HYDROLOGY K10/D5 4 PLANS

K10/D5

4 Plans

Bellamah Development Corp.

January 15, 1981

RECEIVED
JAN 19 1981
CITY ENGINEER

Mr. Richard Heller
City Engineering Department
P.O. Box 1293
Albuquerque, NM 87103

Dear Mr. Heller:

Please find attached a summary plat for property located at the southwest corner of I-40 & Coors, NW. Please review and comment so that this document may be recorded on the earliest possible date.

Kindest regards,
BELLAMAH DEVELOPMENT CORP.

Kerry E. Kimball

Kerry E. Kimball, CSM
Associate Director of Development

KEK:vm

Enclosure

K.B 10-11

Any problems?

Yes we may need an easement on the N.W. Corner for the Atrisco Res. PK channel diversion! also property in Hide Flood area! need to find out from Chris what the story is

R.C. 1/20/81

RSH	RRA	ADM	
HRO		SUR	
CDS		COUN	
DES		SEC	
INSP		FILE	
HYDRO		RETURN	ASAP

This has been checked and returned to you.

6121 Indian School Road, NE / PO Box 3325 / Albuquerque, New Mexico 87190 / (505) 883-3000

LETTER OF TRANSMITTAL

MEURER, SERAFINI AND MEURER, INC.

2601 Wyoming Blvd., N.E. Suite F
Albuquerque, N.M. 87110/505 292-1936

Date September 19, 1979

To City of Albuquerque

P.O. Box 1293

Albuquerque, New Mexico 87103

Attn. Bruno Conigliano

Re:

Comments: Returning for your files.

Enclosures:

Quantity	Type of Enclosure and Description
1	Drainage Report

Signed: VLT

Copy to:

If enclosures are not as noted, kindly notify us at once.

City of Albuquerque
P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

MAYOR
Harry E. Kinney

CHIEF
ADMINISTRATIVE OFFICER
Frank A. Kleinhenz

August 11, 1976

Dale Bellamah Land Co., Inc.
P. O. Box 3325
Albuquerque, New Mexico 87110

Attention: Joe Shipley

SUBJECT: CITY OF ALBUQUERQUE PROJECT P75-13, PROPOSED PAVING IN MONTANO RD.,N.W. FROM EXISTING PAVING ON COORS ROAD WEST 4,278 FEET.

The above-referenced project has been constructed to acceptable standards by Universal Constructors, Inc. except that drainage provisions required on the plans have not been provided by the developer. Since adequate drainage has not been provided, the City cannot accept the project at this time. At such time as suitable drainage is provided, the condition of the facilities constructed by Universal Constructors will be reinspected to determine any needed repair due to damages caused by lack of adequate drainage. The City will consider the project for acceptance upon completion of any repairs found necessary at the time of reinspection. Warranty period for the project will not begin until final acceptance by the City.

Yours very truly,

C. D. Sheppard, P.E.

C. D. Sheppard
Assistant City Engineer-Field

CDS/fs
cc: V. M. Kimmick
Ray Dawson
Universal Constructors, Inc.
Kleston Laws

Public Works Department

Director — Erwin F. Hensch, P. E. 766-7467
Engineering 765-7441 — V. M. Kimmick, P. E.
Street Maint. 766-7755 — G. E. Paul, P. E.
Ass't. Director — Harold R. Orr, Jr. P. E.
Liquid Waste 766-7535 — R. P. Lowe, P. E.
Water 766-7437 — W. H. Otto, P. E.

AN EQUAL OPPORTUNITY EMPLOYER

PUBLIC WORKS DEPARTMENT
CITY ENGINEER'S OFFICE

June 6, 1975

Mr. Ken Bowers
New Mexico Highway Dept. Dist. No. 3
P. O. Box 3768, Station D
Albuquerque, New Mexico 87110

SUBJECT: COORS BLVD. CENTRAL TO I-40 - PROJECT M-4053(1)

Dear Ken:

I am enclosing for your information statements regarding the drainage and pavement designs for this project. I consider the following items important.

1. The engineer should meet with the Liquid Waste Engineer as soon as possible and discuss his comments relating to the Bluewater outfall.

2. The comments on the enclosed memorandum dated May 30, 1975, should be discussed at the same meeting.

3. Paving design and alternate designs appear acceptable. Advanced design methods suggested by an outside agency should receive consideration.

Sincerely,

V. M. Kingston
City Engineer

VMK/fs
Enclosure
cc: E. F. Hensch
Robert P. Lowe
Kleston Laws
Dwayne Sheppard
Leverton-Denney Engineers, Inc.

CITY OF ALBUQUERQUE, NEW MEXICO
CITY ENGINEER'S OFFICE

MEMORANDUM - May 30, 1975

TO: Mr. V. M. Kimmick, City Engineer
FROM: Kleston Laws, Assistant City Engineer - Hydrology KL
SUBJECT: DRAINAGE STUDY - COORS BLVD. PROJECT M-4053(1)

I have reviewed the drainage report and find it satisfactory and acceptable.

The plans have not reflected the changes requested by Bob Lowe relative to the Bluewater outfall. Mr. Lowe's comments are important to the operation of the facility and are based on past experience with another similar design.

Some specific items I feel would improve the design are:

1. At about Sta. 72+00 on Coors the 18" storm sewer could terminate 75 feet north with an angle connector pipe to the west inlet. The east inlet could move north and also join the main at a more desirable angle.

2. I feel an inlet should be placed on the southeast curb return of Avalon to prevent low flows from crossing the intersection.

3. The connector pipe of the northwest inlet at Fortuna Drive would have better hydraulic characteristics if it came into the main at Sta. 117+92.70.

4. An inlet at southeast Brayton Road would prevent low flows from crossing the intersection.

The following comments are for the Bluewater Outfall:

5. Need a manhole at the angle at Station 4+00.

6. Inlets at the following locations would prevent low flow from crossing the intersection and reduce street maintenance problems.

SE 56th. Street
SW Dolores
SE 59th. Street
SE 60th. Street
SE 61st. Street

Generally the consultant replaced existing inlets and there are none at the above locations. I think the cost at this time would be worth the investment.

Item 5 and Mr. Lowe's suggestions are important enough to require compliance and change of plans.

KHL/fs

CITY OF ALBUQUERQUE, NEW MEXICO
CITY ENGINEER'S OFFICE

MEMORANDUM - June 6, 1975

TO: Mr. V. M. Kimmick, City Engineer
FROM: C. D. Sheppard, Asst. City Engineer-Field
SUBJECT: COMMENTS ON PAVEMENT STRUCTURAL DESIGN, COORS BOULEVARD, M-4053(1), ALBUQUERQUE, NEW MEXICO, LEVERTON-DENNY ENGINEERS, INC.

The pavement designs submitted appear generally adequate and concurrence with the suggested alternates for Asphaltic Concrete Pavement and Portland Cement Concrete pavement is recommended.

The following items should be noted but do not change the above recommendation:

1. The value of 500 psi for modulus of subgrade reaction used for 4 inch base over 60 "R" value subgrade seems high; a value of around 260-270 would appear more appropriate.

2. The method used for design of the Portland Cement Concrete Section is acceptable, however, there are other more recently developed methods which should receive consideration.

CDS:ec

RECEIVED
APR 11 1975
CITY ENGINEERS

CITY OF ALBUQUERQUE

DEPARTMENT OF TRAFFIC AND TRANSPORTATION

MEMORANDUM - April 10, 1975

TO: V. M. KIMMICK, CITY ENGINEER

FROM: E. L. BECK, DIRECTOR OF TRAFFIC AND TRANSPORTATION

SUBJECT: MEETING - COORS BOULEVARD PROJECT M-4053(1)

There will be a meeting of the design team for Coors Boulevard project M-4053(1), Thursday, April 17, 1975 at 9:00 a.m. at the Paradise Hills Country Club Meeting Room, 10,035 Gulf Course Road N.W.

The discussion and review will include: Grades, drainage, utilities, temporary construction permits, bus bays, traffic handling pavement marking, intersection and signal design, median openings, construction engineering and other items.

Kleaton —
Please plan to attend with me.
Jim

CITY OF ALBUQUERQUE, NEW MEXICO
CITY ENGINEER'S OFFICE

MEMORANDUM - April 8, 1975

TO: Mr. E. F. Hensch, Director of Public Works
FROM: V. M. Kimmick, City Engineer
SUBJECT: COORS BLVD, CENTRAL TO I-40, AVAILABLE FUNDS FOR

Current funds available for this project are R693,499.85.

VMK:ev

cc: Mr. Dwayne Sheppard, Asst. City Engineer-Field
Mr. Kleston Laws, Hydrology Engineer
Mr. Don Trimble, Bond Fund Coordinator

COORS BOULEVARD

M-4053 (1)

DRAINAGE REPORT

898-2457

Leverton-Denney Engineers, Inc.

Albuquerque, New Mexico

April, 1975

COORS BOULEVARD

M-4053 (1)

DRAINAGE REPORT

PURPOSE: The purpose of this report is to present the results of analyses which have been performed to determine the most effective and economic method of providing for drainage, size of storm drain pipe, and outfall line required in connection with the improvement of Coors Boulevard from Central Avenue North to I-40.

GENERAL: This reach of Coors Boulevard traverses a wide bench or fan consisting of the lower reaches of small arroyos that flow from the west. Flood water from the west spreads into numerous natural basins throughout the area and dissipates by evaporation and percolation. Due to the flatness of the area and the natural basins, no defined channels cross this project. The low point on the project is 200 feet South of the Bluewater Intersection (Elevation 5083±). The high point is near the west intersection of Cloudcroft (Elevation 5104±).

Coors Boulevard presently is acting as a dam or dike as it crosses natural basins, in that, it prevents equalization within the basin. The largest basin intercepted is in the area around the Bluewater Intersection. Storm water from the west tends to cross both sides of Coors on Bluewater Road and pond

on Bluewater east of Coors. An existing 24 inch storm sewer drains this ponding area by way of Central Avenue to the Rio Grande. Coors Blvd. also crosses the east edge of a basin in the area between Fortuna and Hanover. An existing 24" culvert allows ponded runoff from the west to cross the street.

Existing storm drain systems provide minimum drainage of areas east of Coors Boulevard (See Plate II). These systems primarily provide drainage of basins which are presently fully developed and have no overland outlet to the river. While these systems provide for complete drainage of ponded runoff over an extended period of time, they are not capable of handling peak flows or any additional flow from the proposed Coors Boulevard System.

Coors Boulevard is being designed as an Urban Arterial Street which will allow for commercial and industrial development. Limited development is anticipated on the east side and substantial improvement is expected on the west side. The street section and profile is designed to fit existing terrain and will facilitate this type of future development. Drainage areas to Coors Blvd. were selected considering that part of the future development along Coors Blvd. will drain to the street. On the west, which for the most part is undeveloped, a strip 100 feet deep, can reasonably be graded to drain to the street. On the east, considerable development already exists. Undeveloped

tracts were selected where future development is feasible and the front 50 feet of those tracts are assumed as potentially draining to the street. (See Plate I).

The major concern in designing the Storm Sewer System for the subject project is selection of an outfall route to the Rio Grande. The alternatives considered in this study are as follows:

1. BLUEWATER ROAD: The low point of this project is near the Bluewater Road intersection. This storm sewer outfall can be constructed within dedicated streets to Atrisco Road thence across City of Albuquerque property and Middle Rio Grande Conservancy property to the Rio Grande. In order to maintain a minimum storm sewer grade, cuts up to a maximum of 25 feet will be required between Coors Boulevard and Yucca. Temporary relocation of water, sanitary sewer and gas lines will be necessary during construction. In the vicinity of the deeper cut, paving, curb and gutter and sidewalks will be removed and replaced. The existing outfall between Yucca and the Rio Grande was constructed within a dedicated street and can be paralleled with the new outfall line. Although some dwellings and businesses front on Bluewater, they are accessable from side streets. The length of the Bluewater outfall is approximately 7,000 feet.

2. CENTRAL AVENUE: In order to drain to the Rio Grande via Central Avenue, the logical exit from Coors Blvd. is at the Bluewater intersection. A maximum cut of 20 feet would be required to maintain a minimum storm sewer grade to Central Avenue. The north-south streets from Bluewater to Central are built up with front facing dwellings. The distance along frontage streets to Central Avenue is 2100' ±. Service lines for water, sanitary sewer and gas would have to be removed and replaced for each dwelling. Water, sanitary sewer and gas mains would have to be temporarily removed and relocated during construction. Access to the dwellings would be cut off during construction. In Central Avenue, underground traffic controls and utilities are numerous and would be a considerable problem. A number of marginal businesses fronting on Central Avenue would suffer a significant loss of business during construction. In the past, this section of Central Avenue has been subjected to several construction projects. The length of the Central outfall is approximately 8400 feet.

3. EXISTING SYSTEMS: The 36" storm drain in Glenrio Road possibly has some extra capacity; however, the l[illegible] is too shallow to provide drainage for any significant portion of Coors Boulevard.

The existing system from Bluewater to Central terminating at the Atrisco Drain is presently overloaded. It would be difficult to upgrade this system due to the difficult construction on Central Avenue and the inadequate carrying capacity of the Atrisco Drain.

4. I-40 DRAIN DITCH: The I-40 open drain is a Vee shaped concrete lined ditch along the South Coors entrance ramp. This ditch has sufficient capacity to accommodate additional flow on the order of 55 cfs. The limiting constraint is the elevation of the ditch at the beginning of the retaining wall. Construction of this outfall would involve removal and replacement of concrete pavement, curb and gutter, utilities, and sidewalk. It is possible to drain Coors from the west intersection of Cloudcroft Road North to Iliff through this outlet. The length of the outlet is approximately 1200 feet.

5. 64TH STREET NORTH: A proposed drainage system was planned from Fortuna and 64th Street North along 64th to I-40; thence east along the right-of-way of I-40 to a buried concrete box culvert under I-40 in the vicinity of Estancia; then under I-40 and Coors Boulevard to the Rio Grande. This system could drain the North half of Coors Boulevard and solve some local drainage problems near West Mesa High School. The construction along this route would not be complicated to any great extent

by existing utilities. Cuts up to 40 feet deep would be required between Coors Boulevard and the bluff above the Rio Grande, plus an extensive structure to convey the storm water down the steep slope to the riverbed. The length of this route from Fortuna to the river is approximately 2 miles. It should be noted that future construction of this project to correct a local problem west of Coors Boulevard and also to provide an outlet for Coors Boulevard drainage North of I-40 and that area in the northwest quadrant of the interchange will probably be indicated. This should be analyzed and programed.

CRITERIA:

1. Drainage area used consists of the highway right-of-way, a 100 foot strip adjacent to the west right-of-way line and undeveloped areas east of the highway within 50 feet which will drain into the project. (See Plate I).

2. Spread for inlet spacing was computed to allow storm flows to cover no more than one lane during a 10 year storm. Including the gutter (2') and one traffic lane (12') the spread is 14 feet. Maximum spacing for inlets are in accordance with formulas and nomographs set forth in "Drainage of Highway Pavements - Hydraulic Engineering Circular No. 12."

2" 02X12 = .24
.17
.41 head on inlet

3. Rainfall intensities were computed by formulas from "Master Plan of Drainage - City of Albuquerque, New Mexico 1963," as follows:

can we fill pipe?

Inlet Spacing - 10 years: $i_{10} = \frac{91}{t_c + 24}$

Storm Sewer Pipe - 25 years: $i_{25} = \frac{123}{t_c + 27}$

i = inches per hour

t_c = time of concentration

4. The Rational Method was used to determine the Peak flows:

Q = C i A

Q = Peak Flow in cfs.

C = Runoff Co-efficient.

i = Rainfall Intensity - inches per hour.

A = Drainage Area in Acres.

5. Coors Boulevard frontage will become commercial or industrial type development in the future. A composite runoff co-efficient of 0.80 has been developed for the total drainage area.

6. Standard Storm Sewer routing procedure was used to determine pipe size (See routing calculation forms).

BLUEWATER OUTFALL: It was determined that the existing outfall from Yucca to the Rio Grande has a capacity of 45 cfs (See computation sheets). The following two conditions have been used for outfall line size comparison:

1 Only storm water from the southern portion of Coors Boulevard, NW to be conveyed to the river, assuming no other storm sewer system exists.

2. Provide capacity to accommodate storm water from the southern portion of Coors Boulevard, NW plus existing storm drains in Bluewater. The existing storm sewer from Yucca is to be fully utilized.

LINE SIZE COMPARISON

STATION	#1*	#2**
0+00 - 2+00	24"	30"
2+00 - 2+60	24"	30"
2+60 - 8+35	30"	30"
8+35 - 19+50	36"	36"
19+50 - 24+00	30"	30"
24+00 - 28+00	24"	30"
28+00 - 30+20	24"	30"
30+20 - 62+00	48"	60"
62+00 - 68+00	48"	54"
68+00 - 70+00	48"	48"

* Sizes given are for an hypothetical sewer line required to drain Coors Boulevard.

** These sizes are for replacement lines and parallel lines required to drain Coors and maintain the capacity of the existing system.

STORM ANALYSIS: The 100 year - 6 hour rainfall was analyzed to measure the effect a severe storm would have on the project. Due to the flatness of the terrain in this area, peak flow routing is impossible to forecast with any accuracy. Drainage areas and ponding areas have been defined and a volumetric relationship established. Runoff volumes from drainage areas are compared to storage basin volumes to obtain overflow volumes.

Total rainfall for the 100 year - 6 hour storm is 2.2 inches ("Master Plan of Drainage - City of Albuquerque - 1963"). A composite runoff factor of 0.40 is representative for the area. Calculations for the volume of run-off are based on the following formula:

$$V = PRA$$

where

P = Total rainfall in feet (use $^{2.2}/12 = 0.1833$)

R = Rainfall runoff factor (use 0.40)

A = Area of watershed in sq. ft.

Plate III shows watersheds, ponding and overflow across Coors Boulevard. The point, south of Fortuna Road, where overflow is likely to occur is shown on Plate III. Presently, there is a low point or dip at that point. It should be emphasized that this condition will be improved by the proposed

system out that protection for the 100 year condition can not be justified. Given proper property development to the west little damage for the 100 year storm is anticipated. The proposed improvements will in no way increase the damage but will in fact mitigate that damage to a considerable degree.

CONCLUSIONS:

1. An underground storm sewer system is necessary to drain Coors Boulevard. The absence of outlet channels or routes make outfall lines to the Rio Grande necessary.

2. The elevation of the Vee ditch at the retaining wall is 5080, this is the lowest practical point of connection. Since the low point of the project at the Bluewater Intersection is 5083, the Vee ditch is too high at that point to drain the entire project. Therefore, two outlets are necessary.

3. Additional flow of 55 cfs to the Vee ditch along the ramp lines of the I-40 and Coors Boulevard Interchange will be fully utilized.

4. The Bluewater-Yucca-La Bajada outfall route will be used for the second outfall to the Rio Grande. Part of the existing outfall (Yucca to Rio Grande) has the capacity of 45 cfs.

5. It is probable that the 100 year - 6 hour storm will overtop Coors Boulevard at a point south of Fortuna. (See Plate III). At low points, a maximum of 33 feet wide and 670 feet long ponds will occur and will require approximately 1.5 hours to drain through the storm drain systems.

RECOMMENDATIONS:

Based on the foregoing, a preliminary system design has been developed and is recommended as follows:

1. Construct Collection System in Coors Boulevard to flow north from Cloudcroft Road (to west) to the existing Vee ditch on the east bound on ramp of I-40.

2. Construct Collection System in Coors Boulevard between Central and Cloudcroft draining to Bluewater Road, thence east along Bluewater, Yucca and La Bajada to the Rio Grande.

3. That funding participation agreements be developed based on function and comparative costs as contained in estimates shown herein and labeled Exhibit A.

LEVERTON - DENNEY ENGINEERS, Inc.
5543 Paradise Blvd., N.W.
Albuquerque, New Mexico 87114

area between sta. 105+00 to 110+00

North End To Vee Ditch

STORM SEWER SYSTEM

Q = C i A 1 acre = 43,560 ft.^{2}

Geographical Area --Albuquerque

Base i = 123 / 1+27

Roughness Coeff. n = 0.013

Storm Frequency = 25 yrs.

PIPE Station to Station	Inlet Station	Surface Drainage Length(Ft)	Surface Drainage Width (ft.)	Surface Drainage Area (Acres)	Coefficient of Runoff	Equivalent area (acres)	CA Total Equiv. Area	Time of Concentration (min.)	Rainfall Rate in/hr	Flow Rate ft^3/sec	Grade ft/ft	Diam. of pipe (in.)	Time of flow in pipe	Length of pipe (ft)	Capacity of Sewer Line
110+00 - 115+00	110+00	500	220	2.5	0.8	2.0	2.0	10	3.3	6.6	0.007	18	1.7	500	8.8
115+00 - 117+00	115+00	700	270	4.3	0.8	3.5	5.5	11.7	3.2	17.6	0.0015	36	1.0	200	25.8
117+00 - 122+75	117+00	300	Varies	3.7	0.8	2.9	8.4	12.7	3.1	26.0	0.0015	42	2.4	575	39.0
122+75 - 125+50	122+75	275	220	1.4	0.8	1.1	9.5	15.1	2.9	27.8	0.0015	42	1.0	275	39.0
125+50 - 128+00	125+50	275	270	1.7	0.8	1.4	10.9	16.1	2.9	31.1	0.0015	42	1.0	250	39.0
128+00 - 133+00	128+00	250	Varies	1.3	0.8	1.0	11.9	17.1	2.8	33.3	0.0015	42	2.1	500	39.0
133+00 - 137+00	133+00	500	Varies	2.8	0.8	2.2	14.1	19.2	2.7	38.1	0.0015	42	1.7	400	39.0
137+00 - 140+30	137+00	400	220	2.0	0.8	1.6	15.7	20.9	2.6	40.8	0.0015	42	1.4	330	~~55.6~~ 39.0
140+30 - 145+00	140+30	600	Varies	3.3	0.8	2.6	18.3	22.3	2.5	45.7	0.0015	48	2.0	470	55.6
145+00 - 7+50	145+00	200	270	1.2	0.8	1.0	19.3	24.3	2.4	46.3	0.0015	48	1.4	328	55.6
7+50	7+50	327	Varies	1.9	0.8	1.5	20.8	25.7	2.3	46.5	0.0015	48			55.6

where is pond drain?

LEVERTON-DENNEY ENGINEERS, INC.
5643 Paradise Blvd., N.W.
Albuquerque, New Mexico 87114

Bluewater (Coors to Yucca)

Base i = $\frac{123}{t+27}$ Storm Frequency = 25 yrs. **STORM SEWER SYSTEM** Q = C i A 1 acre = 43,560 ft² Geographical Area -- Albuquerque

Roughness Coeff. n = 0.013

Station to Station	Inlet Station	Surface Drainage Length (Ft)	Surface Drainage Width (ft.)	Surface Drainage Area (Acres)	Coefficient of Runoff	Equivalent area (acres)	CA Total Equiv. Area	Time of Concentration (min.)	Rainfall Rate in/hr	Flow Rate ft³/sec	Grade ft/ft	Diam. of pipe (in.)	Time of flow in pipe	Length of pipe (ft)	Capacity of Sewer Line
70+00 - 68+00							17.1	19.7		53.5	.0015	48	0.8	200	55
	68+00			9.3	0.5	4.7	21.8	20.5	2.5						
68+00 - 65+00										64.5		54	1.1	300	76
	65+00			4.9	0.5	2.5	24.3	21.6	2.5						
65+00 - 62+00										70.8	.0015	54	1.0	300	76
	62+00			13.1	0.5	6.6	30.9	22.6	2.5						
62+00 - 59+00									→	+4.0 87.3 91.3	.0015	60	1.0	300	101
	59+00			11.4	0.5	5.7	36.6	23.6	2.4						
59+00 - 57+00									→	+4.0 97.8 105.8	.002	60	0.7	200	116
	57+00			5.7	0.5	2.9	39.5	24.3	2.4						
57+00 - 47+50									→	+1.0 104.8 113.8	.002	60	3.1	950	116
				6.3	0.5	3.2	42.7	27.1	2.3						
									→	+1.0 106.2 114.8	.002	60			116
				50.7											
				72.00											

LEVERTON-DENNEY ENGINEERS, Inc.
5643 Paradise Blvd., N.W.
Albuquerque, New Mexico 87114

South End Coors - Bluewater Outfall

Base $i = \frac{123}{t+27}$ Storm Frequency = 25 yrs.

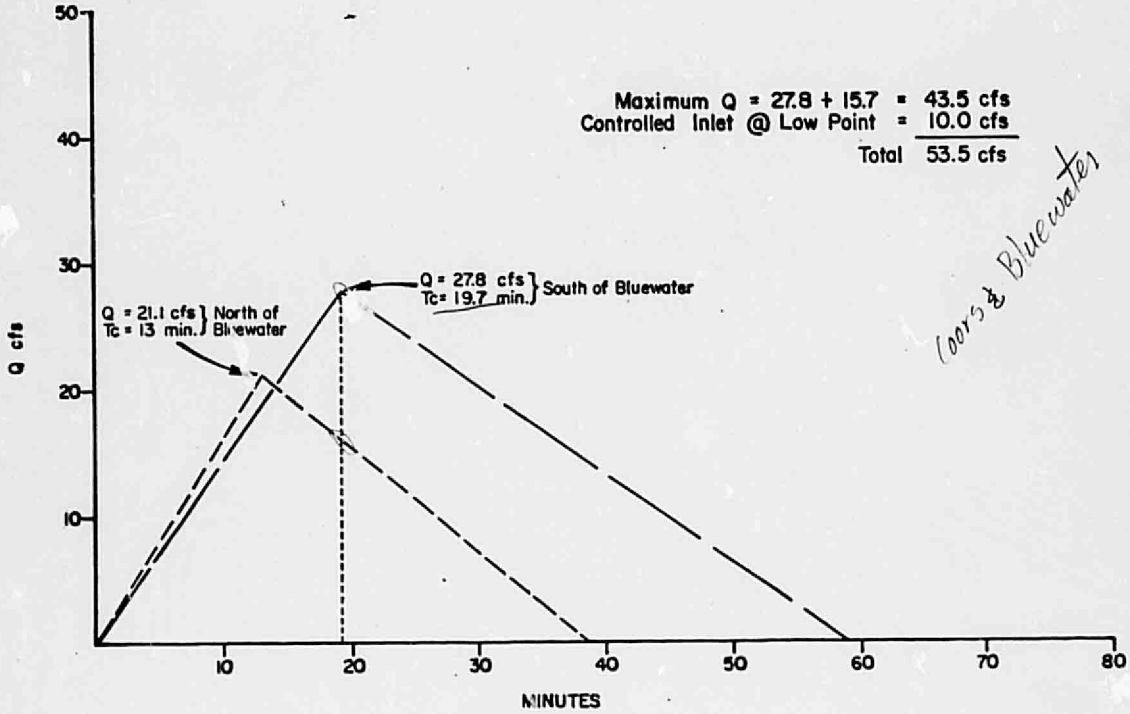
Roughness Coeff. n = 0.013

STORM SEWER SYSTEM

Q = C i A 1 acre = 43,560 ft.^{2}

Geographical Area -- Albuquerque

PIPE Station to Station (CENTRAL COORS)	Inlet Station	Surface Drainage Length (ft)	Surface Drainage Width (ft.)	Surface Drainage Area (Acres)	Coefficient of Runoff	Equivalent area (acres)	CA Total Equiv. Area	Time of Concentration (min.)	Rainfall Rate in/hr	Flow Rate ft^3/sec	Grade ft/ft	Diam. of pipe (in.)	Time of flow in pipe	Length of pipe (ft)	Capacity of Sewer Line
470+50 - 66+00	470+50	300	120	0.8	0.8	0.64	0.64	10	3.30	1.7	0.002	18	2	280	4.7
66+00 - 71+50	66+00	200	270	1.2	0.8	0.99	1.63	12	3.15	5.1	0.003	18	2	350	5.76
71+50 - 76+50	71+50	350	270	2.2	0.8	1.80	3.4	14	3.00	10.2	0.004	24	2	500	14.29
76+50 - 79+00	76+50	500	270	3.1	0.8	2.5	5.9	16	2.9	17.1	0.0132	24	.5	250	25.8
79+00 - 82+00	79+00	250	220	1.3	0.8	1.0	6.9	16.5	2.8	19.3	0.0033	30	1.0	300	23.5
82+00 - 84+00	82+00	500	220	2.5	0.8	20	8.9	17.5	2.8	34.9* / 24.9	0.005	36	.8	200	47.2
84+00 - 87+40	84+00	340	220	1.7	0.8	1.4	10.3	18.3	2.7	37.8* / 27.8	0.006	36	1.4	340	51.7
				South of Bluewater		Total Tc =		19.7	Total Flow =	31.8					
				12.8				* 10 cfs outside drainage instead of culvert							
99+25	100+00	500	220	2.5	0.8	2.0	2.0	10	3.30	6.6	0.0077	18	2.0	625	9.40
93+00 - 87+40	93+00	625	220	3.2	0.8	2.5	4.5	12	3.2	14.4	0.0263	18	1.0	560	20.0
	87+40	560	220	2.8	0.8	2.3	6.8	13	3.1	21.1					
				North of Bluewater		Total Tc =		13 minutes	Total Q =	21.1					
Bluewater Outfall - See Sheet															
				21.3											



HYDROGRAPHS
SOUTH COORS SYSTEM

LEVERTON-DENNEY ENGINEERS, Inc.
5643 Paradise Blvd., N.W.
Albuquerque, New Mexico 87114

R.C.P. CAPACITIES

n	Dia. (in.)	V / Q Scope (%) 0.15	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.3	1.5	2.6
0.013	18	2.30 4.06	2.66 4.70	3.26 5.76	3.76 6.64	4.20 7.42	4.60 8.13	4.97 8.78	5.32 9.40	6.78 11.98	7.28 12.86	9.58 16.93
0.013	24	2.79 8.77	3.22 10.12	3.94 12.38	4.55 14.29	5.09 15.99	5.58 17.53	6.02 18.91	6.44 20.23	8.21 25.79	8.82 27.71	11.61 36.47
0.013	30	3.24 15.90	3.74 18.36	4.58 22.48	5.28 25.92	5.91 29.01	6.47 31.76	6.99 34.31	7.47 36.67	9.53 46.78	10.23 50.22	13.47 66.12
0.013	36	3.65 25.80	4.22 29.83	5.17 36.54	5.97 42.20	6.67 47.15	7.31 51.67	7.89 55.77	8.44 59.66	10.76 76.06	11.56 81.71	15.21 107.51
0.013	42	4.05 38.97	4.68 45.03	5.73 55.13	6.61 63.60	7.39 71.10	8.10 77.93	8.75 84.18	9.35 89.96	11.92 114.68	12.81 123.25	16.86 162.21
0.013	48	4.43 55.67	5.11 64.21	6.26 78.67	7.23 90.85	8.08 101.54	8.85 111.21	9.56 120.13	10.22 128.43	13.03 163.74	14.00 175.93	18.43 231.60
0.013	54	4.79 76.18	5.53 87.95	6.77 107.67	7.82 124.37	8.74 139.00	9.58 152.36	10.34 164.45	11.06 175.90	14.10 224.25	15.14 240.79	19.94 317.13
0.012	60	5.57 109.37	6.43 126.25	7.87 154.53	9.09 178.48	10.16 199.49	11.13 218.54	12.02 236.01	12.85 252.31	16.38 321.62	17.60 345.58	23.17 454.94
0.012	66	5.93 140.89	6.85 162.74	8.39 199.33	9.68 229.98	10.83 257.30	11.86 281.77	12.81 304.34	13.70 325.49	17.46 414.82	18.75 445.47	24.69 586.59

Combined Flows

Q (From Coors Blvd.) = 53.5 cfs
Q (Bluewater Area) = 61.3 cfs
Q Total = 114.8 cfs

Existing Storm Sewer

24" R.C.P. Max. H @ Junction Box = 9 ft.

From Chart II - Inlet Control

Grooved Entrance $\frac{HW}{d} = \frac{9}{2.5} = 3.6$ $\frac{12}{2.5} = 4.8$

Q = 45 cfs

Use Q = 45 cfs Determine if Existing Storm Sewer has Capacity

0+00 – 0+60 d = 36" S = 0.0075
S½ = 0.0866

Assume Open Channel - Compute D (Depth of Flow)

$$K' = \frac{Qn}{D^{2.67} S^{0.5}} = \frac{(45)(0.013)}{(18.72)(.0866)} = 0.361$$

From Table 7-14

D/d = 0.663 ∴ D = 2.00 ft.

∴ 0+00 – 0+60 Q = Less Than Capacity & Head = 0

0+60 – 1+38 d = 36" S = 0.0075

Assume Open Channel - Compute D (Depth of Flow)

$$K' = \frac{(45)(0.013)}{(18.72)(.0866)} = 0.361$$

From Table 7-14

D/d = 0.663 ∴ D = 2.00 ft.

∴ 0+60 – 1+38 Q = Less Than Capacity & Head = 0

1+38 – 3+91 d = 30" S = 0.08903

Assume Open Channel – Compute D (Depth of Flow)

$$K' = \frac{(45)(0.013)}{(11.51)(0.298)} = 0.171$$

From Table 7-14

D/d = 0.42 ∴ D = 1.05 ft.

∴ 1+38 – 3+91 Q = Less Than Capacity & Head = 0

3+91 – 10+85 d = 30" S = 0.0197

Assume Open Channel – Compute D (Depth of Flow)

$$K' = \frac{(45)(0.013)}{(11.51)(0.140)} = 0.363$$

From Table 7-14

D/d = 0.667 ∴ D = 1.66 ft.

∴ 3+91 – 10+85 Q = Less Than Capacity & Head = 0

10+85 – 22+91 d = 42" S = 0.003283

Assume Open Channel – Compute D (Depth of Flow)

$$K' = \frac{(45)(0.013)}{(28.24)(0.0573)} = 0.362$$

From Table 7-14

D/d = 0.665 ∴ D = 2.33 ft.

∴ 10+85 – 22+91 Q = Less Than Capacity & Head = 0

22+91 - 30+20 d = 24" S = 0.06477

Assume Open Channel - Compute D (depth of Flow)

$$K' = \frac{(45)(0.013)}{(6.35)(.254)} = 0.362$$

From Table 7-14

$D/d = 0.665$ ∴ $D = 1.33$ ft.

∴ 22+91 - 32+16 Q = Less Than Capacity & Head = 0

Conclusion: The outfall line is running at less than capacity from 0+00 to 30+20 (Junction Box); therefore entrance conditions at the Junction Box controls flow. The maximum head in the junction box is 9 feet. At this head a maximum of 45 cfs can be conveyed to the Rio Grande leaving the balance 69.8 cfs to be conveyed by an additional new line.

Design of Additional line 0+00 – 30+20

Q design = 69.8 cfs Use 70 cfs

0+00 - 2+00

Try d = 30" S = 0.04

Assume Open Channel Flow – Compute D (Depth of Flow)

$$K' = \frac{(70)(0.013)}{(11.51)(0.2)} = 0.395$$

From Table 7-14

D/d = 0.71 ∴ D = 1.78 ft.

∴ 0+00 – 2+00 Q = Less Than Capacity & Head = 0

d = 30" O.K.

2+00 – 2+60

Try d = 30" S = 0.292

Assume Open Channel Flow – Compute D (Depth of Flow)

$$K' = \frac{(70)(0.013)}{(11.51)(0.54)} = 0.146$$

From Table 7-14

D/d = 0.386 ∴ D = 0.97

∴ 2+00 – 2+60 Q = Less Than Capacity & Head = 0

d = 30" O.K.

S = .076 $\frac{70}{.2757}$ = 253.899 27"

2+60 – 8+35

Try $d = 30''$ $S = 0.03$

Assume Open Channel Flow – Compute D (Depth of Flow)

$$K' = \frac{(70)(0.013)}{(11.51)(0.173)} = 0.456$$

From Table 7-14

$D/d = 0.810$ ∴ $D = 2.02$

∴ 2+60 – 8+35 Q = Less Than Capacity & Head = 0

$\underline{d = 30'' \text{ O.K.}}$ $\frac{70}{.1732} = 404.16$

8+35 – 19+50

Try $d = 36''$ $S = 0.002$

Assume Open Channel Flow – Compute D (Depth of Flow)

$$K' \frac{(70)(0.013)}{(18.72)(0.447)} = 1.09 \text{ – Greater Than Full Gravity Flow}$$

Full Flow Under Head - $d = 36''$

$$\frac{P_2}{W} + \frac{V_2^2}{2g} + Z_2 = \frac{P_1}{W} + \frac{V_1^2}{2g} + Z_1 + hf$$

$$P_1 = 0 \; ; \; V_2 = V_1 \; ; \; hf = 4.66 \frac{n^2 l Q^2}{d^{5.333}} \; ; \; Z_1 = 0$$

$$\frac{P_2}{W} + Z_2 = 4.66 \frac{n^2 l Q^2}{d^{5.333}}$$

$$\frac{P_2}{W} = 4.66 \frac{(0.013)^2 (1115)(70)^2}{350.47} - 2.25$$

$\frac{70}{.04472} = 1565.205$

$$\frac{P_2}{W} = \underline{10.03 \text{ ft.}}$$

∴ $d = 36''$ O.K. Flowing Full Under Head of 10 ft.

19+50 - 24+00

Try 30" S = 0.0367

Full Flow Under Head

$$\frac{P_3}{W} + \frac{V_3^2}{2g} + Z_3 = \frac{P_2}{W} + \frac{V_2^2}{2g} + Z_2 + hf$$

$$\frac{P_2}{W} = 10 \; ; \; V_3 = V_2 \; ; \; Z_2 = 0 \; ; \; Z_3 = 16.5$$

$$\frac{P_3}{W} + 16.5 = 10 + 4.66 \; \frac{(0.013)^2 (450)(70)^2}{132.54}$$

$$\frac{P_3}{W} = 6.63 \text{ ft.}$$

∴ d = 30" o.k. Flowing Full Under Head of 6.63 ft.

24+00 – 28+00 d = 30" S = 0.05375

Difference in elevation between 24+00 & 28+00 is 21.5. Assume backup over length "ℓ" then less than Capacity over length (400 - ℓ).

Solve for ℓ:

$$\frac{P_4}{W} + \frac{V_4^2}{2g} + Z_4 = \frac{P_3}{W} + \frac{V_3^2}{2g} + Z_3 + hf$$

$$P_4 = 0 \; ; \; V_4 = V_3 \; ; \; Z_3 = 0 \; ; \; Z_4 = .05375\,\ell \; ; \; \frac{P_3}{W} = 6.63$$

$$0.0537\,\ell = 6.63 + 4.66 \; \frac{(0.013)^2\,\ell\,(70)^2}{132.54}$$

$\ell = 269$ ft. $400 - \ell = 131$ ft.

∴ 26+69 – 28+00 is Flowing Less Than Capacity

Use 30" Diameter R.C.P.

28+00 – 30+20 $d = 30''$ $S = 0.0575$

Assume Open Channel Flow

$$K' = \frac{(70)(0.013)}{(11.51)(0.34)} = 0.329$$

From Table 7-14

$D/d = 0.62$ ∴ $D = 1.55$

∴ 28+00 – 30+20 is Flowing Less Than Capacity
Check Entrance Conditions For 30" R.C.P.

From Chart 2 : $\frac{HW}{D} = 3.2$

HW = 8 ft. O.K. Less Than Maximum of 9 ft.

Coors Drainage Only

$Q = 53.5$ cfs

0+00 - 2+00

Try 30" $S = 0.04$

Assume Open Channel Flow - Compute D (Depth of Flow)

$$K' = \frac{(53.5)(0.013)}{(11.51)(.2)} = 0.302$$

From Table 7-14

$D/d = 0.59 \therefore D = 1.48$

$\therefore$ Q = Less Than Capacity

Try 24" $S = 0.04$

$$\frac{P_2}{W_2} + \frac{V_2^2}{2g} + Z_2 = \frac{P_1}{W_1} + \frac{V_1^2}{2g} + Z_1 + hf$$

$$\frac{V_2^2}{2g} = \frac{V_1^2}{2g} \; ; \; P_1/W = 0 \; ; \; Z_1 = 0 \, , \; Z_2 = 8$$

$$\frac{P_2}{W} + 8 = 4.66 \; \frac{(0.013)^2 (200)(53.5)^2}{40.32}$$

$$\frac{P_2}{W} = 3.18$$

$\therefore$ d = 24" O.K. Flowing Full Under Head of 3.18

2+00 – 2+60

Try 24" $S = 0.292$

Difference in elevation between 2+00 & 2+60 is 17.5 feet, Assume backup over length "ℓ" then less than capacity over length $(60-\ell)$.

Solve for ℓ:

$$\frac{P_3}{W} + \frac{V_3^2}{2g} + Z_3 = \frac{P_2}{W} + \frac{V_2^2}{2g} + \frac{Z_2^2}{2g} + Z_2 + hf$$

$P_3 = 0$; $V_3 = V_2$, $Z_3 = S\ell$, $\frac{P_2}{W} = 3.18$

$Z_2 = 0$

$$0.292\,\ell = 3.18 + \frac{4.66\,(.013)^2\,\ell\,(53.5)^2}{40.32}$$

$\ell = 13.47$ feet $\quad 60 - \ell = 46.5$

$\therefore$ 2+13.47 – 2+60 is Flowing Less Than Capacity

Use 24" diameter R.C.P.

2+60 – 8+25

Open Channel – Full $\quad H = 0$

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2} \; ; \; AR^{2/3} = \frac{Qn}{1.486\,S^{1/2}}$$

$$AR^{2/3} = \frac{(535)(0.013)}{(1.486)(.173)} = 2.71$$

$$AR^{2/3} = 0.3117\, d^{8/3} = 2.71$$

$$d^{8/3} = 8.68$$

$d = 2.25$ Use $d = 2.5$ or 30"

8+35 - 19+50

Try 36" $S = 0.002$

$$\frac{P_2}{W} + Z_2 = \frac{P_1}{W} + Z_1 + hf$$

$P_1 = 0$; $Z_2 = 2.23$; $Z_1 = 0$

$$\frac{P_2}{W} + 2.23 = 4.66 \frac{(.013)^2 (11.15)(53.5)^2}{350.47}$$

$$\frac{P_2}{W} = 4.94$$

Use $d = 36"$ - Flowing Full Under 4.94 feet head

19+50 - 24+00

$d = 30"$ $S = 0.0366$

$$\frac{P_3}{W} + \frac{V_3^2}{2g} + S\ell = \frac{P_2}{W} + \frac{V_2^2}{2g} + 4.66 \frac{n^2 \ell Q^2}{d^{16/3}}$$

$$0.03667\,\ell = 4.94 + \frac{(4.66)(0.013)^2 \ell (53.5)^2}{132.54}$$

$$0.01966\,\ell = 4.94$$

$$\ell = 251$$

$\therefore$ 22+01 - 24+00 Will Run at Less Than Capacity

24+00 - 28+00 $S = 0.05375$

Try $d = 24''$

$$\frac{P_2}{W} + \cancel{\frac{V_2^2}{2g}} + Z_2 = \frac{P_1}{W} + \cancel{\frac{V_1^2}{2g}} + Z_1 + hf$$

$$\frac{P_1}{W} = 0 \; ; \; Z_1 = 0 \; ; \; Z_2 = 21.5$$

$$\frac{P_2}{W} + 21.5 = 4.66 \; \frac{(.013)^2 (400)(53.5)^2}{40.32}$$

$$\frac{P_2}{W} = 0.862 \text{ ft.}$$

$d = 24''$ O.K. Head @ 28+00 = 0.9 ft.

28+00 - 30+20

Try 24"

Entrance Conditions Will Control

From Chart 2: $\frac{HW}{D} = 4.5$

$\therefore HW = 9.0$ O.K.

King's Handbook 5th ed.

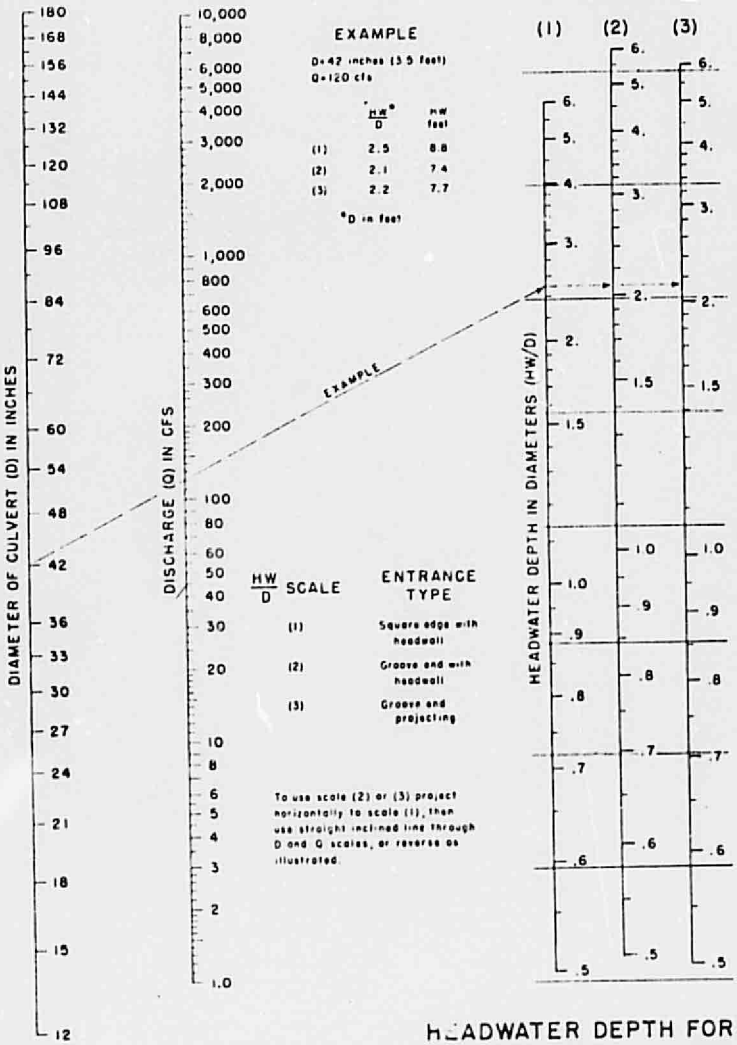
Table 7-14. Values of K' for Circular Channels in the Formula

$$Q = \frac{K'}{n} d^{8/3} S^{1/2}$$

D = depth of water d = diameter of channel

$\frac{D}{d}$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
.4	.1561	.1633	.1705	.1779	.1854	.1929	.2005	.2084	.2160	.2239
.5	.232	.239	.247	.255	.263	.271	.279	.287	.295	.301
.6	.311	.319	.327	.335	.343	.350	.358	.366	.373	.380
.7	.388	.395	.402	.409	.416	.422	.429	.435	.441	.447
.8	.453	.458	.463	.468	.473	.477	.481	.485	.488	.491
.9	.494	.496	.497	.498	.498	.498	.498	.494	.489	.483
1.0	.463									

CHART 2



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN 1963

EXHIBIT A

PRELIMINARY ESTIMATES

April, 1975

COORS BOULEVARD

STORM SEWER

PRELIMINARY ESTIMATE

ITEM	QUANTITY	UNIT PRICE	AMOUNT
NORTH END: (Common to Both Estimates)			
15" RCP	1350 LF	12.00	16,200.00
18" RCP	650 LF	20.00	13,000.00
36" RCP	200 LF	32.00	6,400.00
42" RCP	2330 LF	40.00	93,200.00
48" RCP	2074 LF	42.00	87,108.00
Manholes 4' Dia.	3 EA	450.00	1,350.00
Manholes 6' Dia.	10 EA	850.00	8,500.00
Inlets Type "C"	25 EA	850.00	21,250.00
Inlets Type Dbl. "C"	2 EA	1,200.00	2,400.00
Inlets Type "D"	1 EA	1,000.00	1,000.00
Outfall Structure	1 EA	5,000.00	5,000.00
Remove & Replace Curb & Gutter, Sidewalk, Utilities	L.S.	10,000.00	10,000.00
	Sub Total		265,408.00
SOUTH END: (Common to Both Estimates)			
15" RCP	1400 LF	12.00	16,800.00
18" RCP	1915 LF	20.00	38,300.00
24" RCP	750 LF	24.00	18,000.00
30" RCP	300 LF	28.00	8,400.00

ITEM	QUANTITY	UNIT PRICE	AMOUNT
36" RCP	540 LF	32.00	17,280.00
Manholes 4' Dia.	2 EA	450.00	900.00
Manholes 6' Dia.	6 EA	850.00	5,100.00
Inlets Type "C"	20 EA	850.00	17,000.00
Inlets Type Dbl "C"	2 EA	1,200.00	2,400.00
Inlets Type "D"	1 EA	1,000.00	1,000.00
Junction Box	1 EA	3,200.00	3,200.00
Total			128,380.00
TOTAL COORS BOULEVARD			$393,788.00

BLUEWATER ROAD OUTFALL. (Combined - Bluewater Area & Coors Blvd)

48" RCP	200 LF	45.00	9,000.00
54" RCP	600 LF	57.00	34,200.00
60" RCP (Over 15' deep)	3180 LF	114.00	362,520.00
30" RCP	1905 LF	30.00	57,150.00
36" RCP	1115 LF	33.50	37,352.50
Manholes 4' Dia.	5 EA	450.00	2,250.00
Manholes 6' Dia.	10 EA	1,600.00	16,000.00
Junction Boxes	9 EA	3,200.00	28,800.00
Canal Crossings	1 EA	11,000.00	11,000.00
Outfall Structure	1 EA	4,000.00	4,000.00

REMOVE AND REPLACE:

Pavement	85500 SF	0.95	81,225.00
Curb & Gutter	2300 LF	4.50	10,350.00
Sidewalk	1300 SY	9.25	12,025.00

ITEM	QUANTITY	UNIT PRICE	AMOUNT
8" Sani Sewer	350 LF	8.25	2,887.50
4' Manholes	10 EA	450.00	4,500.00
Connect existing inlets	15 EA	450.00	6,750.00
Total Outfall			680,010.00
TOTAL PROJECT			$1,073,798.00
Contingencies @ 5%			53,689.90
GRAND TOTAL			$1,127,487.90

April, 1975

COORS BOULEVARD

STORM SEWER

PRELIMINARY ESTIMATE

ITEM	QUANTITY	UNIT PRICE	AMOUNT
NORTH END: (Common to Both Estimates)			
15" RCP	1350 LF	12.00	16,200.00
18" RCP	650 LF	20.00	13,000.00
36" RCP	200 LF	32.00	6,400.00
42" RCP	2330 LF	40.00	93,200.00
48" RCP	2074 LF	42.00	87,108.00
Manholes 4' Dia.	3 EA	450.00	1,350.00
Manholes 6' Dia.	10 EA	850.00	8,500.00
Inlets Type "C"	25 EA	850.00	21,250.00
Inlets Type Dbl. "C"	2 EA	1,200.00	2,400.00
Inlets Type "D"	1 EA	1,000.00	1,000.00
Outfall Structure	1 EA	5,000.00	5,000.00
Remove & Replace Curb & Gutter, Sidewalk, Utilities	L.S.	10,000.00	10,000.00
	Sub Total		265,408.00
SOUTH END: (Common to Both Estimates)			
15" RCP	1400 LF	12.00	16,800.00
18" RCP	1915 LF	20.00	38,300.00
24" RCP	750 LF	24.00	18,000.00
30" RCP	300 LF	28.00	8,400.00

ITEM	QUANTITY	UNIT PRICE	AMOUNT
36" RCP	540 LF	32.00	17,280.00
Manholes 4' Dia.	2 EA	450.00	900.00
Manholes 6' Dia.	6 EA	850.00	5,100.00
Inlets Type "C"	20 EA	850.00	17,000.00
Inlets Type Dbl "C"	2 EA	1,200.00	2,400.00
Inlets Type "D"	1 EA	1,000.00	1,000.00
Junction Box	1 EA	3,200.00	3,200.00
Total			128,380.00
TOTAL COORS BOULEVARD			$393,788.00

BLUEWATER ROAD OUTFALL: (Coors Boulevard Only)

48" RCP	200 LF	45.00	9,000.00
48" RCP	600 LF	52.00	31,200.00
48" RCP (Over 15' deep)	3180 LF	100.00	318,000.00
24" RCP	880 LF	26.50	23,320.00
30" RCP	1025 LF	30.00	30,750.00
36" RCP	1115 LF	33.10	36,906.50
Manholes 4' Dia.	5 EA	450.00	2,250.00
Manholes 6' Dia.	10 EA	1,600.00	16,000.00
Junction Boxes	9 EA	3,200.00	28,800.00
Canal Crossings	1 EA	11,000.00	11,000.00
Outfall Structure	1 EA	4,000.00	4,000.00

REMOVE AND REPLACE:

Pavement	78500 SF	0.95	74,575.00
Curb & Gutter	2100 LF	4.50	9,450.00
Sidewalk	1200 SY	9.25	11,100.00

ITEM	QUANTITY	UNIT PRICE	AMOUNT
8" Sani Sewer	350 LF	8.25	2,887.50
4' Manholes	10 EA	450.00	4,500.00
Total outfall			613,739.00
TOTAL PROJECT			1,007,527.00
Contingencies @ 5%			50,376.00
GRAND TOTAL			$1,057,903.00