

Storm Drainage Plan ¹⁹⁷⁵ and Program for the Town of Bernalillo



Middle Rio Grande Council of Governments of New Mexico

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STORM DRAINAGE
PLAN AND PROGRAM
FOR THE
TOWN OF BERNALILLO, NEW MEXICO

This Storm Drainage Plan and Program was prepared by the Town of Bernalillo with the assistance of the Middle Rio Grande Council of Governments of New Mexico, and the technical services of Molzen-Corbin and Associates, Inc., Consulting Engineers, through the cooperation of the New Mexico State Planning Office, and funded in part by a Locality Planning Assistance (Section 701) grant from the U.S. Department of Housing and Urban Development.

July 14, 1975

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TABLE OF CONTENTS

<u>PART</u>		<u>PAGE</u>
I	INTRODUCTION.	1
II	SUMMARY	2
III	PLAN AND PROGRAM.	8
IV	PRELIMINARY ENGINEERING	23

LIST OF FIGURES

<u>FIGURE</u>		<u>PAGE</u>
1	Areas Vulnerable to Flooding and Storm Drainage Treatment Areas.	4
2	Surface Flow Time Curves.	25
3	Rainfall Intensity Duration	26
4	Nomograph for Computing Size of Circular Drain.	27

APPENDIX A - Major Storm Drainage Problems in the
Bernalillo Area

APPENDIX B - Location and Preliminary Design of Drainage
Improvements

PREFACE

The work documented in this report is part of the comprehensive and functional planning and programming being conducted by the Bernalillo Town Council and its various citizen task forces assisted by the Middle Rio Grande Council of Governments staff under a Locality Planning Assistance (LPA) Grant funded by the U. S. Department of Housing and Urban Development.

The program is designed to provide local officials with a capacity for planning, managing, and evaluating long range development programs for their community. The LPA program is a logical extension of the areawide comprehensive planning program conducted by the Middle Rio Grande Council of Governments (COG). The COG program of cooperative decision making by local member governments in the area provides a framework for the formulation of long range functional plans and programs by each individual community.

As part of its Overall Program Design, the COG Board of Directors made the COG staff available to furnish community planning services to local communities as requested. Under the COG arrangement, COG staff functions in a supportive role providing technical services, making recommendations, assembling data, and drafting and publishing the various planning documents. Decisions and directions on policy for the planning activities requested are the responsibility of the governing body of the community. Functional plans are developed by Citizen Task Forces, supported by COG staff members. Each task force's work is reviewed by the governing body prior to adoption. Under this system, the entire planning process is conducted under the guidance of local officials and citizens. The community is also assisted in developing management systems in such areas as codes, ordinances, and administrative procedures necessary to implement the functional plans and ensure programmatic continuity.

A major goal of the COG is to encourage orderly and properly distributed development in the area and the improvement and standardization of local government management and control procedures. The LPA program serves as an excellent mechanism for accomplishing this goal.

PART I

INTRODUCTION

This document presents a plan and program for storm drainage management by the Town of Bernalillo. It is part of the comprehensive and functional planning and programming being carried out by the elected officials of Bernalillo, their staff, and their various citizen task forces. Assistance in this planning and programming has been provided by staff of the Middle Rio Grande Council of Governments. In addition, special supportive technical and professional engineering services have been provided by the firm of Molzen-Corbin and Associates.

Previously prepared storm drainage documents have contributed essential information and direction to this latest plan and program document. The Bernalillo Development Statement (LPA Report No. 1) established an information base and community guidance policies regarding various planning elements to be undertaken by citizen task forces. Part VIII of the Development Statement dealt with storm drainage. The appointed task force began with the basic information given there as a means of developing a more comprehensive approach to storm drainage management in the Bernalillo area.

The work of the task force resulted in publication of the Storm Drainage Management Guidelines document (LPA Report No. 2), which is the first of two volumes on this planning element. Volume II is this Storm Drainage Plan and Program. Together, these two documents provide the necessary information from which local officials can develop specific courses of action on storm drainage projects.

PART II

SUMMARY

The principal source of excessive runoff within the Bernalillo area is from the Sandia Mountains to the east of the Town. This area is currently under study by the U.S. Department of Agriculture, Soil Conservation Service. The study will result in a plan and program and eventual implementation of the resulting recommendations to alleviate the majority of the flood hazard caused by the runoff from the mountains. Since this is a significant factor in the flooding of the Town of Bernalillo, it is recommended that S.C.S. complete the study and implement retardant measures as soon as possible.

In addition to the major drainage problem cited above, additional drainage problems exist within the Town and surrounding area. The Bernalillo storm drainage planning area for which this plan and program was developed is shown in FIGURE 1. There are three apparent causes for the major flooding and ponding which occurs within the areas of concern. These are: (1) inadequate control of runoff from the Sandia Mountains east of Interstate Highway I-25; (2) inadequate ditches and drainage openings; and, (3) inadequate drainage outfall facilities.

Problems in the area are amplified by the relatively flat terrain which gently slopes from northeast to southwest. Some drainage discharge is provided by irrigation, drainage and street ditches, and culverts. However, because of the flat terrain, velocity of flow in the ditches is low, resulting in silting and clogging of the available ditches. It is for this reason that maintenance of existing and proposed facilities is vitally important to the success in alleviating flooding problems.

Recommended project actions for alleviating the identified problems and gaining relief for affected residents include outfall ditches, culverts, storm sewers and reconstruction of

existing ditches to serve as main discharge facilities. These facilities will also serve as collectors for area improvements to complete an overall drainage plan. Therefore, at such time as construction plans are developed, the individual areas should be planned with lateral ditches or storm sewers as dictated by the particular area.

The storm drainage planning area is divided into six sub-areas designed as major storm drainage problem areas. These areas, as designated in FIGURE 1, are as follows:

- Area I Bernalillo Acequia
- Area II Area between Acequia and AT&SF
and II(A) railroad tracks
- Area III Industrial park
- Area IV Lady of Sorrows channel
- Area V Downtown neighborhood A
- Area VI Downtown neighborhood B

In addition to these areas, there are isolated ponding areas, generally adjacent to or near ditches and canals, which create infrequent problems for some properties.

Detailed comments on each of these areas, covering problem description, existing drainage facilities, apparent reasons for problems and possible alternative measures are contained in Part II of this document.

The following is a summary by area of recommended actions to alleviate the flooding problems and estimated costs of these improvements. APPENDIX B shows the location and suggested preliminary design of the improvements. Alternative recommendations and costs are also provided, where appropriate, in Part II. These alternatives, in general, include concrete lining of the acequia and irrigation ditches and storm sewers in lieu of open ditches.

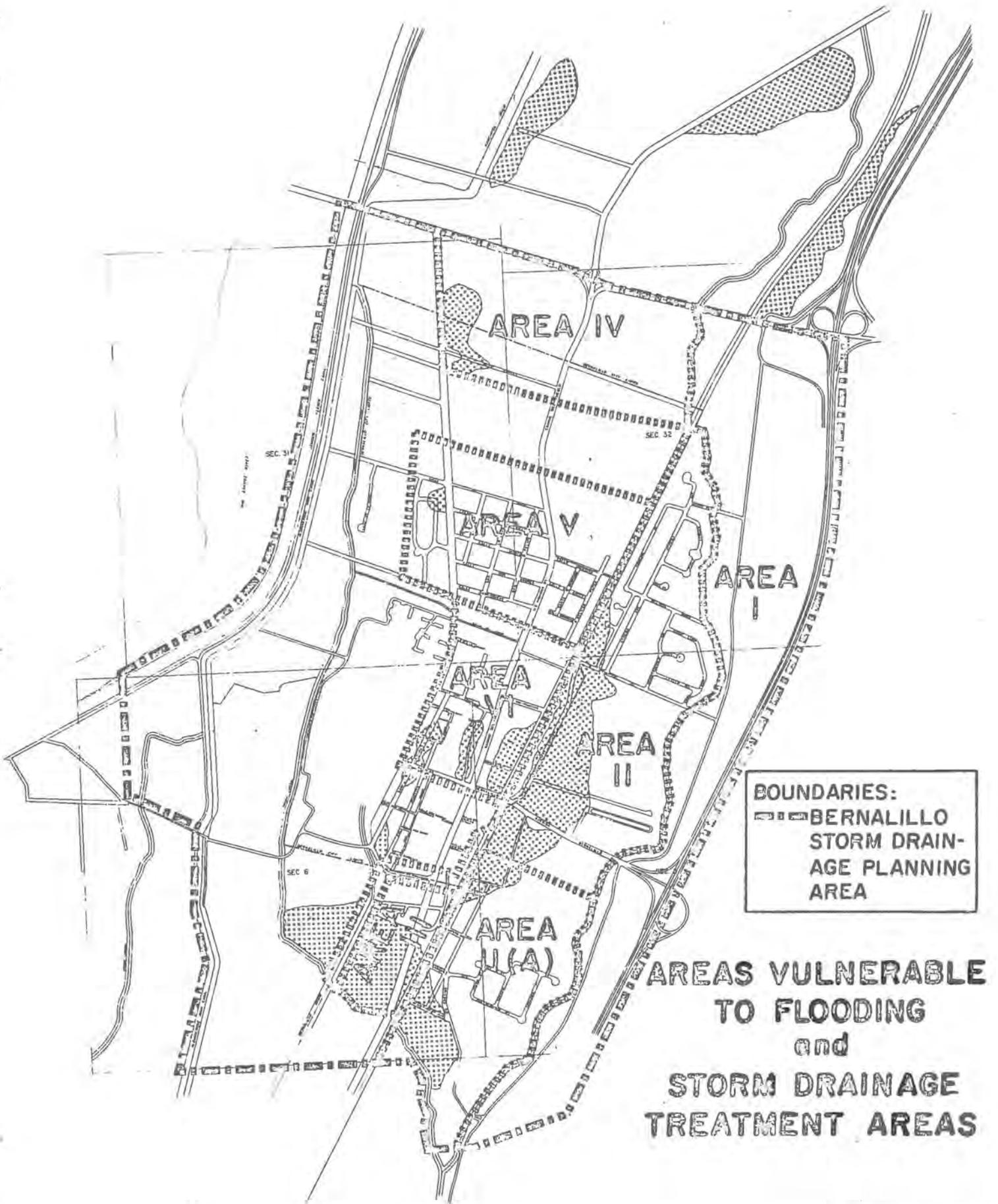


FIGURE 1

Consequently, the costs for these alternatives are considerably higher. These alternatives should be considered, especially if the Town is contemplating construction of a storm sewer system or where, for various unforeseen reasons, open ditches are not considered by the Town to be the most appropriate solution to the problem.

Area I. Bernalillo Acequia

Project actions: Reconstruct acequia and spoil bank dike on west bank.

Replace present crossings (bridges) with slabs to provide unobstructed openings the same as reconstructed acequia.

Estimated cost: \$246,595

Area II and II(A). Area between acequia and AT&SF railroad tracks

Project actions: Clean channel of Bernalillo Interior Drain.

Construct drainage ditch, including necessary culvert and storm sewer, along Calle del Bosque and AT&SF railway north.

Construct drainage ditch, including necessary culverts along AT&SF railway south and west to Bernalillo Interior Drain.

Estimated cost: \$126,672

Area III. Industrial park area

Project actions: Complete current project.

Flood-proof building.

Estimated cost: None beyond current program.

Area IV. Lady of Sorrows channel

Project actions: Construct drainage ditch and storm sewer from Camino del Pueblo to Riverside Drain.

Estimated cost: \$80,220

Area V. Downtown neighborhood A

Project actions: Construct drainage ditch and 30-inch storm sewer along east side of Calle Don Tomas and a 42-inch storm sewer west along Calle del Banco under Sandia Acequia to Albuquerque Main Canal.

Estimated cost: \$201,120

Area VI. Downtown neighborhood B

Project actions: Construct drainage ditch along east boundary of N. M. Timber Co. from Calle del Banco to Bernalillo Interior Drain, and clean drain to join work of Area III.

Construct storm sewer along Avenida Bernalillo from AT&SF railroad west to proposed ditch near San Lorenzo.

Estimated cost: \$42,414

The total cost of the six area projects is summarized as follows:

Area I	\$246,595	Area IV	\$ 80,220
Area II	126,672	Area V	201,120
Area III	-0-	Area VI	<u>42,414</u>
		TOTAL	\$654,541

Implementation and Funding

Because of the diverse land and facilities ownership in the Bernalillo area, implementation of this plan and program will require a cooperative effort among several local and State governmental entities and agencies, primarily the Town of Bernalillo, Middle Rio Grande Conservancy District, New Mexico State Highway Department, and Sandoval County. Although each of these governmental units would not be involved in the provision of the improvements in all of the sub-areas, each should be aware of how their participation affects the success of the total program.

It is important to note also that this plan and program has been developed to the greatest extent possible to allow for phased implementation. Consequently, it is not necessary that all of the funding required be available at the same time, but rather that as limited resources become available, portions of the program can be implemented.

Potential resources which could be utilized in the provision of the improvements identified in this plan and program include those of the Federal, State and local governments. These include the following:

U. S. Department of Commerce - Job Opportunities Program and
EDA Public Works Impact Program

U. S. Department of Housing and Urban Development - Housing
and Community Development Act of 1974

Four Corners Regional Commission

New Mexico State Highway Department

Town of Bernalillo - General Revenue Sharing and General
Obligation Bonds

Middle Rio Grande Conservancy District

Competition for available resources is always strong and, consequently, funds for this purpose may not be readily available.

One final point which should be considered is that maintenance of the improvements has not been included in the estimated costs. It is estimated that the majority of this cost could be covered by existing resources, especially immediately after implementation. However, maintenance of the facilities over time should be considered and provided for as it is more economical to provide periodic maintenance as needed than to substantially rehabilitate the facility at some point in the future when it is only marginally serviceable.

PART III

PLAN AND PROGRAM

In order to develop objectives for a functional plan and program, consistent with community goals and the management guidelines established earlier, the storm drainage task force worked to narrow the major problem areas for potential development. Six major areas were identified. Summaries of how the task force viewed the problems, their apparent causes, the effectiveness of existing drainage facilities (if any), and possible alternative solutions were prepared for guidance in the process of developing the specific project plans. These area summaries are found in the Appendix to this document.

Given the basic evaluations and alternatives, the consulting engineer was asked to provide professional services to the task force in the form of storm runoff calculations, preliminary designs for facilities, and cost estimates by treatment area. From this detailed engineering data, a basis for decision making by local officials is more accurately laid whereby adequate storm drainage management facilities can be implemented.

The engineering assessment of the areas and the recommended actions necessary to meet the drainage demands are given below. Cost estimates are included, consisting of two options for some area improvements, i.e., choice of earth ditches and culverts or concrete lined ditches, storm sewers and culverts. The foldout map indicates the relative location of the various treatment areas.

At the present time, the Soil Conservation Service is preparing a work plan that includes the area with which this report is concerned. This S.C.S. work plan deals in part with three areas of specific concern to Bernalillo. These areas are as follows: The first is just south of Avenida Bernalillo; another approximately 2200 feet south of Avenida Bernalillo and the third, 4400 feet north of Avenida Bernalillo. This

S.C.S. work plan does not deal with three 36" culverts and two 36" culverts located approximately 180 and 960 feet north of Avenida Bernalillo. These culverts do not have controlled discharge outlets and carry runoff in large quantities toward the Bernalillo Acequia and, depending on the quantity of storm waters, cause flooding in the area.

The priority of the S.C.S. project for this area is such that it will be a minimum of six to ten years before actual construction of storm water retention facilities could begin. The possibility exists, however, that because of the urgency of controlling storm waters originating in the Sandias, a project could be funded at an earlier date than is presently anticipated.

In regard to the facilities controlled by the Middle Rio Grande Conservancy District, such as acequias and drains, the District has indicated that it is not opposed to allowing the use of these facilities for the purpose of discharging storm water runoff. There are, however, MRGCD requirements with respect to the quality of and method used to introduce storm waters into District facilities, necessitating review and approval of plans by the Conservancy District before permits are issued.

In considering implementation of any capital improvement project, operating and maintenance costs should be considered as a part of the total project cost. This consideration should be of foremost importance during the planning stages of the project and available means of financing such costs should be explored and identified. Estimates of operating and maintenance costs are not made a part of this report, as the estimates presented herein are for construction planning and programming purposes only.

A summary of estimates for recommended and alternate solutions are presented as follows:

SUMMARY OF ESTIMATES

<u>Area</u>	<u>A</u> <u>Recommended</u>	<u>B</u> <u>Alternates</u>
I	\$246,595	\$609,787
II	101,292	242,632
II (A)	25,380	139,980
IV	80,220	80,220 *
V	201,120	201,120 *
VI	42,414	42,414 *
	<u>\$697,021</u>	<u>\$1,316,153</u>

*There are no alternate recommendations for these areas; therefore, the cost estimates are the same as column A.

1. Estimate A - Proposed improvements consisting of earth ditches, culverts, and where necessary, storm sewers.

2. Estimate B (alternates) - Proposed improvements consisting of lined ditches and storm sewers.

Area I-Bernalillo Acequia

This area is bounded on the east by Interstate 25, on the west by the Bernalillo Acequia, on the north by State Road 44 and on the south by the Sandia Indian Reservation. This area is occupied by small industry, campgrounds and mobile homes with approximately one half of the area undeveloped.

Runoff in this area originates in the foothills of the Sandias to the east of the Town and drains west under Interstate 25 toward the Bernalillo Acequia. There is a 50 CFS controlled discharge facility capable of discharging a one hundred year storm within 48 hours located east of I-25 at the northern extremity of this area, and was constructed as the result of recommendations contained in a 1955 Soil Conservation Service (S.C.S.) Work Plan. This 1955 study recommended a second structure to be constructed approximately midpoint between the two Bernalillo I-25 interchanges and would be of the same type as the existing facility.

At present the Bernalillo Acequia has a capacity of 225 CFS which is of insufficient size to carry the potential runoff from the Sandias. As a result, breaching of the spoil bank on the west side of the acequia causes flooding in the area west of the acequia. The Bernalillo Acequia was designed for primary use as an irrigation ditch and as a result has limited potential in its current condition to carry storm water runoff. The following subsection contains recommendations which would enhance the capacity of the acequia to the extent necessary to effectively carry storm waters from a one hundred year storm.

With reference to the flow of storm water through culverts beneath Interstate 25 just north of the south Bernalillo Interchange, it should be noted that the New Mexico State Highway Department, acting on a request from the Sandoval County Board of County Commissioners, had begun a project which, if completed, would have provided a measure of protection to the residents of the area. After construction had begun, however, right-of-way problems developed

and the project was abandoned. It now appears that the right-of-way problems could be eliminated by moving the proposed discharge to the north. This relocation proposal has been called to the attention of the N.M.S.H.D. District III Engineer, and the District is receptive to renewing work on this drainage outlet if a request is received from the Sandoval County Board of County Commissioners.

Recommendations - Reconstruction of the Bernalillo Acequia to a ten foot bottom, one and one half to one slope for approximately two miles north from the junction of Bernalillo Acequia with Sandia Acequia, reconstructing the spoil banks to the west of the Acequia in a continuous earth dike to the west.

Replace present crossings with flat slabs to provide unobstructed openings the same as the reconstructed acequia.

Reconstruct Avenida Bernalillo by raising the grade at Bernalillo Acequia to permit the construction of a dike on the west side of the acequia.

Cost Estimates - In order to accomplish the recommendations, it is estimated that between \$246,595 and \$609,787 will be required, depending upon the manner in which channelization is to be finished. The Estimate of Cost I-A is for earth channel and Estimate of Cost I-B is for lined channel.

ENGINEER'S PRELIMINARY ESTIMATE OF COST
FOR AREA I ESTIMATE OF COST "A"

<u>Item No.</u>	<u>Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	
1.	Excavation, including shaping & compacting new and existing spoil banks.	5833	C.Y.	\$ 3	\$17,499
2.	Cut, burn or remove weeds.	1	Lot	L.S.	5,400
3.	Channel Crossing Structure - 36 foot Roadway.	1	Ea.	43200	43,200

4.	Channel Crossing Structure - 20 foot Roadway.	1	Ea.	24000.00	24,000.00
5.	Channel Crossing Structure - 16 foot Roadway.	5	Ea.	19200.00	96,000.00
6.	Road Excavation	1200	C.Y.	1.50	1,800.00
7.	Bituminous Base, 6-inch Hot Mix.	940	Ton	11.00	10,340.00
8.	Bituminous Surface 4 inch.	600	Ton	11.30	6,780.00
9.	Prime	1190	Gal.	0.32	380.80
10.	Tack	300	Gal.	0.32	96.00
	Sub-Total				\$205,495.80
	Engineering & Contingencies				<u>41,099.16</u>
	Total				\$246,594.96

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ENGINEER'S PRELIMINARY ESTIMATE OF COST FOR AREA I
ESTIMATE OF COST "B"

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>UNIT</u>	<u>UNIT PRICE</u>	<u>EXTENSION</u>
1.	Channel Lining	32,853	S.Y.	\$ 10.50	\$344,956.50
2.	Channel Crossing Structure - 36 foot Roadway	1	EA.	43200.00	43,200.00
3.	Channel Crossing Structure - 20 foot Roadway	1	EA.	24000.00	24,000.00
4.	Channel Crossing Structure - 16 foot Roadway	5	EA.	19200.00	96,000.00
	Sub-Total				\$508,156.00
	Engineering & Contingencies				<u>101,631.20</u>
	TOTAL				\$609,787.20

AREA II - East of A.T. & S.F. Railroad Tracks

This area is bounded on the south at the point where the railroad spur takes off from the main line approximately 900 feet south of Avenida Bernalillo, on the north and east by the Bernalillo Acequia and on the west by the A.T.&S.F. Railroad Mainline. Outfall from this area drains to the Bernalillo Interior Canal, which is proposed to be reconstructed to receive this outfall along with the outfall from the facilities proposed for Area V. Drainage from the north of the railroad spur and along in the area adjacent to the Bernalillo Interior Drain would be improved by the ditch along the north side of the railroad spur. Drainage in the area north of the Bernalillo Interior Drain would also be improved by the ditches serving as outfall for the two areas.

The existing drainage structures in this area consist of pipe culverts along Avenida Bernalillo at property entrances and a 24-inch pipe across Avenida Bernalillo, which is above the flow line of the present ditch and clogged entrances to the pipes.

Runoff from this area consists of flow from the area east of Bernalillo Acequia which breaches the west spoil bank of Bernalillo Acequia during high rainfall and resulting high runoff periods, and runoff from rainfall within the area.

When the high rainfall periods may occur is impossible to predict. With the possible implementation of the recommendations contained in the work plan of S.C.S., the discharge from the Sandia Mountains will not be considered in the recommended solutions for this area. Other measures, including zoning and flood insurance, for this area should be explored so as to minimize the damages caused by storm water runoff. Implementation of the recommendations for Area I will afford this area some relief from high rainfall east of Interstate Highway I-25.

Recommendations - Recommended improvements for this area include the cleaning of the channel of the Bernalillo Interior Drain from the intersection of the drain and Sandia Acequia, north to the A.T. &S.F. railroad spur near the south end of Calle Placitas; construction of a drainage ditch along the north side of the A.T.&S.F. railroad spur to the A.T.&S.F. railroad main line, then in a northeasterly direction under the A.T.&S.F. railraod main line through a culvert pipe to the east side of the railroad; construction of a drainage ditch north along the east side of the railroad to Avenida Bernalillo; installation of a culvert pipe under Avenida Bernalillo, north 800 feet in a drainage ditch, continuing north 1200 linear feet in a storm sewer. This will permit ditches and/or storm sewer to be constructed and/or installed in the area east and north of the recommended drainage outfall as required by present development or future construction.

Cost Estimates - The construction of the recommended improvements can be done adequately for an estimated cost of \$101,292 as shown in Estimate of Cost II-A. This work is primarily for construction of a drainage ditch. Should a storm sewer be considered more desirable than a ditch, the accomplishment of the recommendations would cost \$244,632, as shown in Estimate of Cost II-B.

ENGINEER'S PRELIMINARY ESTIMATE OF COST FOR AREA II
ESTIMATE OF COST "A"

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>UNIT</u>	<u>UNIT PRICE</u>	<u>EXTENSION</u>
1.	Excavation	4200	C.Y.	\$ 1.50	\$ 6,300
2.	Rehabilitate Existing Bernalillo Interior Drain	1600	L.F.	10.00	16,000
3.	42 inch Storm Sewer Pipe	1200	L.F.	35.00	42,000
4.	48 inch Culvert Pipe	70	L.F.	33.00	2,310

5.	48 inch Storm Sewer Pipe Jacked under Railroad & Highways	220	L.F.	70.00	15,400
6.	Reinforced Concrete Inlet	3	EA.	800.00	2,400
	Sub-Total				\$84,410
	Engineering & Contingencies				<u>16,882</u>
	TOTAL				\$101,292

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ENGINEER'S PRELIMINARY ESTIMATE OF COST FOR AREA II
ESTIMATE OF COST "B"

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>UNIT</u>	<u>UNIT PRICE</u>	<u>EXTENSION</u>
1.	Excavation	1000	C.Y.	\$ 1.50	\$ 1,500
2.	Rehabilitate Existing Bernalillo Interior Drain	1600	L.F.	10.00	16,000
3.	42 inch Storm Sewer Pipe	2200	L.F.	35.00	77,000
4.	48 inch Storm Sewer Pipe	2180	L.F.	42.00	91,560
5.	48 inch Storm Sewer Pipe Jacked Under Railroad & Highway	220	L.F.	70.00	15,400
6.	Reinforced Concrete Inlet	3	EA.	800.00	2,400
	Sub-Total				\$203,860
	Engineering & Contingencies				<u>40,772</u>
	TOTAL				\$244,632

The recommendations and cost estimates given above are for the major portion of Area II. For purposes of setting priorities and for making the accomplishment of drainage improvements more manageable, Area II(A) was designated and treated separately. The specific recommendations and costs for II(A) are given below.

AREA II(A) - East of A.T. & S.F. Railroad Tracks

This area is bounded on the west by the A.T. & S.F. railroad, on the east by the Bernalillo Acequia, on the south by the Sandia Acequia and on the north by a line originating at the point where the A.T. & S.F. railroad spur intersects the mainline of the A.T. & S.F. and running east at a right angle from the mainline to the Bernalillo Acequia.

The drainage structures in this area consist of a 24" culvert pipe under Highway U.S. 85 approximately 250 feet north of Sandia Acequia. The runoff is from the area between the Bernalillo Acequia and the Bernalillo Interior Drain and from Sandia Acequia to the A.T. & S.F. Railroad spur and the line of the spur extended east to the Bernalillo Acequia.

Recommendations - Construction of a drainage ditch along the east side of the A.T. & S.F. railroad from the railroad spur south to approximately 250 feet north of Sandia Acequia, then west under the A.T. & S.F. railroad track and U. S. Highway 85 in a culvert pipe, then west in a drainage ditch to the Bernalillo Interior Drain.

Cost Estimates - Construction of the ditch and necessary structures is estimated at \$25,380 as shown in Estimate of Cost II(A)-A. The ditch will be adequate to accomplish the desired protection for the area. Should a storm sewer be considered more desirable, the cost would be substantially higher as shown in Estimate of Cost II(A)-B.

ENGINEER'S PRELIMINARY ESTIMATE OF COST FOR AREA II(A)
ESTIMATE OF COST "A"

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>UNIT</u>	<u>UNIT PRICE</u>	<u>EXTENSION</u>
1.	Excavation	4500	C.Y.	\$ 1.50	\$ 6,750
2.	42 Inch Storm Sewer Jacked under A.T. & S.F. Railroad and U.S. 85	120	L.F.	70.00	8,400

3.	Inlets	8	Ea.	600.00	4,800
4.	Outlet Structure at Bernalillo Interior Drain	1	Ea.	1200.00	1,200
	Sub-Total				21,150
	Engineering & Contingencies				<u>4,230</u>
	TOTAL				\$25,380

* * * * *

ESTIMATE OF COST "B"

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>UNIT</u>	<u>UNIT PRICE</u>	<u>EXTENSION</u>
1.	Excavation	500	C.Y.	\$ 1.50	\$ 750
2.	42 Inch Storm Sewer	2900	L.F.	35.00	101,500
3.	42 Inch Storm Sewer Jacked under A.T. & S.F. Railroad and U.S. 85	120	L.F.	70.00	8,400
4.	Inlets	8	Ea.	600.00	4,800
5.	Outlet Structure	1	Ea.	1200.00	1,200
	Sub-Total				\$116,650
	Engineering & Contingencies				<u>23,330</u>
	TOTAL				\$139,980

AREA III. Industrial Park

The Industrial Park is the area bounded on the west and south by the Sandia Acequia, on the east by U.S. 85, and on the north by the northern boundary of the right-of-way of the A.T. & S.F. railroad spur.

A project is now under construction to install water and wastewater lines, sewage lift station, curb and gutter, bituminous pavement and storm sewer.

This project when completed should provide flood protection for the area; however, future buildings should be constructed above potential high water until such time as all recommended drainage improvements in other areas are completed.

AREA IV - The Lady of Sorrows Channel

This area is bounded on the east by the Bernalillo Acequia, on the west by Calle Don Tomas, on the north by State Road 44, and on the south by a line just south of the 20th street right-of-way.

There is an existing concrete ditch from the west side of Camino Del Pueblo extending 412 feet to the west. Drainage then flows to the west in a ditch on the north side of the traveled way, which is 20th street, to Calle Don Tomas. At this point the drainage turns to the north in the east ditch along Calle Don Tomas. However, the flow line of the ditch to the north has very little fall and is inadequate for positive flow.

Calle Don Tomas is practically flat from 20th Street south for a distance of approximately 1200 feet. Calle Del Norte is approximately 1800 feet south of 20th Street. The possible grade on a ditch or storm sewer along Calle Don Tomas, south from Del Norte to the Bernalillo Interior Drain is approximately 0.20 percent. This grade is not adequate for positive flow, and therefore, is not acceptable to drain the ditch on 20th street from the concrete ditch near Our Lady of Sorrows Church north or south on Calle Don Tomas.

Recommendations - Construction of an earth drainage ditch from the west and of the concrete ditch west from Camino Del Pueblo to the east side of the traveled way on Calle Don Tomas, then to continue drainage from west of the traveled way on Calle Don Tomas to the west in a storm sewer under the Sandia Acequia and the Albuquerque Main Canal to discharge into the Riverside Drain.

There is apparently no particular concern with flooding or ponding in the area west of Calle Don Tomas; however, the proposed storm sewer west from Calle Don Tomas would provide relief for the immediate area adjacent to the storm sewer, should future building increase the runoff to such an extent that relief would be desirable.

Cost Estimate - The following Estimate of Cost provides for the implementation of the necessary ditch and storm sewer to insure protection for the area.

ENGINEER'S PRELIMINARY ESTIMATE OF COST FOR AREA IV

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>UNIT</u>	<u>UNIT PRICE</u>	<u>EXTENSION</u>
1.	Excavation	1600	C.Y.	\$ 1.50	\$ 2,400
2.	42 Inch Storm Sewer	1190	L.F.	35.00	41,650
3.	42 Inch Storm Sewer Jacked under Ditches	290	L.F.	70.00	20,300
4.	Inlets	3	Ea.	600.00	1,800
5.	Outlet Structure	1	Ea.	700.00	700
	Sub-Total				66,850
	Engineering & Contingencies				<u>13,370</u>
	TOTAL				\$80,220

AREA V. Downtown Neighborhood Ponding A

This area is bounded on the east by the A.T. & S.F. railroad tracks, on the west by Calle Rio Grande, on the south by Calle Del Banco and on the north by a line midway between Calle Del Norte and 20th Street.

Most of this area is included in a paving project and most of the streets have been paved but drainage facilities were not installed.

Recommendations - Construction of a drainage ditch along the east side of Calle Don Tomas, from midway between Calle Del Norte and 20th Street, south to approximately 300 feet south of Calle Del Norte; then construct a 30 inch storm sewer continuing on the east side of Calle Don Tomas to Calle Del Banco, then continuing with a 42 inch storm sewer west along Calle Del Banco under Sandia Acequia to the Albuquerque Main Canal.

Cost Estimate - The following Estimate of Cost provides for the necessary drainage ditches and storm sewer to provide adequate protection for the area.

ENGINEER'S PRELIMINARY ESTIMATE OF COST FOR AREA V

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>UNIT</u>	<u>UNIT PRICE</u>	<u>EXTENSION</u>
1.	Excavation	1800	C.Y.	\$ 1.50	\$ 2,700
2.	30 Inch Storm Sewer	1900	L.F.	29.00	55,100
3.	42 Inch Storm Sewer	2400	L.F.	35.00	84,000
4.	42 Inch Storm Sewer Jacked under Ditches	290	L.F.	70.00	20,300
5.	Inlets	8	Ea.	600.00	4,800
6.	Outlet Structure	1	Ea.	700.00	700
	Sub-Total				\$167,600
	Engineering & Contingencies				<u>33,520</u>
	TOTAL				\$201,120

AREA VI. Downtown Neighborhood Ponding B

This area is bounded on the south by Avenida Bernalillo, on the east by the A.T. & S.F. railroad tracks, on the west by New Mexico Timber Company property line and on the north by Calle Del Banco.

Plans for Phase I, Paving and Drainage Plan, dated 1973, cover part of this area. These plans provide for pavement, ditches and culverts. The pavement has been constructed but not the ditches and culverts. Drainage flow is to the west and south.

Recommendations - Construct a drainage ditch along the east boundary of the New Mexico Timber Company property from south of Calle Del Banco, south to the beginning of the Bernalillo Interior Drain, just north of the A.T. & S.F. railroad spur, which connects to the recommended improvement for Area II.

Construct storm sewer along the north side of Avenida Bernalillo from just west of the A.T. & S.F. railroad west to the proposed ditch west of San Lorenzo.

This proposed construction will provide outfall for the area and discharge from storm drainage and/or any ponding at such time as adequate local ditches or culverts are provided.

Cost Estimate - The following Estimate of Cost provides for the necessary drainage ditches, storm sewers and outfall facilities to provide adequate protection for the area.

ENGINEER'S PRELIMINARY ESTIMATE OF COST FOR AREA VI

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>UNIT</u>	<u>PRICE</u>	<u>EXTENSION</u>
1.	Excavation	2500	C.Y.	\$ 1.50	\$ 3,750
2.	24" Storm Sewer	1430	L.F.	16.50	23,595
3.	Inlets	10	Ea.	800.00	8,000
	Sub-Total				\$ 35,345
	Engineering & Contingencies				7,069
	TOTAL				\$ 42,414

Isolated Ponding Areas

Isolated ponding areas within the limits of the Town of Bernalillo or in the outlying areas, not covered by the principal areas, are in general adjacent to or near a ditch or canal. In general, these areas may be drained by the construction of ditches and/or culverts into the ditch or drain. In each case, the junction with the ditch or canal must be planned in accordance with the requirements of the Middle Rio Grande Conservancy District as to the quality of water to be discharged into the ditch or drain and the angle of entrance.

PART IV

PRELIMINARY ENGINEERING

This part of the Storm Drainage Plan and Program document presents the preliminary engineering cross sections for the work recommended in Part II. The cross section sheets include sufficient data from which more detailed designs can be developed and from which construction work can be undertaken. The criteria by which the preliminary engineering was done is given below.

Criteria:

Runoff: 25 year frequency, Technical Paper No. 40
Rainfall Frequency Atlas of the United States.

Basis of Design for Drainage Structure and Drainage Ditches:

$Q = CIA$ (Rational Formula)

$Q = A \times \frac{1.486}{n} \times R^{2/3} \times S^{1/2}$ (Manning)

$V = \frac{1.486}{n} \times R^{2/3} \times S^{1/2}$ (Manning)

$C = .90$ Paved Areas

$C = .30$ Unpaved Areas

T_c = Time of Concentration determined from nomograph using length of flow and difference in elevation between crest and inlet.

Drainage areas consist of paved and ground areas.

Culvert Pipe Sizes determined from nomograph for computing required size of circular drain flowing full $n = .012$

$n = 0.013$ $n = .012$ used.

FIGURE I - Time of Concentration, Length of Flow and Slope of Terrain

FIGURE II - Rainfall Intensity Duration

FIGURE III - Culvert Sizes for $n = .013$ & $.012$

Procedure:

Selection of Rainfall Frequency of 25 years, enter Chart 12 Page 19, Technical Paper No. 40, Rainfall Frequency Atlas of the

United States, with the result of 1.7 inches per hour for the Bernalillo Area.

Determine the number of acres in the area to be drained by the ditch, culvert pipe or storm sewer.

Determine the difference in elevation, between the crest and the flow line at outfall, and the length of flow. Divide the difference in elevation by the length of flow to determine the grade, feet per one hundred feet, or feet per foot.

Select the Runoff Coefficient. If more than one, which is the usual case, prorate the area of each coefficient and determine the acreage coefficient.

i.e. paved area .90, 50% paved
unpaved area .30, 50% unpaved
 $(.50 \times .90) + (.50 \times .30) = .60$ equals C.

From figure determine the T_c , time of concentration, from the nomograph or computer from:

$$T = 1.8 \frac{(1,1-C) \sqrt{D}}{3 \sqrt{S}}$$

T = Time of Concentration

D = Difference in elevation flowline and crest

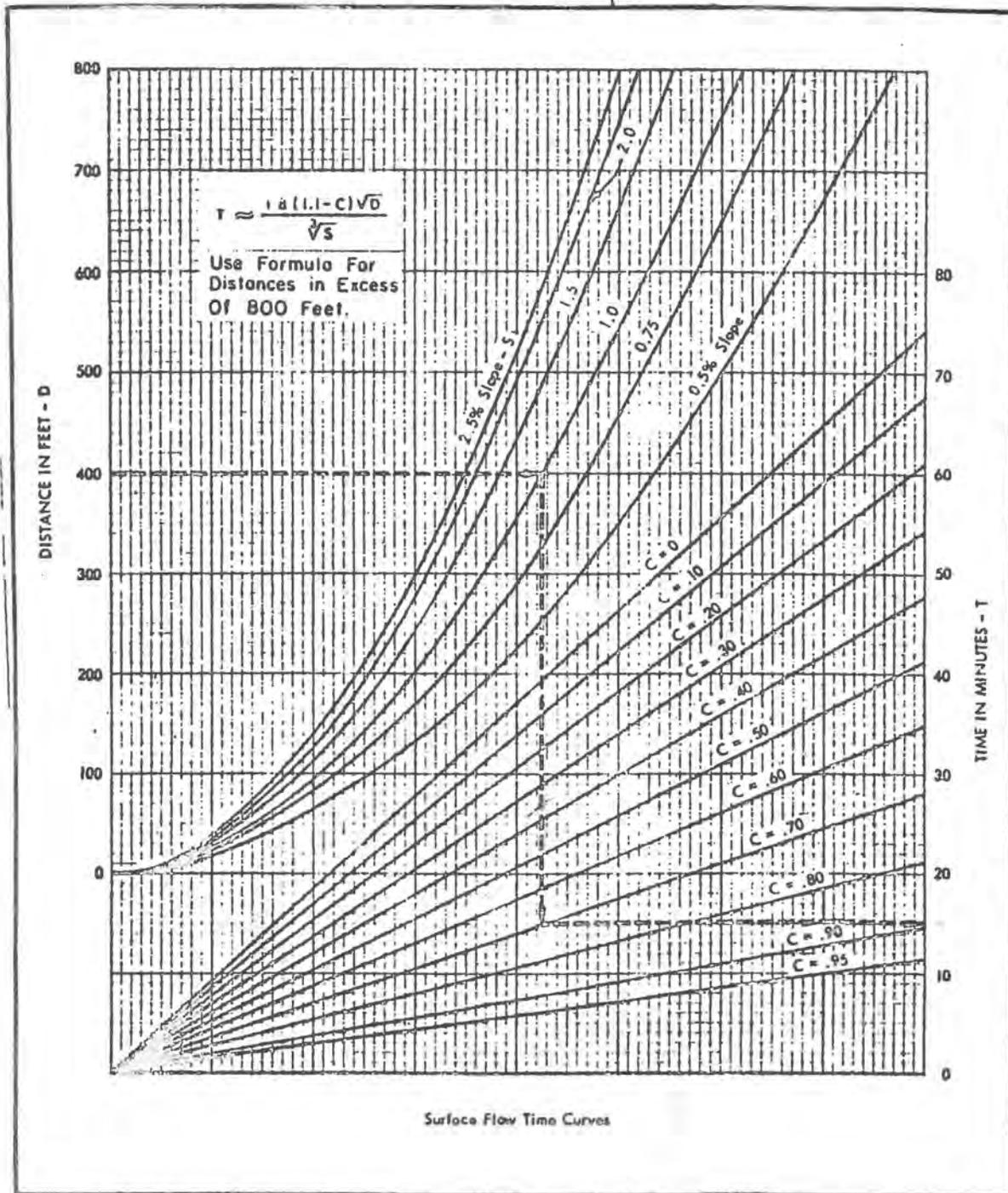
S = Slope, feet per one hundred feet

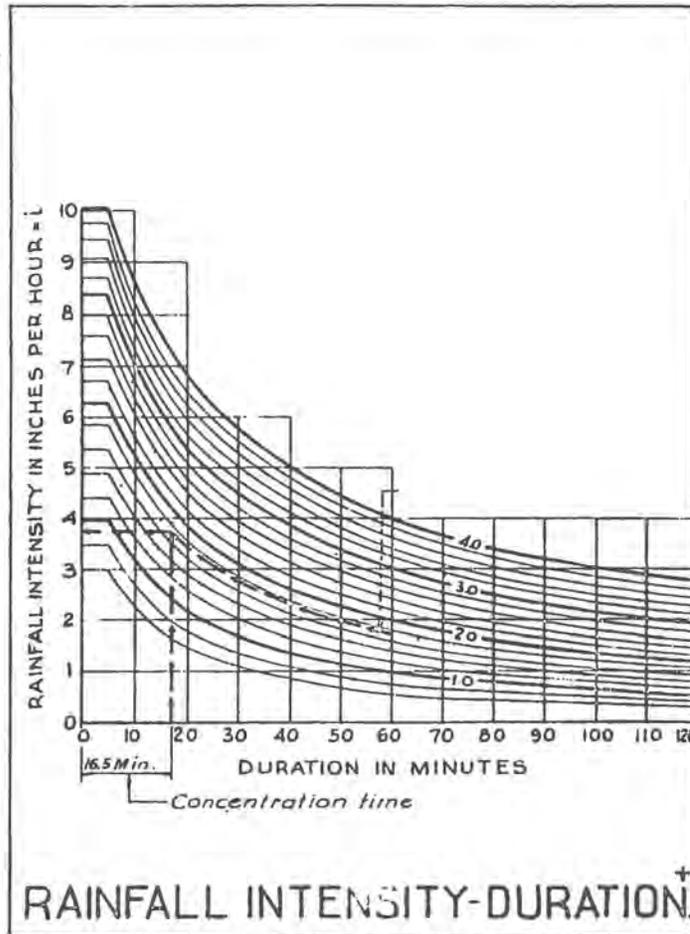
Enter FIGURE II with T_c and rainfall intensity to determine rainfall intensity at maximum runoff, i.e., time of concentration.

From $Q = CIA$ determine discharge Q by substituting values of C, roughness coefficient, I, intensity of rainfall, A, area drained in acres.

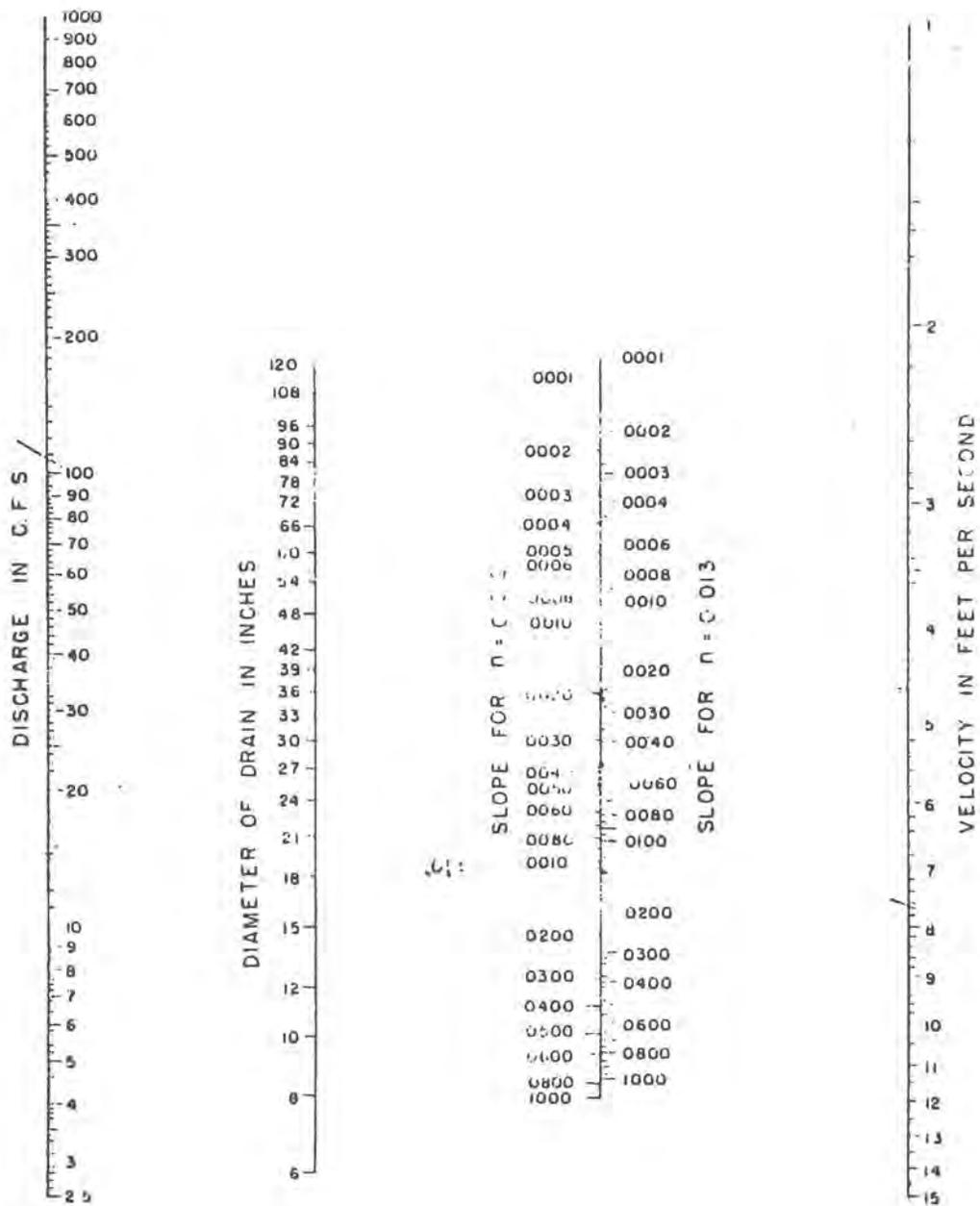
Select a channel size, substitute values in Mannings Formula to determine Q, capacity of channel. Cut and try until channel size is sufficient for runoff as determined from the rational formula.

For culvert on storm sewer, enter FIGURE IV with required Q, available slope to determine pipe size.





* Adapted from *Miscellaneous Publication NO. 204, U.S. Dept. of Agriculture* by David L. Yarnell.
 † Adapted from *Engineering Manual of the War Department*, July, 1942.



Nomograph for computing required size of circular drain, flowing full - $n = 0.012$ or 0.013

APPENDIX A
MAJOR STORM DRAINAGE PROBLEMS
in the
BERNALILLO AREA

June 1974

APPENDIX A

AREA I - BERNALILLO ACEQUIA

Problem Description: Potential breaching of the Bernalillo Acequia, located east of the Town limits, exists along the western bank. Breaching of the Acequia at indeterminable points along its length results in the inundation of much of the developed area west of the acequia to the A.T. & S.F. railroad tracks. Water and silting damage occur in the developed area. This area essentially becomes the flood plain for the acequia.

Existing Drainage Facilities - Earth levee, composed of material dredged from the acequia, Bernalillo Acequia, and arroyos entering the acequias.

Apparent Reason for Problem: The Bernalillo Acequia intercepts runoff from the Sandia foothill area. When the acequia exceeds its capacity, due to intercepted flow and silting, overflow occurs. Road crossings at intervals along the acequia may collect floating material, resulting in reduced ditch capacity.

Possible Alternative Measures:

1. Develop a flood wall along the west bank of the acequia to contain foothill runoff and protect the developed area.
2. Increase capacity of the existing acequia, to provide a multiple purpose use, for irrigation and flood control from the foothills.
3. Construct retention dams and provide land treatment measures east of Interstate 25, to reduce flow to the acequia. Probably a long range solution.
4. In order to limit flow into the acequia, provide crossing points for certain arroyos and direct their flows west to the river.
5. Provide spillways for overflow of the acequia and channel overflow to the river.

AREAS II & II(a) - EAST OF A.T. & S.F. RAILROAD TRACKS

Problem Description: The area east of the A.T. & S.F. railroad tracks, north and south of Avenida Bernalillo, collects and ponds direct rainfall and runoff from the area gently sloping from the Bernalillo Acequia. First floor elevations of buildings in the area are generally below the high water lines, consequently extensive damage results from the ponded water.

Existing Drainage Facilities: Ditches run west along the north and south side of Avenida Bernalillo to the railroad tracks. Several culverts along the north ditch are crushed. A single 24" culvert passes under Avenida Bernalillo. A ditch continues south along the railroad tracks.

Apparent Reason for Problem: The areas north and south of Avenida Bernalillo along the east side of the A.T. & S.F. are natural ponding areas. The railroad track embankment establishes a barrier to drainage to the west. The single 24" culvert beneath Avenida Bernalillo is inadequate to drain ponded water across Avenida Bernalillo and south. Direct rainfall as well as drainage from the north and east contribute to the ponding hazard. As the Bernalillo Acequia is susceptible to breaching or overflow when channel capacity is reached, this area becomes a flood plain of the acequia. Local streets are graded higher than adjacent properties. Thus, the streets act as barriers to runoff, resulting in ponding in bordering lots.

Possible Alternative Measures:

1. Provide increased culvert capacity beneath Avenida Bernalillo to drain area north of this roadway.
2. Provide a network of channels in the developed area to reduce "sheet flow" and route runoff toward outlet culverts.
3. Improve major collection channel adjacent to A.T. & S.F. railroad tracks, in order to reduce ponding and provide effective drainage of the area.
4. Provide necessary culverts across A.T. & S.F. railroad embankment.

AREA III - INDUSTRIAL PARK SITE

Problem Description: Ponding of storm water occurs in the area of the Industrial Park site, west of U.S. 85 and south of the Town.

Existing Drainage Facilities: Ditch located north of the site from U.S. 85 west to the Bernalillo Drain.

Apparent Reason for Problem: The site is a natural low lying area, bounded on the south and west by embankments of the Middle Rio Grande Conservancy District ditches and on the east by the U.S. 85 embankment.

Possible Alternative Measures:

1. Evacuate the industrial park site and utilize it as a ponding area, for temporary retention of runoff from other portions of the developed area.
2. Flood proof existing and future buildings and other facilities in the Industrial Park Site.
3. Provide drainage channels to intercept runoff to the site and provide minor channels or storm sewers to drain the industrial park site from direct rainfall and local runoff.

AREA IV - OUR LADY OF SORROWS CHANNEL

Problem Description: Ponding occurs west of the vicinity of Our Lady of Sorrows school and church. Generally, the area north of 20th Street and east of Don Tomas becomes flooded. Water will also stand on U.S. 85 in the vicinity of the church and school.

Existing Drainage Facilities: Concrete channel running 400' westward from U.S. 85, continuing as an earth ditch for 1000' turning north along Don Tomas and terminating 100' north of the intersection of Don Tomas and 20th St. Pavement and gutter along U.S. 85.

Apparent Reasons for Problem: Runoff drains south and north along U.S. 85 toward the concrete channel. Runoff then drains west but tends to backup and overflow, due to the termination of the ditch.

Possible Alternative Measures:

Extend Our Lady of Sorrows Channel to Don Tomas. Construct storm sewer across Don Thomas west to Riverside drain.

AREAS V & VI DOWNTOWN NEIGHBORHOOD PONDING AREAS A & B

Problem Description: Ponding occurs in certain neighborhood areas within the Town. In particular, ponding occurs along San Felipe and along San Lorenzo at Calle Del Bosque, at Avenida Bernalillo, at Calle Don Pedro, and near Calle Del Norte. Because of numerous unpaved streets throughout the area, travel is difficult during periods of heavy rainfall. As streets are paved, drainage of water along streets must be controlled so that low lying lots adjacent to the streets do not experience additional flooding.

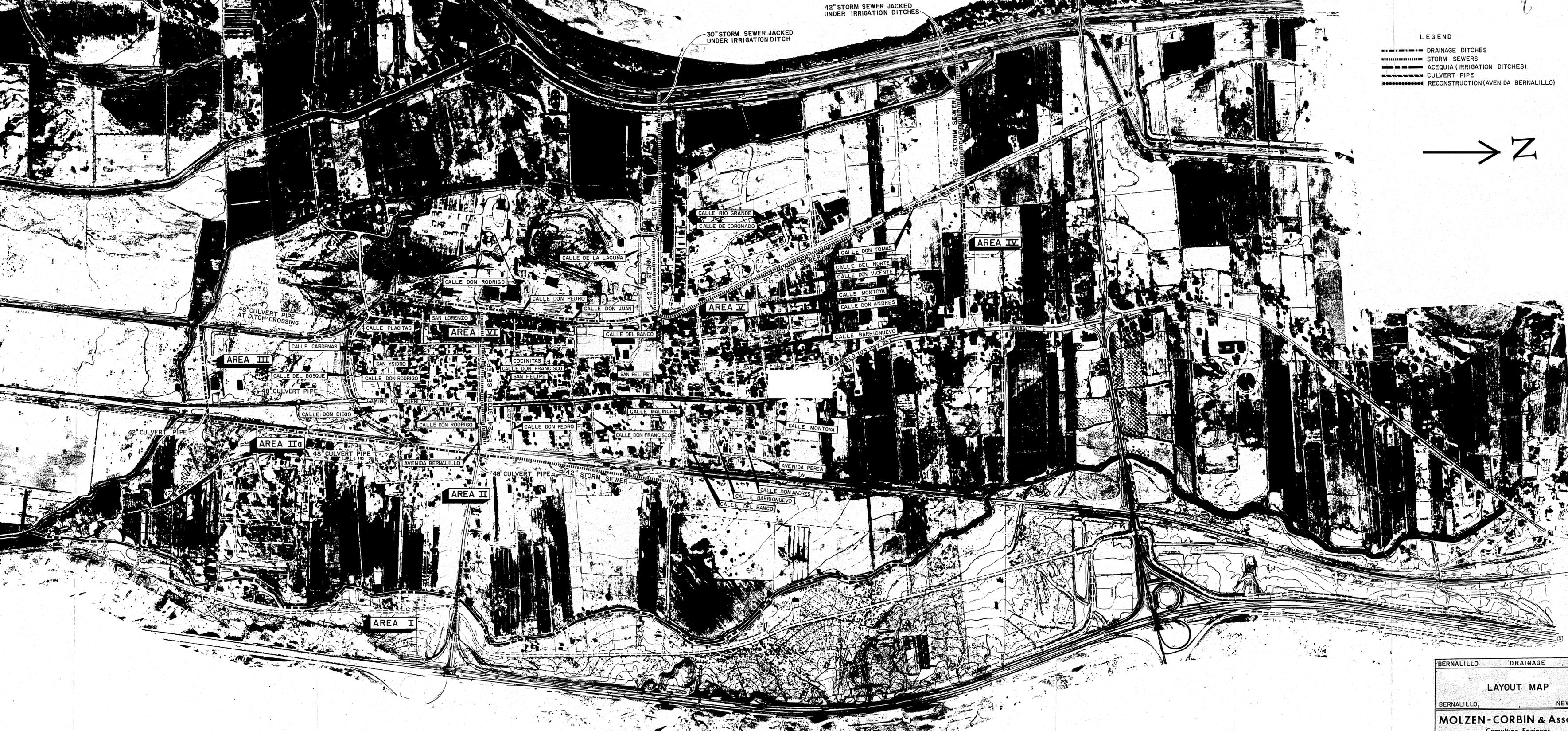
Existing Drainage Facilities: Discontinuous ditches along Don Tomas.

Apparent Reasons for Problem: Ponding is essentially a result of direct rainfall and runoff from adjacent lots or streets to lower lying areas.

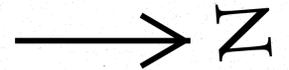
Possible Alternative Measures: Construct a ditch along the length of San Lorenzo and Don Tomas midway between Del Norte and 20th Street, routing storm water to the Bernalillo and Riverside drains. Provide minor channels or gutters and culverts along side streets in the area to direct the flow of runoff to the new ditch.

APPENDIX B

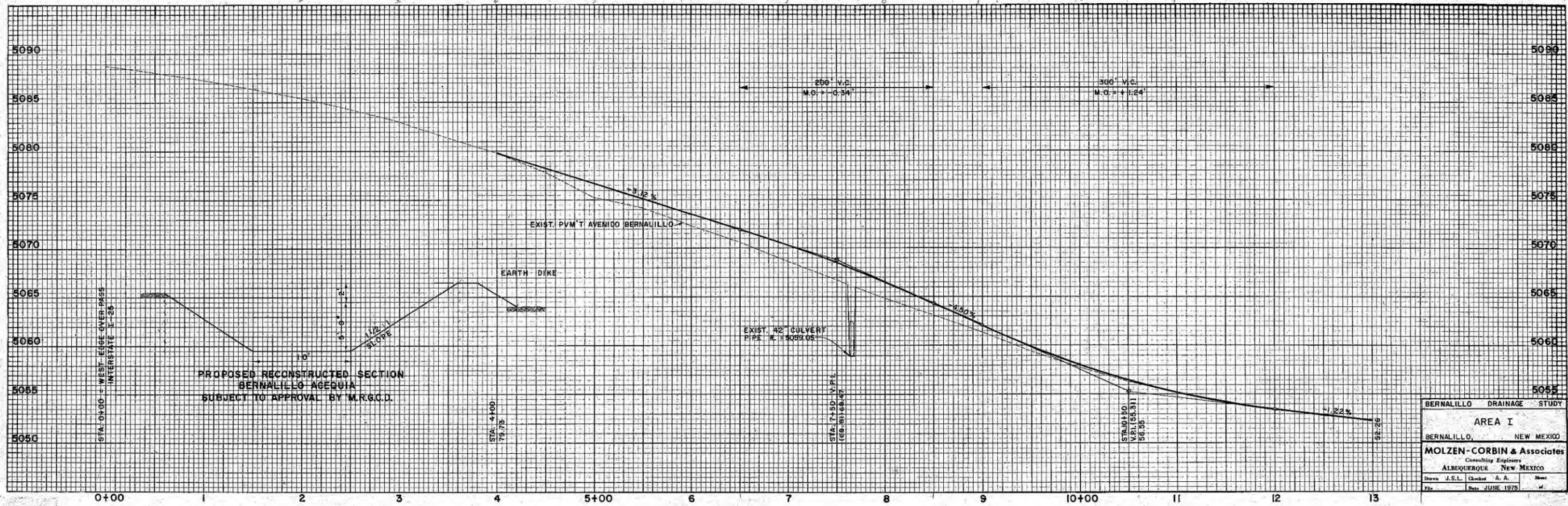
LOCATION AND PRELIMINARY
DESIGN OF DRAINAGE IMPROVEMENTS



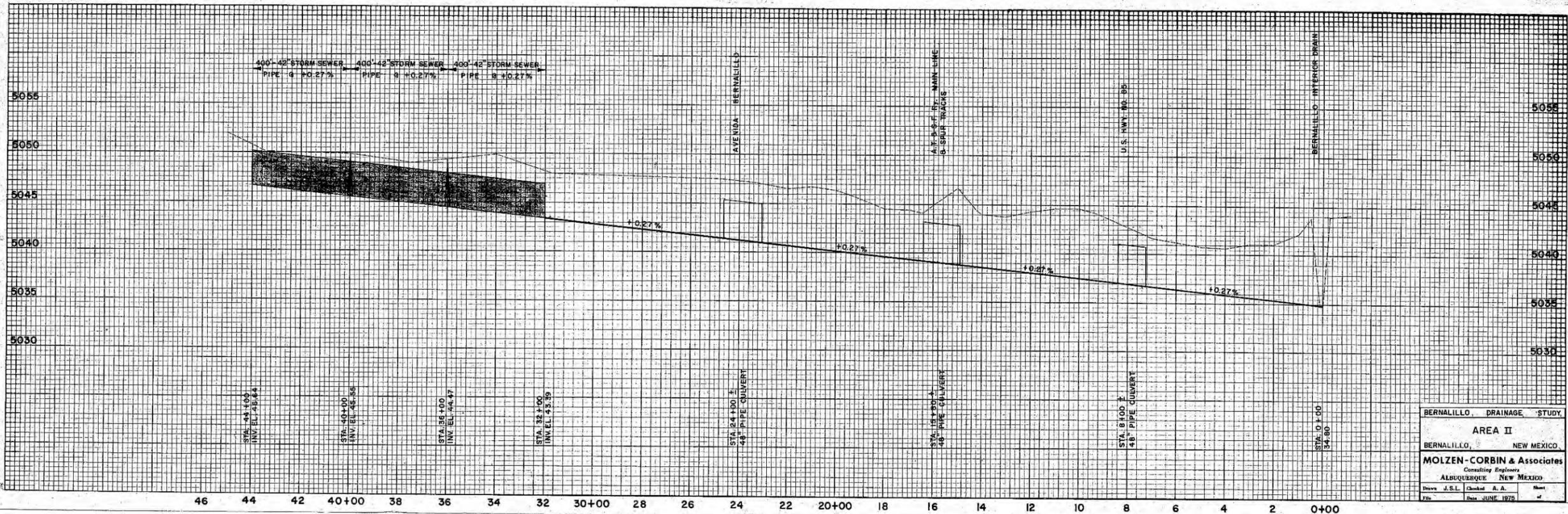
- LEGEND
- DRAINAGE DITCHES
 - STORM SEWERS
 - ACEQUIA (IRRIGATION DITCHES)
 - CULVERT PIPE
 - RECONSTRUCTION (AVENIDA BERNALILLO)



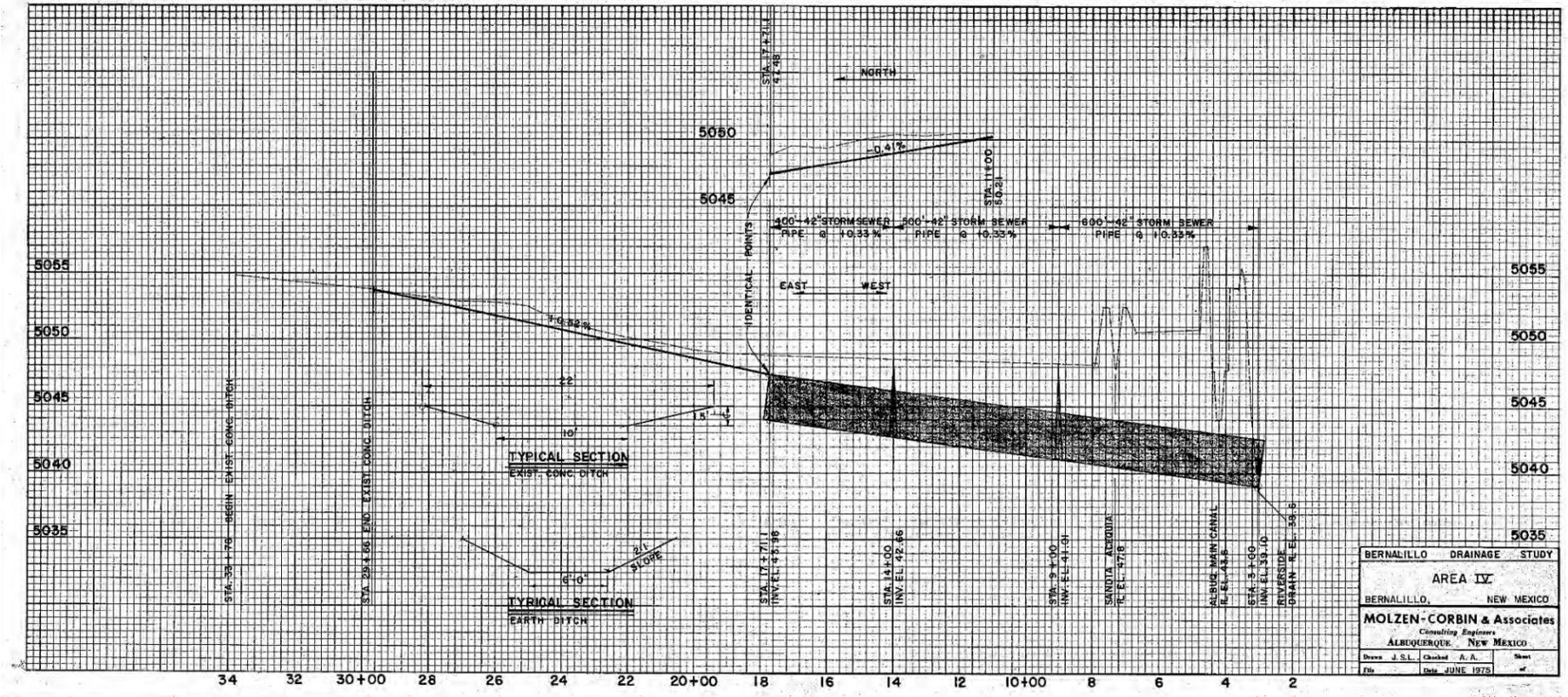
BERNALILLO DRAINAGE STUDY		
LAYOUT MAP		
BERNALILLO, NEW MEXICO		
MOLZEN-CORBIN & Associates		
<i>Consulting Engineers</i>		
ALBUQUERQUE NEW MEXICO		
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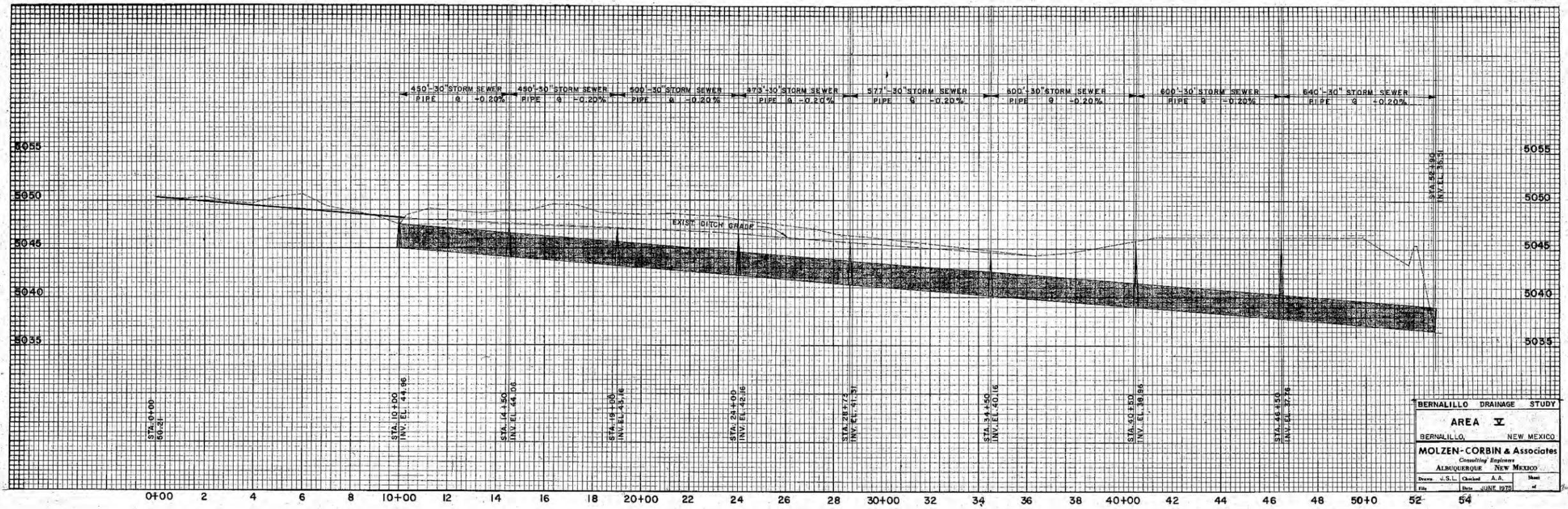
BERNALILLO DRAINAGE STUDY	
AREA I	
BERNALILLO, NEW MEXICO	
MOLZEN-CORBIN & Associates	
Consulting Engineers	
ALBUQUERQUE, NEW MEXICO	
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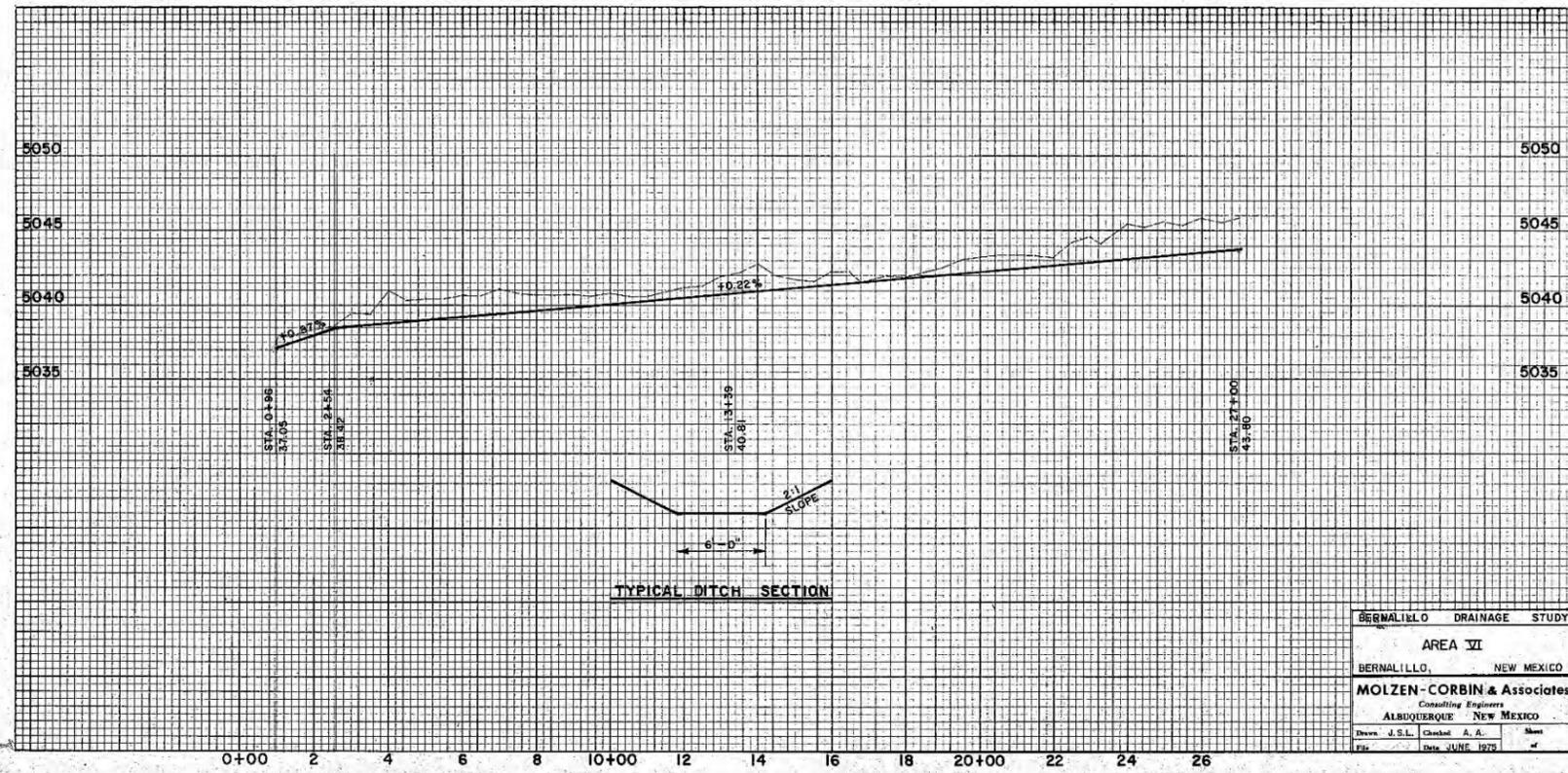
BERNALILLO DRAINAGE STUDY	
AREA II	
BERNALILLO, NEW MEXICO	
MOLZEN-CORBIN & Associates	
Consulting Engineers	
ALBUQUERQUE, NEW MEXICO	
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File	Date JUNE 1975



BERNALILLO DRAINAGE STUDY
 AREA IV
 BERNALILLO, NEW MEXICO
MOLZEN-CORBIN & Associates
 Consulting Engineers
 ALBUQUERQUE, NEW MEXICO
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 Date JUNE 1973



BERNALILLO DRAINAGE STUDY
 AREA V
 BERNALILLO, NEW MEXICO
MOLZEN-CORBIN & Associates
 Consulting Engineers
 ALBUQUERQUE, NEW MEXICO
 Drawn J.S.L. Checked A.A. Sheet #
 Date JUNE 1973



BERNALILLO DRAINAGE STUDY
 AREA VI
 BERNALILLO, NEW MEXICO
MOLZEN-CORBIN & Associates
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 ALBUQUERQUE NEW MEXICO
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