131.	131.	131.	1	5	0	.00	88.35	100.69

TW STA 5+00 TO 5+34

ASO	OCOMP	ERRAC	TASO	TCO	TABER	NITER	DSWS	USWS	DSSNO	USSNO
17.40	17.36	.20	17.40	17.36	.20	11	49.991	49.983	500.000	534.000

TW STA 5+34 TO 6+00

ASO	OCOMP	ERRAC	TASO	TCO	TABER	NITER	DSWS	USWS	DSSNO	USSNO
90.76	90.77	.01	108.16	108.13	.03	11	49.983	50.342	534.000	600.000

TW STA 6+00 TO 7+28.5

ASO	OCOMP	ERRAC	TASO	TCO	TABER	NITER	DSWS	USWS	DSSNO	USSNO
93.86	93.86	.00	202.02	201.99	.02	11	50.342	51.327	600.000	728.500

TW STA 7+28.5 TO 8+22

ASO	OCOMP	ERRAC	TASO	TCO	TABER	NITER	DSWS	USWS	DSSNO	USSNO
12.13	12.14	.01	214.16	214.13	.01	11	51.327	52.010	728.500	822.000

TW STA 8+22 TO 9+53

ASO	OCOMP	ERRAC	TASO	TCO	TABER	NITER	DSWS	USWS	DSSNO	USSNO
.01	.01	.00	214.16	214.13	.01	11	52.010	53.023	822.000	953.000

HUFFAKER HILLS DRAINAGE RELIEF SYSTEM

STREET FLOW RATING CAPACITY CALCULATIONS

SEA Engineers
PROJECT NO.: 150-056-864

COMPUTE RATING CURVE ID=1 VS=10 NSEG=3 MIN EL=10. FT INC = -.20 FT

CHSLOPE=0.011 FPSLOPE=0.011

N=0.019 DIST=50. FT N=0.015 DIST=57. FT

N=0.025 DIST=61. FT

DIST(FT)	ELEV(FT)	DIST(FT)	ELEV(FT)
0.0	14.60	0.0	11.16
50.	10.16	52.	10.
52.	10.5	57.	10.6
61.	14.6		

RATING CURVE VALLEY SECTION 10.0

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS
10.00	0.0	0.0
10.20	.3	.6
10.40	2.1	5.6
10.60	6.1	18.6
10.80	13.0	53.4
11.00	21.8	109.6
11.20	32.7	193.5
11.40	44.2	316.0
11.60	55.8	461.3
11.80	67.4	627.8
12.00	79.1	813.8
12.20	90.8	1018.4
12.40	102.5	1240.5
12.60	114.3	1479.5
12.80	126.1	1734.5
13.00	138.0	2005.0
13.20	149.9	2290.5
13.40	161.8	2590.5
13.60	173.8	2904.6
13.80	185.8	3232.3

FINISH

42 FT. STREET
0.74% SLOPE

ME TE RATING CURVE ID=1 VS=9 NSEG=5 MIN EL=95.45 FT MAX EL=100 FT

CHSLOPE=0.0074 FPSLOPE=0.0074

N=0.025 DIST=20 FT N=0.015 DIST=24.5

N=0.019 DIST=66.5 FT N=0.015 DIST=71

N=0.025 DIST=91 FT

DIST(FT)	ELEV(FT)	DIST(FT)	ELEV(FT)
00.00	100.00	20.00	96.00
24.50	96.96	24.50	95.45
45.50	95.87	66.50	95.45
66.50	95.96	71.00	96.00
91.00	100.00		

RATING CURVE VALLEY SECTION 9.0

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS
95.45	0.0	0.0
95.69	2.9	4.7
95.93	11.3	31.4
96.17	22.4	92.9
96.41	34.6	182.8
96.65	47.5	298.5
96.89	61.4	439.3
97.13	76.0	607.2
97.37	91.2	800.9
97.61	107.0	1018.9
97.84	123.3	1260.8
98.08	140.2	1526.3
98.32	157.7	1815.4
98.56	175.8	2128.0
98.80	194.4	2464.0
99.04	213.6	2823.5
99.28	233.4	3206.6
99.52	253.8	3613.3
99.76	274.7	4043.8
100.00	296.2	4498.1

FINISH

42 FT. STREET
1.4% SLOPE

OMPUTE RATING CURVE ID=1 VS=9 NSEG=5 MIN EL=95.45 FT MAX EL=100 FT

CHSLOPE=0.014 FPSLOPE=0.014

N=0.025 DIST=20 FT N=0.015 DIST=24.5

N=0.019 DIST=66.5 FT N=0.015 DIST=71

N=0.025 DIST=91 FT

DIST(FT)	ELEV(FT)	DIST(FT)	ELEV(FT)
00.00	100.00	20.00	96.00
24.50	96.96	24.50	95.45
45.50	95.87	66.50	95.45
66.50	95.96	71.00	96.00
91.00	100.00		

RATING CURVE VALLEY SECTION 9.0

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS
95.45	0.0	0.0
95.69	2.9	6.4
95.93	11.3	43.2
96.17	22.4	127.8
96.41	34.6	251.4
96.65	47.5	410.6
96.89	61.4	604.2
97.13	76.0	835.1
97.37	91.2	1101.6
97.61	107.0	1401.4
97.84	123.3	1734.1
98.08	140.2	2099.4
98.32	157.7	2497.0
98.56	175.8	2927.0
98.80	194.4	3389.1
99.04	213.6	3883.7
99.28	233.4	4410.5
99.52	253.8	4970.0
99.76	274.7	5562.0
100.00	296.2	6186.9

FINISH

42 FT. STREET
0.4% SLOPE

:O PUTE RATING CURVE ID=1 VS=9 NSEG=5 MIN EL=95.45 FT MAX EL=100 FT

CHSLOPE=0.004 FPSLOPE=0.004

N=0.025 DIST=20 FT N=0.015 DIST=24.5

N=0.019 DIST=66.5 FT N=0.015 DIST=71

N=0.025 DIST=91 FT

DIST(FT)	ELEV(FT)	DIST(FT)	ELEV(FT)
00.00	100.00	20.00	96.00
24.50	96.96	24.50	95.45
45.50	95.87	66.50	95.45
66.50	95.96	71.00	96.00
91.00	100.00		

RATING CURVE VALLEY SECTION 9.0

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS
95.45	0.0	0.0
95.69	2.9	3.4
95.93	11.3	23.1
96.17	22.4	68.3
96.41	34.6	134.4
96.65	47.5	219.5
96.89	61.4	323.0
97.13	76.0	446.4
97.37	91.2	588.8
97.61	107.0	749.1
97.84	123.3	926.9
98.08	140.2	1122.2
98.32	157.7	1334.7
98.56	175.8	1564.5
98.80	194.4	1811.6
99.04	213.6	2075.9
99.28	233.4	2357.5
99.52	253.8	2656.6
99.76	274.7	2973.0
100.00	296.2	3307.0

F.NISH

21 FT. STREET
1.4% SLOPE
VERTICAL FLOOD PLAIN

COMPUTE RATING CURVE ID=1 VS=7 NSEG=1 MIN EL=95.50 FT MAX EL=100 FT

CHSLOPE=0.014 FPSLOPE=0.014

N=0.019 DIST=21.6 FT

DIST(FT)	ELEV(FT)	DIST(FT)	ELEV(FT)
00.0	100.00	00.10	96.00
00.25	95.50	10.75	95.71
21.25	95.50	21.5	96.00
21.6	100.00		

RATING CURVE VALLEY SECTION 7.0

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS
95.50	0.0	0.0
95.74	2.8	6.6
95.97	7.8	36.4
96.21	12.9	82.4
96.45	18.0	141.2
96.68	23.0	210.8
96.92	28.1	289.9
97.16	33.2	377.4
97.39	38.3	472.4
97.63	43.4	574.3
97.87	48.5	682.5
98.11	53.6	796.4
98.34	58.7	915.6
98.58	63.8	1039.8
98.82	68.9	1168.6
99.05	74.0	1301.8
99.29	79.1	1438.9
99.53	84.2	1579.8
99.76	89.3	1724.3
100.00	94.4	1872.1

FINISH

21 FT. STREET
1.4% SLOPE
SLOPING FLOOD PLAIN

COMPUTE RATING CURVE ID=1 VS=7 NSEG=3 MIN EL=95.50 FT MAX EL=100 FT

CHSLOPE=0.014 FPSLOPE=0.014

N=0.025 DIST=20 FT N=0.019 DIST=41.5

N=0.025 DIST=61.5

DIST(FT)	ELEV(FT)	DIST(FT)	ELEV(FT)
00.00	100.00	20.00	96.00
20.25	95.50	30.75	95.71
41.25	95.50	41.50	96.00
61.50	100.00		

RATING CURVE VALLEY SECTION 7.0

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS
95.50	0.0	0.0
95.74	2.8	6.6
95.97	7.9	36.5
96.21	13.2	84.2
96.45	19.0	148.3
96.68	25.5	228.5
96.92	32.5	324.8
97.16	40.0	437.4
97.39	48.1	566.5
97.63	56.8	712.5
97.87	66.0	875.6
98.11	75.8	1056.3
98.34	86.2	1254.9
98.58	97.1	1471.9
98.82	108.6	1707.5
99.05	120.6	1962.3
99.29	133.3	2236.6
99.53	146.4	2530.8
99.76	160.1	2845.4
100.00	174.4	3180.8

FINISH

HUFFAKER HILLS DRAINAGE RELIEF SYSTEM
5-YEAR LOCAL AREA HYDROLOGY ANALYSIS

SEA Engineers
PROJECT NO.: 150-056-864

HUFFAKER HILLS DRAINAGE STUDY
26-Nov-86

5 YEAR LOCAL AREA HYDROLOGY

STRUCTURE	LENGTH (FT)	VELOCITY (FPS)	DESIGNATION	AREA (acres)	RUNOFF COEFICIENT	AREA SUMATION	WEIGHTED COEFICIENT	INCREMENT TIME (min)	CUMULATIVE TIME (min)	RAINFALL INTENSITY	RUNOFF CFS
BRANCH "A"											
DETENTION BASIN RUNOFF FIXED AT 50 CFS								120.0	120.0		50
E-9	-	-	9	9.39	0.25	9.39	0.25	15.0	135.0	0.24	51
PIPE	2230	5.5	-	-	-	-	-	6.8	141.8	-	
E-3	-	-	10	36.29	0.60	45.68	0.53	26.6	168.4	0.20	55
E-2	-	-	-	-	-	-	-	2.0	170.4	-	-
M-2			8	41.28	0.60	86.96	0.56	25.0	195.4	0.19	59
BRANCH "B"											
THOMAS CREEK OVERFLOW FIXED AT 27 CFS					-	-	-	25.0	25.0	-	25
B-1	-	-	15	5.94	0.25	5.94	0.25	10.0	35.0	0.60	76
OPEN CHANNEL								13.0	48.0		
M-12	-	-	16	34.01	0.25	39.95	0.25	20.0	68.0	0.37	79
OPEN CHANNEL								30.0	98.0		
B-3 (JUNCTION A-B)			13	40.23	0.6	80.18	0.43	25.0	123.0	0.25	84
B-3 (JUNCTION A-B)			12	28.25	0.25	108.43	0.38	25.0	148.0	0.24	85
COMBINED FLOWS						195.39	0.46	-	195.4	0.19	92
OPEN CHANNEL	1400	4	-	-	-	-	-	5.8	201.2	-	-
F-21	-	-	11	9.57	0.25	204.96	0.45	10.0	211.2	0.38	92 *
S.D.	350	5.5	F-27	-	-	-	-	1.1			28 *
F-14	-	-	7	30.97	0.55	30.97	0.55		212.3	0.18	31
S.D.	850	5.5	-	-	-	-	-	2.6			
F-1	-	-	4	11.83	0.50	42.80	0.54	-	214.8	0.18	35
OPEN CHANNEL	350	4	F-27	-	-	-	-	1.5			
G-15	-	-	-	-	-	-	-	-	212.6	-	64 *
S.D.	1220	5.5	G-15	-	-	-	-	3.7	-	-	32 *
G-1	-	-	5	16.71	0.50	16.71	0.50	-	216.3	0.18	34
S.D.	1830	5.5	G-15	-	-	-	-	5.5	-	-	32 *
G-6	-	-	6	16.27	0.50	16.27	0.50	-	218.2	0.17	34
I-1	-	-	1	7.79	0.50	7.79	0.50	15.0	15.0	1.10	4
J-1	-	-	14	3.93	0.50	3.93	0.50	15.0	15.0	1.20	2
K-1	-	-	2	9.58	0.50	9.58	0.50	15.0	15.0	1.20	6
L-1	-	-	3	7.70	0.50	7.70	0.50	15.0	15.0	1.20	5

Area #12 is not shown on Exhibit "G" but is identified in text as Thomas Creek.

Area #14 is shown twice on map

HUFFAKER HILLS DRAINAGE RELIEF SYSTEM
NDOT U.S. 395 HYDROLOGY CALCULATIONS

SEA Engineers
PROJECT NO.: 150-056-864

Project No. 990-005-851
U.S. 395

HYDROLOGY FOR SIZING STORM DRAINS

U.S. 395, SO.VIRGINIA TO DEL MONTE LN.

"C"

The criteria for sizing storm drain culverts under the proposed mainline required calculating the 50-year and 100-year return frequency storm flows at each collection point along the west side of the alignment. In addition, 5-year and 10-year frequency storm flows were calculated for specific areas where storm drain systems were governed by City of Reno design standards or where it was economically or physically impractical to design for less frequent larger storm flows. Five (5) year flows were developed for the storm drain system in the Frontage Road.

Commercial C = ? area 11 use C = .85

All drainage areas thus derived were small enough to use the Rational Method, with the exception of one drainage area along Thomas Creek. An SCS hydrograph method was used to calculate flows from this area. Drainage areas incorporating the Rational Method were given runoff coefficient ("C") values of 0.25 for rural (undeveloped) areas, 0.45 for single-family developed areas, and 0.60 for multi-family developed areas. Times of concentration were estimated from the nomograph in Figure 3-1, "Urban Hydrology for Small Watersheds, TR-55," SCS. The rainfall intensity-duration-frequency curves for Reno, Nevada in the NDOT design manual were used, with an initial buildup time of ten minutes added to the estimated time of concentration.

The Thomas Creek drainage area (Area #12) was determined by assuming future floodworks would divert all main channel flow to the southeast. This assumption is based upon the City of Reno's policy for the subject drainage area established January 21, 1986, see attached Project Conference Memorandum. The irrigation channel which branches off of the main channel and ultimately crosses Virginia Street at the location of the U.S. 395 interchange was assumed to carry irrigation water and storm runoff from the area tributary to it, but no storm runoff from the main channel. Methods for determining time of concentration, runoff curve numbers and rainfall depths were taken from the SCS NEH, Chapter 4, and the hydrographs generated by a computer program. A 10-year event frequency was used for the South Virginia interchange crossing and detention basin per discussion with the Nevada Department of Transportation. Lesser frequency events will bypass the underground storm drain system and flow down the South Virginia Street Section.

Drainage structures at Dry Creek were sized to convey runoff from a 100-year event. Dry Creek 50- and 100-year design storm flows were provided by the City of Reno.

It was observed during recent (February 1986) large storms that spillage from Evans Creek concentrated in a low area just north of Green Acres Drive. Provisions for handling the spill overflow from Evans Creek were not considered in the design of U.S. 395 as directed by the NDOT; see attached Project Conference Memorandums dated March 7 and 17, 1986.

For purposes of determining the impact of full development on the calculated flows, new flows for all undeveloped drainage areas were calculated using revised times of concentration and runoff coefficients consistent with current development trends in the area, i.e. single-family for Areas 1 through 10, commercial for Area 11, and rural for Area 12.

local areas?   downstream

Areas 6 and 7 are immediately below a detention basin which controls outflow during high inflow periods through a 30-inch diameter storm drain to Area 6 and a 10-foot-wide spillway to Area 7. Hydrographs were generated for Areas 6 and 7 and for the drainage area above the detention basin. This last hydrograph was routed through the detention basin and the outflow ordinates were divided between the 30-inch outlet and the spillway. A travel time of 0.20 hours was added to the detention basin outflow hydrograph and the ordinates of the hydrographs for Areas 6 and 7 were then added to obtain the total flow at the respective collection points. As expected, the lag time gained in the detention basin allows the peak flows from Areas 6 and 7 to pass before the detention basin outflow peaks.

ingress talks?
N, S, E, W?
upstream
downstream
Identify water [illegible] arroyo creek [illegible] drainage as local area?

Surface drainage to be collected in DI's on the mainline were based upon NDOT's design manual except for time of concentration which was modified to a minimum 15 minutes per conversation with NDOT Hydrology Department.

The following items are included as part of this hydrologic analysis:

1. Summary of drainage areas and flows
2. Drainage basin maps
3. Mainline surface flow map for DI's
4. HEC-2 analysis of Dry Creek
    a. Existing conditions (100-year flood)
    b. Post-construction conditions (100-year flood)
5. Detailed calculation of flows
6. Thomas Creek Hydrographs and retention basis routing

Project No. 990-005-852

US395

Hydrology Calc's - Summary

Area No.	Drainage Area (Acres)	Q5	Existing Conditions Q50 (cfs)	Existing Conditions Q100 (cfs)	Fully Developed Q50 (cfs)	Fully Developed Q100 (cfs)
1	1.2		0.9	1.0	1.7	1.9
2	2.5		1.6	1.8	3.4	3.8
3	0.6		0.5	0.6	0.9	1.1
4	4.4		2.4	2.8	5.9	6.7
5	35		10.5	12.3	33.1	37.8
6	24	(15.1)	34	38	34	38
7	49		137	184	137	184
8	-Void-		-	-	-	-
9	176	(3.8)	63.9	69.7	103.0	118.8
10	48		31.0	35.1	40.7	45.8
11	12.6		21.2	24.1	21.2	24.1
12*	537		298	349	399	459
9+10	224	(75.8)	136.9	157.9	136.9	157.9
9+10	224	(47.8)	86.2	94.1	-	-

* Q10 = 115cfs

PROJECT CONFERENCE MEMORANDUM

sea incorporated
ENGINEERS/PLANNERS
950 Industrial Way
Sparks, Nevada 89431
(702) 358-6931

Project Name: U.S. 395 Freeway - Del Monte Lane to South Virginia Street

Project No.: 990-005-852

Date: January 21, 1986

Meeting Place: City of Reno   Telephone Call:

Attending:

Millard Reed	City of Reno
Bill Vann	City of Reno
Steve Varela	SE&A
Guy Sharp	SE&A

Discussion:

The proposed storm drainage system to convey runoff across the U.S. 395 right-of-way was presented to the City of Reno for comment. The items of discussion were as follows:

1. Existing piped drainage systems crossing the right-of-way in developed areas will be extended or replaced using same size of pipe. Some freeway runoff will be diverted into the storm drain in Patriot Boulevard as the contributing flow from the freeway is not more than the contributing flow from the area the freeway displaces.

2. In most cases, irrigation tailwater and storm runoff will be collected at the right-of-way and piped across the right-of-way to existing irrigation drainage ditches or pipes. Storm drain culverts will be sized to convey runoff from a 50-year event per NDOT requirements.

3. If feasible, a drainage structure under South Virginia Street and U.S. 395 will be provided to convey runoff from a 50-year event (NDOT criteria) from a tributary area which currently contributes flows from a portion of the alluvial fan west of the main channel of Thomas Creek (see attached map). The City's policy, established at this meeting, stated that the flow in the main channel above the alluvial fan will ultimately be conveyed, through flood improvements, along the main channel alignment to Mays Lane and thence east. Runoff in excess of the capacity of this structure, which may occur during the 100-year event or during the interim period before flood improvements are made to Thomas Creek, will be conveyed overland within the South Virginia Street section across the right-of-way, generally as it now does.

4. The FIRM maps for the subject area indicate Zone B flooding along the U.S. 395 alignment between South Virginia Street and Huffaker Lane. To prevent the possibility of floodwater from becoming trapped against the

freeway embankment between Patriot Boulevard and the proposed Longley Lane extension, provisions could be made to convey flood flows in excess of the local storm drain capacity to Longley Lane and thence within the Longley Lane street section under the freeway. SE&A pointed out that existing and planned development of Meadow Creek Estates could cause flood flows to concentrate at or near the point where Longley Lane will cross the freeway. If so, flood flows would not be substantially diverted from the expected overland flow course by the proposed flood routing.

5. Drainage structures at Dry Creek will be provided to convey runoff from a 100-year event without increasing the expected 100-year flood water surface elevation under existing conditions more than one foot. SE&A pointed out that the existing structure under Meadow Vista Drive is expected to be overtopped by the design flow (3850 cfs per City of Reno) and as a result flow could be lost from the Dry Creek floodway to the proposed Longley Lane street section. It was suggested that the profile of Longley Lane could be designed to help prevent this occurance.

GAS:df

Distribution:
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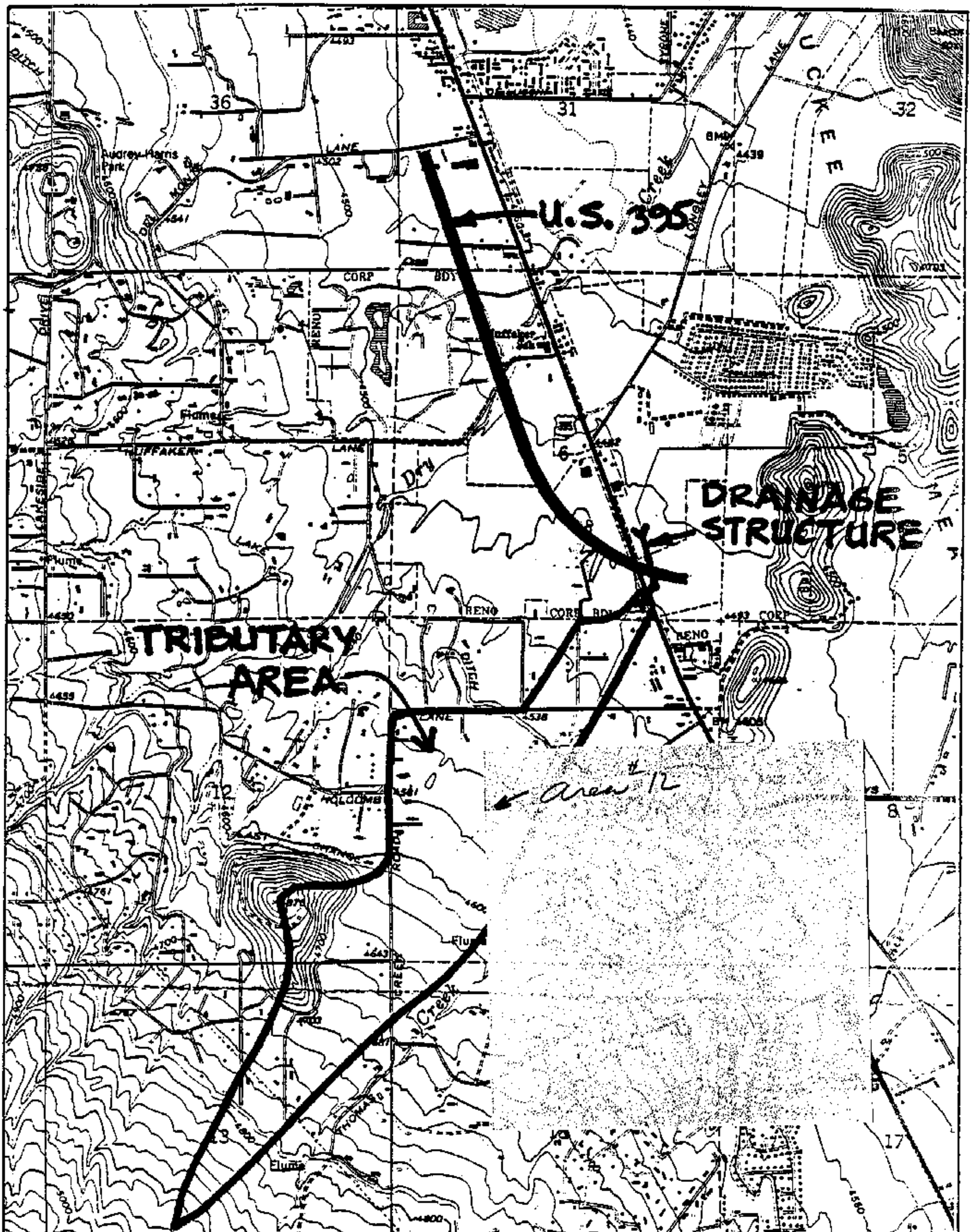
- RDB
- MAD
- FGA
- SV
- City of Reno
- NDOT - Jim Dodson

S E & A, INC.

Guy A. Sharp, P.E.

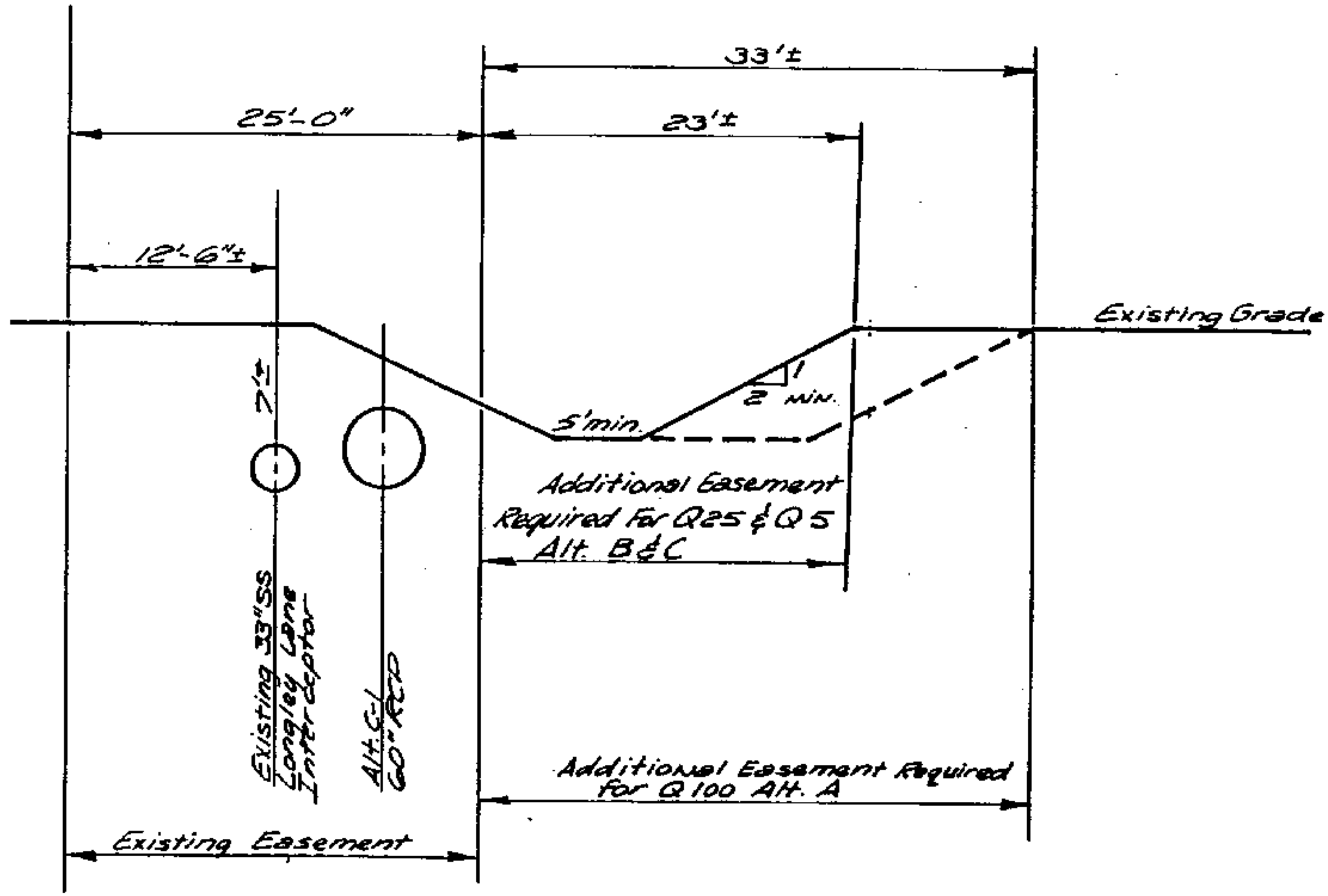


sea
ENGINEERS/PLANNERS
SPARKS, NEVADA
LAS VEGAS, NEVADA

U.S. 395 FREEWAY
DRAINAGE STRUCTURE FOR 50-YEAR STORM RUNOFF

PROJECT NO. 990-005-652
FIGURE
PAGE

DATAPRINT



SEA ENGINEERS/PLANNERS
SPARKS, NEVADA
LAS VEGAS, NEVADA
SEATTLE, WASHINGTON

HUFFAKER HILLS RELIEF SYSTEM ALTERNATIVES

CROSS SECTION FROM COCHRAN DITCH TO McCARRAN

PROJECT NO 160-056-864
FIGURE
PAGE