APPENDIX A

Coordination Letters and Responses

United States
Environmental Protection
Agency

Region 6
1201 Elm Street
Dallas, TX 75270

Arkansas, Louisiana,
Oklahoma, Texas,
New Mexico

EPA

April 6, 1979

Colonel Bernard J. Roth
District Engineer
U.S. Army Corps of Engineers
P.O. Box 1580
Albuquerque, New Mexico 87103

Dear Colonel Roth:

We have completed our review of the Draft Environmental Impact Statement on the proposed Middle Rio Grande Flood Protection project from Bernalillo to Belen, New Mexico. This Federal action would provide a higher degree of protection to flood-threatened areas of the Rio Grande Valley. This increased protection would be accomplished largely by rehabilitating and/or raising the existing levee system and installing additional bank protection works.

Approximately 92 miles of levee in a 60-mile reach would be raised an average of 4 feet. With the exception of levees in the Albuquerque Unit, existing levees would be torn down and rebuilt to higher structural standards. Mitigative and compensatory measures involving grassing, planting of trees and shrubs, marsh development, woodland management, and woodland acquisition are planned to restore aesthetic and wildlife values impacted as a result of the project activity.

1. We classify your Draft Environmental Impact Statement as LO-1. Specifically, we have no objections to the project as it relates to Environmental Protection Agency's (EPA) legislative mandates. The statement contained sufficient information to evaluate adequately the possible environmental impacts which could result from project implementation. Our classification will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal actions, under Section 309 of the Clean Air Act.

Definitions of the categories are provided on the enclosure. Our procedure is to categorize the EIS on both the environmental consequences of the proposed action and on the adequacy of the Impact Statement at the draft stage, whenever possible.

We appreciated the opportunity to review the Draft Environmental Impact Statement. Please send our office two copies of the Final Environmental Impact Statement at the same time it is sent to the Office of Federal Activities, U.S. Environmental Protection Agency, Washington, D.C.

Sincerely,

Adlene Harrison
Regional Administrator (6A)

Enclosure

1. No response necessary.

A-1

United States Department of the Interior
OFFICE OF THE SECRETARY
SOUTHWEST REGION
POST OFFICE BOX 2088
ALBUQUERQUE, NEW MEXICO 87103

ER-79/141

MAR 2 3 1979

District Engineer
Corps of Engineers, U. S. Army
P. O. Box 1580
Albuquerque, New Mexico 87103

Dear Sir:

This is in response to your request for our review of the draft environmental statement for the Middle Rio Grande Flood Protection Project, Bernalillo to Belen, New Mexico.

We have reviewed the draft statement and find that there are several areas which could be improved in describing the environmental impacts of the project. Our comments on the draft statement are provided as General Comments and Specific Comments as follows:

2. GENERAL COMMENTS

The statement should be revised to fully address and evaluate the environmental impacts of the related Federal actions that will be required as a result of this project. Public lands administered by the Bureau of Land Management (BLM) are within the project area. The BLM lands to be impacted with construction of the proposed project, are located in T9N, R3E, Section 7, Lots 1, 2, and 3; T9N, R2E, Section 12, Lots 1, 2, and 3; and T9N, R2E, Section 13, Lots 1, 2, 3, 4, 5, and 6 which are located in the Albuquerque West unit on the west side of the river and in the Albuquerque East unit on the east side of the river.

These public lands are 309.35 acres in size. The area has been designated an Environmental Educational Area by BLM and is to be used in conjunction with the Albuquerque Public Schools. A Cooperative Agreement on the Rio Grande Environmental Educational Area has been entered into between the Superintendent of the Albuquerque Public Schools, and the District Manager of the Albuquerque District, BLM. A right-of-way permit would be required from BLM for any use of this land.

The project area does include lands of the Sandia and Isleta Indian Pueblos. The project as presently proposed does not provide for any increased flood protection of these lands above that presently available. It should be recognized that if any construction activities does take place on these lands a right-of-way permit from the Bureau of Indian Affairs would be required.

A number of recreational and natural areas have been cited in the report. Some of these areas have received matching funds from the Land and Water Conservation

2. As the degree of flood protection recommended was reduced from SPF protection (69,000 to 72,000 c.f.s.) to 42,000, no work would be performed on the Albuquerque Unit levees. Therefore, no disturbance would occur in BLM's Environmental Education Area. Should permits be required on Pueblo lands, these would be applied for. It is not anticipated that any areas or facilities acquired or developed with financial assistance from the Land and Water Conservation Fund would be converted from their designated purposes.

A-2

Fund. The Land and Water Conservation Fund Act of 1965, as amended, Section 6(f) states that no property acquired or developed with assistance from the Fund shall be converted to other than public outdoor recreation uses without the approval of the Secretary of the Interior. If such conversion is anticipated, the State official responsible for the Land and Water Conservation Fund should be contacted to initiate the process for obtaining approval of the Secretary of the Interior. The responsible official in New Mexico is William S. Huey, Cabinet Secretary, New Mexico Natural Resources Department (Villagra Building, Santa Fe, New Mexico 87503). Coordination efforts related to conversion should be indicated in the appropriate sections of the statement.

3. In general, the statement adequately addresses fish and wildlife resources and the impacts that will likely occur with project implementation. The statement includes specific information and coordinated planning inputs previously provided by the U. S. Fish and Wildlife Service. We are pleased to note that considerable effort and consideration has been given to fish and wildlife habitat loss and the need for mitigation and compensation as part of project planning.

3. No response required.

SPECIFIC COMMENTS

Project Description

4. Page I-6, Paragraph 1.11 - The first sentence states that in the Albuquerque Unit fill would be placed on either the landward or riverward side to increase the levee height. Placing fill on the landward sides of the levee would avoid conflict with the Environmental Education Area. It is stated in the last sentence of this paragraph that the random fill source would be from the area between the levee and the channel. The location of any borrow areas within the Environmental Educational Area would severely impact the integrity of the area. It should be clearly stated whether any borrow material is proposed from this area.

4. As the levees in the Albuquerque Unit provide flood protection up to 42,000 c.f.s., no work would be done in this area and, consequently, the Environmental Education Area would not be affected.

5. Page I-7, Section 1.14 - It is stated that random fill is to be excavated to depths of 4 feet or just above the ground-water level. The analysis of ground-water impacts should include assessment of the magnitude and significance of the changes in evaporation losses as a result of decreased depth to the water table.

5. The impact of borrow activities and removal on ground water has been included in paragraph 4.42, page IV-17, of this revised draft.

6. Page I-12, Paragraph 1.29 - It is stated that 6 months to 2 years is required for construction of any given section of the project. The time period necessary for construction of the total project should be given with an indication of the sequence of construction of the various sections.

6. At this stage in the planning process, it is premature to give a more refined construction period for the entire project. A more accurate time frame would be developed during post authorization studies. While the sequence of construction of the various levee sections is likewise premature, construction would likely begin with the Corrales Unit and progress downstream.

7. Page I-14, Paragraph 1.37 - Considering all the surface disturbance resulting from the project a further discussion of revegetation is warranted. For example, information should be included on whether revegetation would be through artificial or natural means and the estimated time required for such revegetation.

7. Discussions dealing with revegetation, i.e., paragraph 1.36, page I-16, paragraph 4.36, page IV-15, and paragraph 5.04, page V-2, have been expanded.

8. We note that recommendation #8 of the Fish and Wildlife Service's Fish and Wildlife Coordination Act Report requested that borrow sites be converted to palustrine wetlands. We understand that such wetland development is part of Alternative Plan B and will be proposed for authorization along with other project features. This should be clarified in this and other applicable sections of the statement.

8. This information has been incorporated in paragraph 1.36, page I-16, and paragraph 4.21, page IV-11.

9. Mention is made that denuded areas would be grassed where feasible. Recommendation #5 of the Fish and Wildlife Service's Fish and Wildlife Coordination Act Report indicated that grasses, shrubs, and trees of value to fish and wildlife resources should be used for revegetation. Areas such as haul roads and borrow pits would benefit from plantings of shrubs and trees in addition to grasses. Haul roads may be utilized by off-road vehicles. These roads, if planted with trees, would be restored to pre-project condition in shorter time. Thus, tree growth may discourage motor vehicle uses.

9. Restoration of areas disturbed as a consequence of project construction is a prime planning objective. This subject was discussed in detail in the mitigation and compensation section of the Feasibility Report (Appendix F), which included most of the items mentioned by the Service. Paragraph 1.36, page I-15, and paragraph 4.36, page IV-15 of the environmental statement have been expanded to include these concerns.

10. Page I-15, Paragraph 1.38 - The permanent loss of riparian/woodland from the Environmental Education Area would be 6.44 acres and 0.76 acres on the West and East units respectively.

10. As the degree of flood protection has been lessened from that proposed in the draft environmental statement no losses would occur on BLM-administered riparian woodland.

11. Page I-15, Paragraph 1.39 - The Fish and Wildlife Service in close coordination with the Corps of Engineers and the New Mexico Department of Game and Fish utilized a system to determine relative habitat values of the riparian woodland. Estimates of necessary acreages of management areas are also projected and displayed in the Fish and Wildlife Service Coordination Act Report. Results indicated that 750 acres of management area would be required for partial compensation of woodland losses. It is indicated in this paragraph that an independent evaluation of mitigation and compensation measures was developed separately by the Corps of Engineers which resulted in differing measures for mitigation and compensation. These measures are discussed in this section of the statement. The differences between the two analyses should be highlighted with a brief discussion of how the proposed compensation measures included in this paragraph were determined and why they are being proposed.

11. While these items were extensively covered in Appendixes H and I of the Interim Feasibility Report, not all reviewers had the opportunity to see the Feasibility Report. Consequently, a brief discussion and comparison of compensatory measures proposed by each agency are presented in Appendix F.

Environmental Setting Without the Project

12. Pages II-33 and II-34, Paragraphs 2.87-2.91 - This discussion of historical floods does not support the project purpose of controlling floods likely to result from intense weather activities. It is indicated that construction of Cochiti Reservoir has provided protection to the Albuquerque Greater Urban Area from spring runoff originating in the Rio Grande Drainage above Cochiti Reservoir. These sections should be revised to document and discuss the types of floods for which the project is being proposed to provide protection.

12. Additional data have been supplied in paragraph 2.93, page II-35 regarding the type of flood that the current proposal is designed to protect against.

13. Page II-40, Paragraph 2.102 - Mention is made that the greatest factor influencing riparian woodlands has been introduction of tamarisk and Russian olive. Undoubtedly, these introductions have significantly contributed to alterations of plant communities. However, the Fish and Wildlife Service has concluded that past alterations to the riverine ecosystem from agricultural and urban uses has had a far greater influence on the riparian woodlands and associated habitats. This should be recognized in the statement.

13. The reference to tamarisk and Russian olive being the greatest factor influencing the riparian woodland was made in relation to the makeup or structure of the plant community. Later discussion in the paragraph, as well as in subsequent paragraphs, details losses of riparian woodland due to urbanization and agriculture as well as their effect on wildlife and their habitat. Paragraph 2.104, page II-41 has been rewritten to clarify this issue.

14. Page II-44, Paragraph 2.113 - The plant specie *Tetalostemon scariosum* is listed as being proposed for endangered status under the Endangered Species Act of 1973. The possible impacts which could occur to this plant from construction of this project should be discussed.

14. It was stated in the draft environmental statement that this plant species probably does not inhabit the riparian woodland. This fact and probable impacts of the proposed plan of action have been discussed in paragraph 4.18g, page IV-9.

Relationship of the Proposed Action to Land-Use Plans

15. PageIII-3, Paragraph 3.06 - It is stated in the last sentence of this paragraph

15. This paragraph has been modified to reflect this fact.

A-4

that management of riverine areas is proposed as a benefit to wildlife. It should be clarified that management of the riverine areas is part of the plan for mitigation and compensation of wildlife resource losses due to the project and will not provide for benefits to wildlife.

The Probable Environmental Impact of Constructing, Operating, and Maintaining the Project

16. The proposed project does not appear to involve an undue commitment of mineral resources; however, a brief summation of the affected sand and gravel resources in this section would improve the statement.

16. The impact of the proposed project on these resources has been discussed in paragraph 4.47, page IV-19 of this revised draft.

17. Page IV-4, Paragraph 4.10 - The Fish and Wildlife Service's report recommended that compensation lands be acquired as part of project cost and that these lands and appropriate operation and maintenance funds be provided to the New Mexico Department of Game and Fish. It is indicated in this section that borrow areas may be allowed to decrease in size due to siltation. It should be clarified whether operation and maintenance funds will be provided to insure continued mitigation and compensation effects after project development.

17. It is the Corps of Engineers intention that O&M funds would be provided to insure optimum benefits from developed marsh areas and any purchased lands. The reference to allowing some borrow areas to silt in is directed to those borrow areas that would not be converted into marshes. These points have been clarified in paragraph 1.38, page 1-17 and paragraph 4.10, page IV-4.

18. Page IV-7, Paragraph 4.16 - No mention is made of probable impacts that may occur to fishery resources in the drains resulting from removal of overhanging cottonwood trees. These possible impacts were discussed in the Fish and Wildlife Service report which indicated such impacts as altering water temperatures with the elimination of overhanging shading and possible loss of food sources due to removal of the trees. These possible impacts should be recognized in the statement.

18. The section of drain and levee primarily addressed by this comment is a 1.3 mile stretch of the Corrales Unit. At the time of this writing, the trees on this section of levee are being removed to strengthen the levee and prepare for a flood fight in anticipation of high flood flows. Thus, the evaluation of impacts resulting from their removal has become a moot point, as related to the proposed action. Although there are some areas where limited numbers of trees or brush overhang the drain, their association with the aquatic biotic community would require further study since differing viewpoints exist in the biological community.

19. Page IV-9, Paragraph 4.19 - We note that compensation for fish and wildlife losses can be attained by implementing recommended measures. Continued coordination with our Fish and Wildlife Service will be beneficial during the advanced planning stages of the project to identify the specific requirements necessary to provide the required compensation. In this regard we note that the Corps of Engineers is currently including fish and wildlife measures in documents proposing authorization for construction.

19. As in the past, all aspects of the proposed action will be fully coordinated with the Service and their recommendations fully evaluated.

20. Page IV-10, Paragraph 4.21 - The Fish and Wildlife Service's Report recommends purchase of fallow fields for management to attain riparian habitats. Theoretically, such management is required to compensate for resource values lost due to project construction. The management potential of existing woodlands is less than the management potential of fallow fields. This relates to the number of acres of management areas required to compensate losses. Therefore, less areas of fallow fields (greater management potential) would be required for compensation. This paragraph should be expanded to adequately consider these concepts of management requirements.

20. Although the Corps agrees that the management potential for fallow fields is greater than that of existing riparian woodland and realizes the savings in land and dollars that this measure offers, it is believed that the environmental statement is not the vehicle for the dissemination of this information. This management concept is discussed in Appendix F of the Interim Feasibility Report. Also, there are other factors that would influence the consideration of either fallow or wooded areas or both.

21. Page IV-10, Paragraph 4.22 - Mention is made that consideration for drain improvement structures such as logs, rocks, low flow dams, and trees be installed for enhancement to improve the aquatic community and recreational use. The Fish and Wildlife Service's report recommended that drain improvement structures be provided to compensate for expected degraded drain conditions. This paragraph should be clarified to indicate that at least a portion of the proposed drain improvement features will be required for compensation of project-caused losses.

21. While no adverse impacts to fish and wildlife species and their habitat greater than that experienced as a consequence of normal maintenance activities, there would be some impairment of recreational pursuits along the drains. While it is believed that a certain amount of recreational impairment is acceptable for enhanced flood protection, the feasibility of providing habitat enhancement features would be pursued. These features, as stated by the Service, would aid in compensating for drain-associated recreation impairment. Paragraph 1.36, page 1-16 has been modified to reflect this.

A-5

22. Page IV-11, Paragraph 4.23 - This section should be expanded to discuss the impacts of the project on the Environmental Educational Area in terms of recreational and educational values that could be lost.

22. Since no work would be done in this area, the discussion of impacts is a moot point. However, the loss of recreational and educational areas may have been minimal. While there would have been a permanent loss of about 7 acres out of 309, the creation of marshes may very well have been an asset to the development, expanding recreational and educational opportunities.

23. Page IV-12, Paragraph 4.24 - It is stated that the upper one-third of the bicycle trail, presumably the Paseo del Bosque Bikeway, would be removed during levee rehabilitation. This bikeway has been designated a National Recreation Trail. We recommend that an alternate route be provided for this affected section of the bikeway during levee rehabilitation so that the bikeway will remain continuous and not disrupt recreational use. This should be discussed in the statement.

23. Since the Albuquerque Unit would not be affected by the proposed action, the bikeway would, correspondingly, not be affected.

Alternatives to the Proposed Action

This section discusses the impacts of a number of structural alternatives necessary to attain the Standard Project Flood protection which is a design flow of 69,000 - 72,000 c.f.s. or the 700 year flood.

24. The discussion of structural alternatives should be expanded to include an analysis of the impacts of alternatives necessary to attain a Standard Project Flood protection of a different design flow. For example a structural alternative of providing for a design flow of 42,000 c.f.s. or the 270 year flood would minimize many of the identified impacts particularly in the Albuquerque Unit. A full discussion of the impacts of viable structural alternatives for different design flows would greatly improve the statement.

24. It is not possible to "attain a Standard Project Flood protection of a different design flow". The Standard Project Flood is a specific discharge rate defined as that flood or flow that may be expected from the most severe combination of meteorological conditions considered reasonably characteristic of the geographical area in which the basin is located, but excluding extremely rare combinations. Lesser degrees of flow protection were not discussed since it is Corps policy to provide SPF protection whenever possible to highly urbanized areas where sudden levee failure might result in loss of life or catastrophic property losses.

Coordination with Others

25. Page IX-2 - The list of federal agencies and individuals coordinating and consulting on this project should include the Bureau of Land Management.

25. Because copies of the environmental statement are sent to the Office of the Secretary in Washington, D.C. for distribution to appropriate interior agencies, only the Office of the Secretary was listed. Also, in the Revised Draft ES only the Office of the Secretary will be listed as a respondant since the Corps of Engineers does not know specifically which Interior Agencies responded.

We appreciate the opportunity to review this statement.

Sincerely,

Raymond P. Churan

Raymond P. Churan
Regional Environmental Officer

A-6

United States Department of Agriculture
Soil Conservation Service
Box 2007
Albuquerque, NM
87103

February 26, 1979

Colonel Bernard J. Roth
Department of the Army
Corps of Engineers
P. O. Box 1580
Albuquerque, NM 87103

Dear Colonel Roth:

The draft interim feasibility report and environmental statements for the Middle Rio Grande Flood Protection project have been reviewed by members of our staff. We appreciate the opportunity to see these reports in draft form and hope that our comments might be useful in preparing the final report and environmental statement. As requested, we are returning both copies.

Our review of the "main report" elicited the following comments:

1. The plan should be expanded to present additional information on flooding potentials from side drainages.

2. Page 29, Item a, is unclear as to the meaning of "potential for flooding" or "impede existing drainage into the Rio Grande." We suggest this item be explained.

3. Page 15, "without" condition, states that development has been unaffected by "inadequate flood protection." We agree that development will go on at very high rates without concern for flooding. We do not agree with Table 29 on page 131 which states that property values will be increased due to flood protection. We believe that the demand for valley land is so high, and values have become so inflated, that the factor of additional flood protection will not add incremental value in the marketplace. We suggest that these contradictions be rectified in the final reports.

From our view of the Draft Environmental Statement, we would pose the following comments or questions:

There is sufficient, detailed, descriptive or explanatory material concerning natural resources to understand almost all of the stated impacts or purposes. However, we suggest that the final EIS should provide additional clarification about:

A-7

26. 1. The utilization of borrow pits as managed wetland habitats. It is our opinion that excavation to below the top elevation of average high water table will provide reliable and valuable wetlands. Considering the overall lack of wetlands within the project area, and their known value as wildlife habitats, esthetic and recreation resources, would indicate that the creation of new wetlands would be a project purpose which is in the public interest.

27. 2. We suggest that the negative impacts of the loss of tree vegetation have been consistently overstated. From the point of view of wildlife habitats within the project area, the characteristic is of a monotypic bosque, lacking in species diversity, foliage-height diversity and age diversity. As wildlife habitat, the bosque would be benefited by additional openings to provide herbaceous ground cover and additional openings to provide needed wetlands.

Considering the present bosque from esthetic and recreational perspectives also suggests that diversification of the dense, older tree communities would improve their utility and attractiveness.

28. 3. It is unclear if the existing Paseo del Bosque bikeway along the east levee would be destroyed, and if so, would it be reconstructed?

29. 4. We question item 136, page I-14, the placement of downed trees within the floodway for the benefit of wildlife. Would this material be anchored in some way or could it float away during periods of flood?

30. 5. There appears to be considerable indecision about various mitigation measures such as wetlands, fishing ponds, recreational trails and landscaping. Our opinion would be that these types of project purposes should be maximized. The citizens and elected officials of the Albuquerque Greater Urban Area have repeatedly demonstrated their interest in utilizing the Rio Grande floodway for these purposes. This project provides many opportunities for single and joint-venture accomplishment, and we feel that these opportunities should be aggressively pursued.

31. 6. We found that Section II-P-1, Plant Communities, was particularly well detailed and helpful in understanding the historic changes along the valley. Combined with Section IV-C, which describes the probable project induced impacts, a rational basis for prediction

26. The Corps concurs with the Service.

27. We concur that woodland diversity in terms of plant height and density, age, and species, as well as the presence of open areas, is highly important to the riparian wildlife community. As stated in the environmental statement, the existing bosque is progressing towards maturity with nothing except periodic fire to maintain early stages. This progression would, as commented, result in a monotypic bosque providing fewer ecological niches than a varied age bosque with some open areas and marshes. The draft environmental statement recognizes the benefits to be had by the creation of open areas and regression of seral development in paragraph 4.14. Conversely, it recognizes the additional losses to a limited woodland that historically has been reduced in area. This sensitive issue was handled as objectively and accurately as possible. However, the discussion will be reviewed to insure that the impact was accurately conveyed.

28. Under the originally proposed SPF flood protection, that section of the bikeway between the U.S. 66 and 85 Bridges would have been removed. Under the items of local cooperation it would have been the responsibility of the sponsor to reconstruct the bikeway. However, under the currently proposed plan of providing 42,000 c.f.s. flood protection the bikeway would not be affected.

29. Brushpiles would be strategically located in areas that are removed from the main channel and have considerable foliage that would reduce the velocity of floodflows and trap plant material that might float away. This is reflected in paragraph 1.35, page I-14.

30. The development of wetlands is a project purpose, and, even with the lessened degree of flooding, would be included in the project authorization. Development of recreational trails will be recommended and thoroughly studied during post-authorization studies. Since recreational development involves cost sharing, more coordination would be required as the study progresses. Revegetation and landscaping are a normal part of any project and would be a part of this project. The Corps, too, recognizes the many opportunities the project affords and would pursue their implementation. However, with lessened degree of flood protection that will be recommended, these opportunities would correspondingly be lessened, especially in the Albuquerque reach where no work would be performed. These aspects have been strengthened in subheading H, page I-8.

31. Concur.

is established. We suggest that a good case can be made for the overall improvement through created diversity of the existing plant communities as will be brought about by the proposed project.

32. 7. We suggest that further detail should be provided for Q-1, 2.139, on page II-59, listing the recreation areas to describe the recreation facilities and capacities provided. Also "b", "Hunting Opportunities", would be more meaningful if expressed as a percentage of the land which is available for public hunting.

33. 8. Page III-3, item 3.05, should be corrected to indicate that the lands acquired for Candaleria Farms Park are outside the east levee but within the historic floodplain.

34. 9. On page V-1, under Adverse Effects, Wildlife, again we feel that the first sentence overly stresses the negative side of tree clearing. Very probably, there will be, over time, very little actual loss of vegetation. To paraphrase, a change of vegetation is synonymous with a change of habitat for wildlife species.

As summary, if fully implemented, the selected project alternative could substantially improve the environment of the valley, primarily through flood control, but also through improved esthetic, outdoor recreation and wildlife habitat values. Conversely, if only the flood control aspects are implemented, there will be environmental and social values lost.

Thank you for the opportunity of commenting on these draft reports.

Sincerely,

Harold C. McCrossen

A. W. Hamelstrom for
State Conservationist

Attachments (3)

32. Additional data concerning the activities available at the various recreational areas and areas available for hunting have been incorporated in paragraph 2.141, page II-61. Capacities and number of facilities were not included and it is believed that this information would not add substantially to the statement.

33. Paragraph 3.05, page IV-3 has been restructured to state that in addition to the Candelaria Farms development which is located in the historic floodplain on the landward side of the levees, a portion of the bosque on the riverward side of the levee and west of the development has been leased by the State from the OMRGCD.

34. Reference is made to comment 27.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Region 3
517 Gold Avenue SW
Albuquerque, New Mexico 87102

3500
FEB 26 1979

Colonel Bernard J. Roth
District Engineer
Department of the Army
Albuquerque District, Corps of Engineers
P. O. Box 1580
Albuquerque, New Mexico 87103

Dear Colonel Roth:

We have reviewed the draft "Middle Rio Grande Flood Protection, Bernalillo to Belen, New Mexico" report and draft EIS. Our comments are as follows:

35. 1. We were pleased to note that some of the proposed revegetation of disturbed areas will be to trees and other woody vegetation. Suggest utilizing species that are especially suited to providing cover, food and habitat for birds and mammals endemic to this area.

36. 2. Suggest utilizing adapted tree species for planting as cover and screening around burrow pits, especially where burrow pits are to be developed for recreation purposes or marsh areas.

37. 3. A source of additional technical assistance in forestry and related resources would be the State Forester of New Mexico who is cooperating with our agency through the Urban Forestry Program.

38. 4. Suggest you give some consideration to the harvest and sale, as firewood, of woody species that cover areas scheduled for construction. This would tend to reduce disposal costs, subsequent air pollution, and in general improve the esthetics of construction areas.

39. 5. The management, treatment and uses of the upper reaches of the watersheds draining into this Rio Grande River segment were given cursory treatment in your report, although the results have considerable effect on storm runoff levels. Ownerships include the Cibola National Forest, the Bureau of Land Management, Indian Tribal lands, State and private.

35. The emphasis of any revegetation plan would be to replace native riparian vegetation while concurrently providing for the needs of resident, as well as seasonal and migratory species. Exotics such as Russian olive would also be incorporated into the plan.

36. This suggestion is appreciated and would be evaluated during the planning and design of these areas.

37. The suggested source of additional technical assistance would be contacted during the detailed planning and design stage.

38. This suggestion would be evaluated for its practical and economic feasibility. While some woody plant material would be disposed of some would be retained to benefit wildlife in the form of brush piles and as basking and rooting plain in created marshes.

39. This subject has been expanded in the Main Report of the Interim Feasibility Report under the heading of Flooding from Arroyo and Sheet Flow Runoff.

A-10

40. 6. The report states the 100 + year storm will be adequately handled by the reconstructed higher levee system with corresponding overlap levees. Does the proposed toe drainage system have the same capability, thus avoiding property damage from the landward side of the levee system during the same intensity storm?

We appreciate the opportunity to review and comment on this draft proposal.

Sincerely,

THOMAS G. SCHMECKPEPER
Acting Regional Forester

40. The toe drainage system has been designed to adequately accommodate seepage from such a storm.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Cibola National Forest
10308 Candelaria NE
Albuquerque, New Mexico 87112

1950
February 15, 1979

Bernard J. Roth, Colonel, CE
District Engineer, Dept. of the Army
Albuquerque District, Corps of Engineers
P.O. Box 1580
Albuquerque, New Mexico 87103

Dear Colonel Roth:

41. We appreciate the opportunity to review the draft environmental statement. We have no comments at this time and, as requested, are returning the draft.

Sincerely,

KEITH T. PFEFFERLE
Forest Supervisor

Enclosure

41. No comment is required.

United States Department of the Interior
BUREAU OF RECLAMATION
SOUTHWEST REGION
HERRING PLAZA BOX H-4377
AMARILLO, TEXAS 79101

IN REPLY
REFER TO: 150
125.1

Colonel Bernard J. Roth
District Engineer
Albuquerque District
Corps of Engineers
P. O. Box 1580
Albuquerque, NM 87103

Re: Draft of Proposed Interim Feasibility Report, Middle Rio Grande Flood Protection, Bernalillo to Belen, New Mexico, and Draft Environmental Statement

Dear Colonel Roth:

The Southwest Regional Office of the Bureau of Reclamation has reviewed the subject statement. We apologize for our lateness in responding; however, the enclosed review comments are forwarded for your consideration in finalization of the subject environmental statement, the interim feasibility report, and appendices.

Sincerely yours,

Robert H. Weimer

Robert H. Weimer
Regional Director

Enclosure

A-13

Appendices

Page A-61 - Reference to proposed connection of the Corrales main canal with the Arenal canal and eliminating the "Oxbow's" water supply. The Bureau has determined it has no authority or responsibility in the issue and that any such proposal is the responsibility of the Middle Rio Grande Conservancy District. Mention of the Bureau of Reclamation in regard to the connection is incorrect and should be removed.

It should be pointed out that the City of Albuquerque has in the past and could in the future arrange for water supply for the "Oxbow" by use of the city's San Juan-Chama water.

Page B-83, third paragraph - Change reference of "water accounting for the Upper Rio Grande Basin" to accounting of the San Juan-Chama Project water in New Mexico.

42. Draft Environmental Statement

Page II-26, paragraph 2.72 - Revise statement that "...levees averaging about 1,000 feet wide..."

Page II-40, paragraph 2.103 - Last full sentance seems incomplete.

Page II-19, IV-12, and IV-13, Cultural Resources - Because the proposed plan includes installation of jetty fields, haul roads, borrow pits, highway approach changes, and disturbance of riparian woodland, we recommend that on-site cultural resource surveys be completed in advance of construction so that impacts may be determined and/or avoided with respect to potential archeological sites.

General

Reclamation recognizes the desirability of providing additional flood protection within the project area.

42. As these comments were incorporated in the Department of the Interior letter commenting on the draft environmental statement, no response will be made to these comments. This action was concurred with via telephone conversation with Mr. Raymond P. Churan, Regional Environmental Officer on April 23, 1979.

A-14

PLNS BR

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
FT. WORTH REGIONAL OFFICE
1100 COMMERCE STREET
DALLAS, TEXAS 75202

REGION VI

April 20, 1979

IN REPLY REFER TO:

Mr. Jasper H. Coombes, Chief
Engineering Division
Albuquerque District
Corps of Engineers
Department of the Army
P.O. Box 1580
Albuquerque, New Mexico 87103

Dear Mr. Coombes:

43. The Draft Environmental Impact Statement for Middle Rio Grande Flood Protection, Bernalillo to Belen, New Mexico, was reviewed in the Dallas Regional Flood Insurance Administration Office and in the Department of Housing and Urban Development's Dallas Area Office. No objections to the proposed project resulted from those reviews.

Sincerely,

Victor J. Hancock
Environmental Clearance Officer

43. No response required.

A-15

State of New Mexico

GOVERNOR
BRUCE KING

DIRECTOR AND SECRETARY TO THE COMMISSION
HAROLD F. OLSON

STATE GAME COMMISSION

F. URREA, JR., CHAIRMAN
ALBUQUERQUE

ROBERT H. FORREST
CARLSBAD

J.W. JONES
ALBUQUERQUE

ROBERT P. GRIFFIN
SILVER CITY

DR. FRANKLIN B. ZECCA
GALLUP

DEPARTMENT OF GAME AND FISH

STATE CAPITOL
SANTA FE
87503

March 23, 1979

Colonel Bernard J. Roth
District Engineer
Corps of Engineers
P. O. Box 1580
Albuquerque, New Mexico 87103

Dear Colonel Roth:

The New Mexico Department of Game and Fish has reviewed the Draft Environmental Statement and Interim Feasibility Report, Middle Rio Grande Flood Protection, Bernalillo to Belen, New Mexico, and I wish to make the following comments:

44. The Department has coordinated our evaluation of the proposed project with the U. S. Fish and Wildlife Service. This effort resulted in the report by the U. S. Fish and Wildlife Service that is included in Appendix G of the Interim Feasibility Report. I concur with the contents of this report and believe that cooperative planning during the next two years will result in the development of more detailed proposals for mitigating measures for wildlife and wildlife habitat.

45. I wish to express my appreciation in that the planning process to date, has developed considerations for wildlife protection and that the requirements of the Fish and Wildlife Coordination Act of 1965 can be achieved in the final plans.

Thank you for the opportunity to review and comment upon the draft statement and interim report.

Sincerely,

Harold F. Olson
Director

cc: U. S. Fish & Wildlife Service

44. No response is required.

45. No response is required.

STATE OF NEW MEXICO
NATURAL RESOURCES DEPARTMENT
FORESTRY DIVISION
P.O. BOX 2167 SANTA FE 87503
827-2312

BRUCE KING
GOVERNOR

WILLIAM S. HUEY
SECRETARY
OF NATURAL RESOURCES

RAYMOND R. GALLEGOS
STATE FORESTER

1 - COOPERATION
203

February 28, 1979

Colonel Bernard J. Roth, CE
District Engineer
Corps of Engineers
P.O. Box 1580
Albuquerque, NM 87103

Dear Colonel Roth:

Your ref: SWAED-EU, February 21, 1979, Draft Feasibility Report, Middle Rio Grande Flood Protection, Bernalillo to Belen, New Mexico.

1. Thank you for the opportunity to review the draft Interim Feasibility Report, including appendices and the draft Environmental Statement.

2. We assume that editorial changes will be made, in-house, including typographical and spelling errors.

3. Some specific comments follows:

   a. In the discussion on page 28 of the Main Report, it may be appropriate to mention watershed restoration measures carried out by the U.S. Forest Service on Cibola National Forest lands in the Bernalillo watersheds.

   b. The discussion of sediment on page 30 might be enhanced by data from the sediment studies currently being conducted by the Soil and Water Conservation Division, Department of Natural Resources, State of New Mexico.

   c. There is an inconsistency in the base maps used to illustrate the plan. For example, the plate used to show Indian lands indicates a different watershed/hydrologic project boundary northwest of Cochiti and Jemez Dams than does plate 15 - which includes the

(Response to comments directed to the Draft Feasibility Report are included in the Final Feasibility Report.)

A-17

Borrego and Peralta drainages on the Santa Fe National Forest. In addition, the land status map, plate 16, does not cover all of the project, nor does it include lands of the Santa Fe National Forest. A portion of the land status map of New Mexico, published by the Bureau of Land Management (1:500,000, 1972, revised 1973) is attached to illustrate this point.

d. In the appendix, page A-46, the discussion of Wastewater Management Problems indicates that the Environmental Improvement Agency is the designated planning agency. This, and other references to State agencies, needs to be corrected in view of the reorganization of State Government and subsequent renaming of some State agencies. In this case, it should read the Environmental Improvement Division of the Health and Environment Department.

e. On page A-78, in the summary of the section on Arroyo and Sheet Flow Runoff, interior flooding is recognized as a significant problem. It is difficult to conceive that this problem is ".....completely unrelated to the Rio Grande and its existing levee system". We feel strongly that this plan and the plans for controling interior runoff should be integrated - at least to the point of discussing and analyzing how one effects the other. Perhaps it is "old hat", but two basic flood control problems come to mind:

(1) How do interior flood waters get through the levees - at all stages of the main stem?

(2) What happens if the standard project flood is exceeded and flood waters are trapped behind the levees? We feel that reexamination and evaluation of this section, beginning on page A-75 is in order.

6. 4. In reviewing the draft Environmental Statement, it appears that the Division of State Forestry through its Urban and Community Forestry and other programs may be able to provide assistance during vegetation modification periods of the plan.

7. 5. We are pleased to see the provision for use of project facilities for wildlife habitat, [illegible] opportunities. However we feel strongly that wetland watershed rehabilitation and improvement plans and [illegible]

46. The Division of State Forestry would be contacted during the detailed planning and design stage for its ideas and recommendations for revegetation and marsh development.

47. This subject has been expanded in the Main Report of the Interim Feasibility Report under the subject heading of Flooding from Arroyo and Sheet Flow Runoff.

by upstream landowners/managers should be discussed in the plan - in particular, those measures that will reduce flood peaks in the project area.

6. Please change your mailing list:

From: Robert Adams
New Mexico State Forestry Dept.
P.O. Box 2167
Santa Fe, NM 87503

To: Raymond R. Gallegos, State Forester
Division of State Forestry
P.O. Box 2167
Santa Fe, NM 37503

If we can provide additional information or further review, please feel free to call on this office.

Sincerely,

Raymond R. Gallegos
State Forester

RRG/tdh
Attch: (1)
Enc.: (2)
1. Feasibility Report (Vols. I & II)
2. Draft EIS

cc: Bill Troxel, FS, R-3, S&PF

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PLANNING DIVISION
(STATE CLEARINGHOUSE)

MIS

REVIEW CERTIFICATION FORM

STATE PLANNING DIVISION
DEPT. OF FINANCE AND ADMINISTRATION
505 DON GASPAR
SANTA FE, NEW MEXICO 87503
(505) 827-2073

TO: Department of the Army

DATE: March 9, 1979

SUBJECT: ____PRELIMINARY REVIEW

____FINAL REVIEW

____STATE/AREA PLAN

__X__E.I.S.

PROJECT TITLE: Middle Rio Grande Flood Protection Bernalillo to Belen

APPLICANT: Department of the Army

FEDERAL CATALOG NO: 12.106

FEDERAL AGENCY: Department of Defense

SAI NUMBER: 9 02 11 042

PROPOSED FUNDING (PER 424 FORM)

	AMOUNT
FEDERAL	$
APPLICANT	
STATE	
LOCAL	
OTHER	
TOTAL	

FOR FINAL APPLICATION ONLY:

REVIEW RESULTS:

48. __X__ The application is supported.
(rw) ____ The application is not in conflict with State Areawide or Local plans.
__#__ Comments are attached for submission with this application.

You may now submit your application package, this form and all review comments to the Federal or State Agency(s) fr whom action is being requested.

Please notify the Planning Division (Clearinghouse) of any changes in this project. Refer to the SAI number on ALL correspo dence pertaining to this project.

TECHNICAL ASSISTANCE AND RESEARCH

A-20

PLANNING DIVISION

2 white

Approved July 1978

48. No response is required.

SIERRA CLUB

ALBUQUERQUE GROUP
P.O. BOX 25271
ALBUQUERQUE, NEW MEXICO 87125

March 25, 1979

HAND DELIVERED

Colonel Bernard Roth
Albuquerque District
Corps of Engineers
United States Army
Federal Building
Albuquerque, New Mexico

Dear Colonel Roth:

We enclose an original and two copies of the comments of the Rio Grande Chapter of the Sierra Club on the Corps' proposed project to raise the levees along the Rio Grande from Corrales to Belen.

We appreciate the assistance which you and your staff have provided.

Very truly yours,

Kevin V. Reilly
Chairman
Rio Grande Levee
Task Force

A-21

COMMENTS OF THE RIO GRANDE CHAPTER OF THE
SIERRA CLUB ON THE CORPS OF ENGINEERS'
DRAFT FEASIBILITY REPORT AND
DRAFT ENVIRONMENTAL IMPACT STATEMENT
CONCERNING MIDDLE RIO GRANDE FLOOD PROTECTION
FROM BERNALILLO TO BELEN

The Sierra Club submits the following comments on the Corps of Engineers' Draft Feasibility Report and Draft Environmental Impact Statement concerning increased flood protection along the Rio Grande from Bernalillo to Belen. The Albuquerque Chapter of New Mexico Citizens for Clean Air and Water, the New Mexico Mountain Club, and the University of New Mexico Mountain Club join in these comments.

The plan recommended by the Corps in its draft Report would rebuild or raise the levees along the Rio Grande from Bernalillo to Belen to provide protection from a flood of approximately 72,000 cubic feet per second (c.f.s.), a flood which the Corps estimates may occur only once in 700 years.

I

The Sierra Club is strongly opposed to any plan which would rebuild the levees in this stretch of the Rio Grande

A-22

to provide protection for a flood expected to occur but once in 700 years. We are opposed primarily for two reasons.

A

49. We also oppose the Corps' proposed project because it would cause severe damage to the riparian and woodland habitats of the Rio Grande. The Rio Grande Valley is the only major flyway for migratory birds for nearly 300 miles to the west and for over 100 miles to the east. In addition, the Rio Grande bosque environment is unique in New Mexico. The Draft Environmental Impact Statement states that if the proposed project is carried out, 750 acres of bosque will be destroyed by the creation of borrow pits for material to construct the levees, haul roads to carry the material and construction equipment to the levees, and by the area taken up by the rebuilt levees themselves. Of this 750 acres, 281 acres will be permanently lost as a bosque ecosystem because they will be covered by the levees or will be adjacent to the levees and will have to be kept clear for maintenance purposes. The remaining acreage will be allowed to return to bosque, but this process will take at least 40 years. In the meantime, severe

49. While there would have been a permanent loss of a maximum of about 286 acres of riparian woodland with SPF flood protection, it is thought that the proposed mitigation and compensation measures, including marsh development, management of riparian woodland purchase and management of cottonwood woodland and/or fallow land; and grassing and landscaping in addition to providing increased age and species diversity within the woodland itself, would have benefitted the riparian biotic community or at least equaled preproject values. With the degree of protection currently recommended the disturbance of the woodland would be far less and, correspondingly, the mitigation and compensation measure that would have been provided. While there would be environmental disturbance in either case, the mitigation and compensation measures do have quite favorable aspects for the riverine biotic community as well as for increased recreational benefits.

damage will be done to the transient and permanent populations of wildlife.

50. The destruction of the bosque will significantly reduce the habitat of a wide variety of wildlife which currently live in the bosque, including quail, pheasant, raccoon, beaver, and foxes. In addition, the destruction of the bosque will provide fewer nesting and feeding areas for migratory birds and this may have adverse effects on many species of these birds, including the rare and endangered whooping crane. The creation of haul roads will open up the remaining area of the bosque to motor bikes and other off-road vehicles, which will further adversely affect the aesthetics and wildlife environment of the river. We feel that the adverse environmental impacts of this project are magnified by the fact that this riparian wildlife environment exists in an increasingly urbanized area where it has special value and thus should be damaged only for the most compelling of reasons. We do not feel that protection from a flood expected to occur but once every 700 years is sufficient to justify this destruction.

50. Proposed mitigation and compensation measures are for the purpose of avoiding adverse impacts to wildlife habitat and dependent wildlife. It is believed that the proposed measures would do this and would maintain or increase nesting and feeding areas for the overall bosque community. While on a much reduced scale mitigation and compensation measures proposed for the lesser degree of flood protection should accomplish the same results. The whooping crane should not be adversely affected by either degree of flood protection. The development of haul roads would not open up the remaining area of the bosque to motor bikes and other off-road vehicles. These roads would be blocked by physical barriers and/or by natural or artificial revegetation. While the effects of SPF flood protection could magnify the negative impacts currently exerted on the woodland by concentrated urbanization without mitigative and compensatory measures, proposed measures would protect and quite possibly enhance wildlife and recreational values. Under the recommended 42,000 c.f.s. degree of flood protection, the bosque in the most urbanized reach, i.e. the Albuquerque Unit, would neither be adversely affected or benefitted. Mitigative and compensatory measures for bosque areas outside the Albuquerque Unit could benefit these areas through management and increased habitat diversity. However, with either plan, there would be a reduction in the riparian woodland.

51. We note with a great deal of concern that, on plate B-3 of Appendix B to the Draft Report, a borrow site has been

51. This oversight has been corrected. However, the project does offer the potential of improving this area by enlarging and deepening it.

placed in the middle of the Ox-bow wetland area. We have been told by an employee of the Corps that plate B-3 is in error. We expect this error to be corrected in the final report.

52. The Corps' Draft Environmental Impact Statement does contain a plan to mitigate the environmental damage which the project would cause. The Fish and Wildlife Service also has proposed a mitigation plan. If the levee plan were to be carried out, the mitigation plan of the Fish and Wildlife Service must be implemented. Mitigation plans, however, are poor substitutes for leaving the natural environment intact and are not able to make whole in any real sense the damaged environment. Furthermore, the Corps has not given--and apparently cannot give--any assurances that the mitigation plan which it has proposed would be carried out.

53. Both the Corps and the Fish and Wildlife Service mitigation plans call for the management of the bosque environment by a governmental agency. We recognize the need for proper management of wildlife in the bosque and endorse the concept that this management ought to be provided for. Such a management plan should not be made contingent

52. Much additional planning, investigation and coordination must be accomplished before a final mitigation plan is developed. Also, the revised degree of flood protection has substantially reduced the initial mitigation plan. The reference to the "natural environment" is not strictly correct since the riverine area has been modified by man for a considerable period. Also, changes to an area, including mitigation plans are not always detrimented. Mitigation and compensation plans will be included as an integral part of the proposed plan of action recommended to Congress for authorization. Other than this recommendation the Corps cannot give any assurance that the mitigation plan would be authorized. Once authorized however, it would be implemented.

53. Concur.

upon the approval of the Corps' levee project: It ought to be done whether or not the proposed project is approved.

B

We also oppose the proposed project because it would be extremely expensive. The Corps has stated that the proposed level of flood protection would cost the taxpayers 48 million dollars at current values. Construction on the project, if it were approved as drafted, would not begin until 1983; and if inflation continues to be with us, the cost of the project in 1983 will be considerably greater than 48 million dollars. Of that 48 million dollars, the Corps' documents state that 8.5 million dollars will have to be provided by the local taxpayers. If the changes in water policy proposed by President Carter in June go into effect, the state and local contribution to this project would increase to 12 million dollars.

The Corps' draft report attempts to justify the cost of the project by the use of benefit/cost ratios for various stretches of the project area. We note that many of these ratios are low and that they are based upon broad, un-

(As the remainder of comments are concerned primarily with the Feasibility Report responses to these comments are included in this report.)

substantiated assumptions concerning both future development in the flood plain and the monetary value of that development. The Sierra Club views these ratios with skepticism. The projected extent and value of development in the flood plain is purely conjectural and, in our opinion, self-serving. The Corps has been given the responsibility to see that inappropriate development does not occur in flood plains. We expect this obligation to be carried out. We feel that the preparation of such benefit/cost ratios should not be left to the agency which will benefit if the project is approved, even if those ratios are reviewed by the Office of Management and Budget. These ratios should be prepared in the first instance by an agency independent of the Corps.

Even if we assume for the moment that the Corps' benefit/cost ratios are on the whole accurate, we have far more pressing needs in our community than providing protection from a flood which will occur but once every 700 years. In this day of limited budgets and resources, the need for the proposed flood protection does not justify the expenditure of scarce public funds that could be better spent elsewhere.

A-27

Despite the high cost of the proposed plan, it would still not provide complete protection for the project area if the 700 year flood were to occur. The levee project will only provide protection from river flooding. If a storm of the magnitude required to cause a 700 year flood occurred over Corrales, for example, much of the damage to Corrales would be done by water flowing through the village toward the river. This damage from "sheet flow" would not be prevented by the rebuilt levees. The levee system, in fact, might actually aggravate the problem by preventing water on the landward side of the levees from reaching the river.

II

The Albuquerque City Council and the Middle Rio Grande Council of Governments have endorsed a modified version of the proposed plan. These bodies have opposed raising the level of flood protection currently provided to Albuquerque but have endorsed raising the level of protection for the areas north and south of Albuquerque to that of Albuquerque. Albuquerque currently is protected from a flood of 42,000 cubic feet per second, a flood expected to occur once every 270 years.

The Sierra Club agrees that the Albuquerque area needs no greater degree of protection than it now has. Indeed, the Corps of Engineers in its August 1976 revision of its "Plan of Study" for the Albuquerque Greater Urban Area stated, at page 40, that the levees protecting Albuquerque are adequate from the standpoint of both capacity and structure. We have not seen any data which adequately explain why the Corps has changed its position on the adequacy of the Albuquerque levees in less than three years.

The Sierra Club does not endorse the idea that all of the levees between Corrales and Albuquerque and between Albuquerque and Belen should be rebuilt to provide 270 year flood protection. Many of these areas are not in the process of becoming urbanized. We feel that nothing should be done to the existing levee system except in the areas of extensively developed communities such as Corrales and Belen. The Corps estimates that the levees in Corrales provide protection from a flood expected to occur once every 19 years and the levees in Belen provide protection from a flood expected to occur once every 26 years. It may well be that these two populated communities and perhaps some others in this stretch of the river

A-29

should have greater protection than they currently have. However, any project to rebuild these levees should be part of an overall coherent approach to flood plain management and erosion control in the Middle Rio Grande area.

It is the Sierra Club's position that man-made devices to control the flow of the river should be kept to an absolute minimum. The flooding of a river is a natural and necessary process, much like forest fires caused by nature. A river flood removes silt from the riverbed and reduces the danger of disastrous floods, much in the same way that periodic fires caused by nature prevent the build-up of undergrowth in a forest which, if allowed to remain, would greatly increase the damage caused by later fires. Man-made devices, such as levees, are, at best, stop-gap and temporary measures that very often, in the long run, merely aggravate the problem which they were created to cure.

The current situation in the Rio Grande is a good example of the results of man's efforts to control the river. The three dams immediately up-river from Albuquerque--Cochiti, Jemez and Galisteo dams--were built for flood protection.

A-30

They have decreased the peak flows of water through the Rio Grande and have thus decreased the ability of the river to carry silt from the riverbed. In addition, the existing levee system has constricted the bed of the river and has prevented sediment from being deposited by the river on the land to the landward sides of the levees. These two constrictions on the river--plus the increased erosion of the watershed area--have caused the Rio Grande to "silt-up," with the result that the bed of the river is in many places a number of feet higher than the land to the landward sides of the levees. In a natural environment, the bed of the river would be in the lowest area in its valley. In the present situation, if the levees of this elevated river channel were breached by a flood, the flood would do much more damage to the surrounding area than a flood occurring in an untampered-with channel. The only permanent solution is for us to learn to live with the river and to keep artificial controls on the river to an absolute minimum.

Thus, any reconstruction of levees along the river must be part of an overall coherent approach to flood plain management and erosion control.

The most important element of this approach must be a strong--and strongly enforced--system of flood plain zoning to severely limit and prevent further development within the flood plain of the river in areas not already extensively developed. Under the current system, all of us are subsidizing the few who choose to live in the flood plain by paying for a levee system to protect those people. A strong plan of flood plain zoning for areas in the flood plain not extensively developed would eliminate the need for greater flood protection in the undeveloped or less developed areas.

Secondly, this comprehensive approach should include an aggressive program of watershed management. Overgrazing and poor construction practices have caused increased erosion in the Rio Grande watershed. This erosion has caused large amounts of sediment to be carried into the river. In addition, the lack of vegetation prevents precipitation from being absorbed into the watershed: The water quickly runs off the watershed into the river, thus increasing the flow of the river and the danger of flooding. This program of watershed management should include the strict control of grazing, timber cutting, farming and construction practices to decrease substantially the ero-

A-32

sion of the watershed. An intensive program of seeding, planting and terracing the watershed should be undertaken in those areas where erosion has already occurred. Small catchment dams should be constructed along the tributaries of the Rio Grande to slow the flow of water into the river. This plan for watershed rehabilitation would, of course, cost money; but it could go a long way toward reversing the alarming trend of increased erosion and aggradation of the riverbed currently present in the Rio Grande.

Thirdly, this comprehensive approach should provide for the controlled release from Cochiti dam of large amounts of water of sufficient velocity to carry away the silt in the riverbed and thus to degrade the channel. This plan for controlled release would have to be carefully coordinated so it would not jeopardize water rights and so it would not damage the irrigation systems along the river. If the bed of the river were lowered by a number of feet, the danger of a flood of a capacity sufficient to top the existing levees would be greatly diminished.

In conclusion, the Sierra Club strongly feels that the reconstruction of the levees in the communities to the

north and south of Albuquerque should be part of a comprehensive approach of flood and erosion control, as outlined above. Any reconstructed levees in this area should be kept as small as is necessary to protect the property already located in the flood plain in these communities. In addition, there should be guarantees from the federal government that the mitigation plan recommended by the Fish and Wildlife Service for the environmental damage to be caused by levee reconstruction in these communities will be implemented.

Rio Grande Levee Task Force,
Rio Grande Chapter,
Sierra Club

By Kevin V. Reilly
Kevin V. Reilly,
Task Force Chairman
P. O. Box 25271
Albuquerque, New Mexico 87125

Submitted: March 26, 1979

A-34

THE UNIVERSITY OF NEW MEXICO ☐ ALBUQUERQUE, NEW MEXICO 87131
DEPARTMENT OF BIOLOGY ☐ TELEPHONE 505: 277-3411

12 March 1979

The Honorable Ann Dunlap, Mayor
The Village of Corrales
Corrales, N.M. 87048

Dear Mayor Dunlap:

The purpose of this letter is to provide you with a comment regarding the proposed levee reconstruction plan currently under consideration by the Army Corps of Engineers. My intent is that you may introduce this statement into the record at tonight's hearing on this subject.

4. In reviewing the report of the Corps, especially the environmental section, I noted with interest the list of agencies, officials, and others that had been advised of the availability of the report. My concern is that the Biology Department at the University of New Mexico has never been consulted in the preparation of the limited environmental study, and is not included on the list of agencies notified of the report. This ommission seems to me to be important because the UNM Biology Department specializes in environmental biology, has a national reputation in this subject, and has a large staff of people whose specialties for many years have involved the environment and life of the Rio Grande Valley. Obviously it makes sense to utilize local experts. I would hope that when the definitive impact study, as recommended by the Fish and Wildlife Service, is planned, local expertise, including that of the many interested and concerned specialists in our department, is involved.

Sincerely,

James S. Findley
Professor and Chairman

54. Much of the biological data presented in the Draft Environmental Statement was obtained from UNM publications, from material developed at UNM, and from occasional consultation. Also, material from New Mexico State University was utilized. UNM will be equally considered for performing detailed biological studies along with other Universities and organizations. It is recognized that UNM contains a national reputation in this subject and that personnel have considerable knowledge of the riparian ecosystem of the Rio Grande in this area.

A-35

12 March 1979
P.O. Box 44
Corrales, N.M. 87048

The Honorable Ann Dunlap, Mayor
The Village of Corrales
Corrales, New Mexico

Dear Mayor Dunlap:

The purpose of this letter is to put on record certain remarks concerning the proposal by the Army Corps of Engineers to rebuild the levees on the river side of the Corrales Riverside drain. We hope that you will enter this letter into the record of the hearings to be held tonight in Albuquerque.

We are concerned that the ACE plan does not address itself adequately to two problems:

(1) Much of the flooding in Corrales comes from heavy rainfall on the West Mesa with attendant runoff down the several arroyos that empty into the Corrales floodplain. The ACE plan addresses itself only to flooding which may result from from high water in the channel of the Rio Grande resulting from local rainfall in a restricted "uncontrolled area" below Cochiti, Jemez, and Galisteo resevoirs. While we obviously would like to be protected from flooding from any source, we feel that the most likely flooding in our area is from West Mesa runoff and from snowmelt. The latter is presumably taken care of by the existent dams, and the former is not dealt with by the ACE plan.

(2) The riverside area in Corrales harbors one of the very few remaining stands of Rio Grande cottonwood gallery forest. At best, the extent of this type of forest was very limited, to parts of Arizona, New Mexico, and adjacent Texas. Most of this forest has been sytematically destroyed (much of it by the Corps of Engineers and other Federal agencies). None of this destruction has been preceded by an adequate environmental impact study with the goal of assessing how much of this habitat is left, what unique species are being destroyed, and the like. The present case is no exception. The fact that biologists employed by the Corps have made studies is completely irrelevant because of the obvious conflict of interests. This is not to impugn the

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We certainly do not suggest that someones home be put in jeopardy simply to save a few trees. Our own home, in which we have lived for 18 years, which we built with our own hands, and in which we have raised our four children, is subject to flooding if the riverside levees fail. We do suggest that before a possibly irreplaceable natural resource is subjected to destruction by Army bulldozers an adequate impact study be ordered and alternative ways of providing added protection be seriously studied.

As a final note, as one who has reviewed and participated in many environmental impact studies, one of us (Jim) is fully aware that a commercial enterpreneur (such as the ACE in this case) can buy any kind of impact study that is wanted. It would seem especially important in this case that the contractor who conducts the impact study be selected by an independent and impartial body, and that the contractor not be a commercial environmental assessment company.

55

Sincerely,

Muriel T. Findley

James S. Findley

55. Refer to response 54.

A-37

APPENDIX B

Evaluation of Section 404(b) Guidelines

Evaluation of Section 404(b) Guidelines

Potentially Affected Parts of the Channel.

1. Riparian Woodland. As stated in Section I 404 is applicable to "waters of the United States." This applies to the Rio Grande. However, the limit of jurisdiction is defined as the "ordinary high water mark." In turn, the ordinary high water mark is defined as "the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of soil; destruction of terrestrial vegetation; the presence of litter and debris; or other appropriate means that consider the characteristics of the surrounding areas." Applying this definition, the ordinary high water mark of the Rio Grande is the low bank on either side of the sandy channel. Therefore, the riparian woodland is outside of the ordinary high water mark and the additional placement of fill required for levee enlargement would not fall within the jurisdiction of Section 404.

2. Wetlands. There are four wetlands in or very near the limits of the proposed plan of action. The project has been designed to avoid any physical disturbance to the three largest and most significant of the four. However, there is a small, approximately 1½-acre wetland located on the west side of the river about one-half mile north of the city of Belen. This area was created on the riverside of the levee as a local fishing pond but in recent years has not been kept up and is currently surrounded by illegally dumped refuse. If levee alignment cannot be moved toward the landward side it would be partially filled. While this wetland currently has low wildlife and recreational values, it is technically a wetland and adverse impacts must be addressed under

Section 404(b) guidelines. Riverside drains would not be considered wetlands since they are regularly maintained.

3. Normal Conveyance Channel. This is the wide, sandy channel between the riparian vegetation. Borrow material will be taken from this area. It is inevitable that during construction a small amount of the sandy bed will be displaced or rearranged. Displacement would be of a localized nature, being generally confined to the sandy channel. This movement of earth would fall within the jurisdiction of Section 404 in that the term "discharge of dredged material" includes "without limitation, the addition of dredged material to a specified disposal site located in waters of the United States . . . ." Compliance with Section 404(b) and other applicable regulations and executive orders is as follows.

EVALUATION OF THE EFFECTS
OF THE DISCHARGE OF DREDGED OR FILL MATERIAL INTO
WATERS OF THE U.S. USING THE SEC 404(b) GUIDELINES

I. Project Description

a. Description of the proposed discharge of dredged or fill materials.

(1) General characteristics of material. See Section II, para 2.16, page II-6.

(2) Quantity of material proposed for discharge. Unknown at this stage of planning, but would be a very small quantity.

(3) Source of material. Normal conveyance channel: From the channel itself. See Section I, para 1.10, page I-6. Wetland: From existing levee and from woodland between channel and levee. See Section I, para 1.10, page I-5.

b. Description of the proposed disposal site(s) for dredged or fill material.

(1) Location. Conveyance channel: Various locations along channel where borrow areas would be located. See Section I, para 1.24, page I-11. Exact locations of borrow areas unknown at this time. Wetland: One-half mile north of New Mexico, Route 6 bridge at Belen on west side of river.

(2) Type of disposal site(s). Conveyance channel: Sand pushed around in channel. Wetland: Within wetland itself.

(3) Method of discharge. Moved by heavy machinery.

(4) When will disposal occur? Exact date unknown, but will commence when borrow activities begin.

(5) Projected life of disposal site(s). Conveyance channel: Disturbed areas should be erased within 1 year. Wetland: Life of levee.

(6) Bathymetry (if open-water disposal) N/A.

2. Physical Effects

a. Potential destruction of wetlands - effects on.

(1) Food chain production. Conveyance channel: Negligible. Wetland: Reduction commensurate with degree of filling. Small reduction as far as ecosystem is concerned.

(2) General habitat. Conveyance channel: Negligible. Wetland: Small impact as far as ecosystem is concerned.

(3) Nesting, spawning, rearing and resting sites for aquatic or land species. Conveyance channel: Negligible. Reduction commensurate with degree of filling. Small impact as far as ecosystem is concerned.

(4) Those set aside for aquatic environment study or sanctuaries or refuges. Both: N/A.

(5) Natural drainage characteristics. Both: Negligible.

(6) Sedimentation patterns. Both: Insignificant impact.

(7) Salinity distribution. Both: No impact.

(8) Flushing characteristics. Both: No impact.

(9) Current patterns. Both: No impact.

(10) Wave action, erosion or storm damage protection. Both: N/A.

(11) Storage areas for storm and floodwaters. Both: N/A.

(12) Prime natural recharge areas. Both: N/A.

b. Impact on water column.

(1) Reduction in light transmission. Conveyance channel: Insignificant impact. Wetland: Turbidity associated with construction activities would temporarily decrease light penetration.

(2) Aesthetic values. Conveyance channel: Insignificant impact. Wetland: Further small degradation of aesthetic values.

(3) Direct destructive effects on nektonic and planktonic populations. Conveyance channel: Insignificant. Wetland: Partial loss of habitat.

c. Covering of benthic communities.

(1) Actual covering of benthic communities. Conveyance channel: Insignificant impact. Wetland: Loss of about 15-20 percent benthic biota.

(2) Changes in community structure or function. Conveyance channel: Insignificant impact. Wetland: In all probability, structure and function would be similar to preproject condition.

d. Other effects.

(1) Changes in bottom geometry and substrate composition. Conveyance channel: Insignificant impact. Wetland: A small portion of bottom would be covered.

(2) Water circulation. Conveyance channel: Insignificant impact. Wetland: Small impact, if any.

(3) Salinity gradients. Both: Insignificant impact.

(4) Exchange of constituents between sediments and overlying water with alterations of biological communities. Both: Insignificant.

3. Chemical - Biological Interactive Effects

a. Does the material meet the exclusion criteria? Both: Yes. Displaced material will be same as surrounding material and will be moved only a short distance.

b. Water column effects of chemical constituents (Elutriate test optional, but recommended.) Are contaminants released? If so, at what levels? Both: Because of the similarity of material no significant impacts would occur.

c. Effects of chemical constituents on benthos. Conveyance channel: No impact. Wetland: Insignificant.

4. Description of site comparison

a. Total sediment analysis. Not necessary.

b. Biological community structure analysis. Conveyance channel: Not necessary because of poverty of aquatic community and severe limitations to development and maintenance. Wetland: Not considered necessary because of limited area of aquatic biota.

5. Review Applicable Water Quality Standards

a. Compare constituent concentrations. Both: Not necessary because of similarity of materials.

b. Consider mixing zone. Both: Insignificant impact.

c. Based on a and b above, will disposal operation be in conformance with applicable standards? Yes.

6. Selection of Disposal Sites for Dredged or Fill Material

a. Need for the proposed activity. Conveyance channel: Haul roads to borrow sites in channel and relocation of small amounts of sand incurred as a consequence of borrow activities. Wetland: Increased area required for levee enlargement.

b. Alternatives considered. Convenance channel: None. Wetland: Alter alignment of levee.

c. Objectives to be considered in discharge determination.

(1) Impacts on chemical, physical, and biological integrity of aquatic ecosystem. Conveyance channel: Insignificant impact. Wetland: Reduction through decrease in area.

(2) Impact on food chain. Conveyance channel: No impact. Wetland: Small reduction through decrease in area.

(3) Impact on diversity of plant and animal species. Conveyance channel: Insignificant impact. Wetland: Possible slight reduction because of reduction in size.

(4) Impact on movement into and out of feeding, spawning, breeding, and nursery areas. Both: N/A.

(5) Impact on wetland areas having significant functions of water quality maintenance. Both: None anticipated.

(6) Impact on areas that serve to retain natural high waters or floodwaters. Both: None.

(7) Methods to minimize turbidity. Conveyance channel: Expected small and momentary increase in turbidity to already turbid waters should not require stringent measures beyond normal environmental protection measures. Wetland: None anticipated.

(8) Methods to minimize degradation of aesthetic, recreational, and economic values. Conveyance channel: Should not be required because of insignificant impact to these values. Wetland: These values are currently low. Best solution to enhance these values would be to restore existing wetland and move levee alignment or create a new wetland and retain existing levee alignment.

(9) Threatened and endangered species. Both: No impact foreseen.

(10) Investigate other measures that avoid degradation of aesthetic, recreational, and economic values of navigable waters. Conveyance channel: Impacts not significant enough to warrant such investigations. Wetland: See c(8).

d. Impacts on water uses at proposed disposal site.

(1) Municipal water supply intakes. Both: N/A.

(2) Shellfish. Both: N/A.

(3) Fisheries. Both: Insignificant impact.

(4) Wildlife. Conveyance channel: Insignificant impact. Wetland: Reduction of aquatic habitat.

(5) Recreation activities. Both: Insignificant impact.

(6) Threatened and endangered species. Both: Insignificant impact.

(7) Benthic life. Conveyance channel: Insignificant impact. Wetland: Significant reduction of limited benthic life.

(8) Wetlands. Conveyance channel: No impact. Wetland: Impair existing aquatic life and associated limited recreational use.

(9) Submersed vegetation. Conveyance channel: No impact. Wetland: Will cover a portion of submerged vegetation.

(10) Size of disposal site. Conveyance channel: Small and localized. Cumulative impact would not be significant. Wetland: Would approach 15 to 20 percent of wetland area.

(11) Coastal Zone Management programs. N/A.

e. Considerations to minimize harmful effects. Because of the largely negligible impacts resulting from the shifting of sand within the normal conveyance channel, no additional construction techniques, other than normal environmental protection measures, are considered necessary. Wetland: See c(8).

(1) Water quality criteria. All applicable city, State, and Federal water standards will be maintained and no degradation of water quality will be permitted.

(2) Investigate alternatives to open water disposal. Both: N/A.

(3) Investigate physical characteristics of alternative disposal sites. Both: Not pertinent.

(4) Ocean dumping. Both: N/A.

(5) Where possible, investigate covering contaminated dredged material with cleaner material. Both: N/A.

(6) Investigate methods to minimize effect of runoff from confined areas on the aquatic environment. Both: N/A.

(7) Coordinate potential monitoring activities at disposal site with EPA. Both: Not considered necessary.

7. Statement as to contamination of fill material if from a land source. Both: "Fill" material will be of same physical and chemical composition as that in channel and surrounding wetland.

8. Determine mixing zone. Mixing zone would be small and, considering the volume of suspended sediment being transported by the Rio Grande, largely insignificant.

9. Conclusions and determinations. Because of the volume of suspended sediment currently carried by the Rio Grande, the relative absence of aquatic biota, and the relatively small and localized displacement of sand within the river bed as a consequence of bridge construction and borrow activities, it is not anticipated that water quality would be significantly deteriorated nor would aquatic or terrestrial biotic communities be adversely affected. Partial filling of the small wetland would result in almost a partial loss of existing limited wetland values for wildlife and recreation use.

10. Findings. The shifting of sand within the normal conveyance channel of the Rio Grande would not result in significant water quality deterioration nor would aquatic or terrestrial biota be degraded. The partial filling of the wetland would result in further degradation of existing minimal wildlife and recreational values. However, if a new expanded wetland can be created as one of many proposed as part of project co struction or the existing wetland restored and levee alignment moved slightly, , both biotic and recreational values can be increased.

APPENDIX C

Letter from State Historic Preservation Officer

STATE PLANNING OFFICE

GREER BUILDING
505 DON GASPAR AVE.
SANTA FE 87503
(505) 827-2073

LEILA ANDREWS
STATE PLANNING OFFICER

JERRY APODACA
GOVERNOR

May 13, 1977

Mr. Jasper H. Coombes, P.E.
Chief, Engineering Division
Albuquerque District
Corps of Engineers
P.O. Box 1580
Albuquerque, New Mexico 87103

Dear Mr. Coombes:

Enclosed as you have requested, is a list of sites on the State Register of Cultural Properties and National Register of Historic Places. All sites on the State Register may be considered eligible for nomination to the National Register. These sites, as well as areas of known concentrations of archaeological sites are located on the enclosed set of maps of the area under consideration. Registered sites within Albuquerque proper have not been noted since it is highly unlikely that they would be affected by projects of the type you describe.

I agree with your assumption that projects constructed within the present confines of the riverside drains will have little impact on cultural resources. However, associated construction activities such as access roads, equipment parks, and material pits could have a serious impact on any cultural resources located within the area.

Since archaeological surveys conducted in the Rio Grande flood plain indicate a good potential for high concentrations of cultural resources, I recommend that any construction projects resulting from this study be surveyed by the Corps Archaeologist or other qualified institution.

Should you require any additional information regarding this request, do not hesitate to contact this office.

Sincerely,

Thomas W. Merlan, State
Historic Preservation Officer

TWM:DR:jf
Enclosure

APPENDIX D

Population, Employment, Personal Income, and Earnings by Industry Historical and Projected Selected Years, 1950-2020

SMSA * Albuquerque, N.Mex.

1972-E OBERS Projections

Population, Employment, Personal Income, and Earnings by Industry, Historical and Projected, Selected Years, 1950-2020

	1950	1962*	1969	1970	1971	1980	1985	1990	2000	2020
Population, midyear	147,343	281,000	314,700	316,768	330,904	369,400	395,200	422,700	461,600	516,600
Per capita income (1967 $)	2,052	2,477	2,981	3,140	3,198	4,300	4,800	5,500	7,300	12,200
Per capita income relative (U.S.=1.00)	.99	.96	.87	.90	.90	.90	.90	.90	.90	.92
Total employment	52,226	94,182		115,440		149,100	159,300	170,200	192,500	216,300
Employment/population ratio				.36		.40	.40	.40	.42	.42
					In Thousands of 1967 Dollars					
Total personal income	302,322	695,914	938,248	994,617	1,058,305	1,592,400	1,928,200	2,334,800	3,390,100	6,309,000
Total earnings	250,991	581,828	761,169	801,121	850,210	1,279,200	1,537,700	1,848,300	2,656,300	4,884,000
Agriculture, forestry and fisheries	2,277	2,674	749	700	-421	1,600	1,600	1,700	1,800	2,300
Agriculture						1,500	1,600	1,600	1,800	2,200
Forestry and fisheries						(S)	(S)	(S)	(S)	(S)
Mining	328	1,472	1,629	1,765	2,082	2,400	2,600	2,800	3,400	4,600
Metal						1,100	1,200	1,400	1,800	2,600
Coal										
Crude petroleum and natural gas						1,500	1,500	1,500	1,700	2,000
Nonmetallic, except fuels						(S)	(S)	(S)	(S)	(S)
Contract construction	41,954	47,231	50,065	56,795	65,300	98,100	115,400	135,800	186,900	316,600
Manufacturing	22,031	53,404	58,956	62,263	66,487	108,800	132,100	160,300	225,300	397,400
Food and kindred products						13,700	15,400	17,300	21,800	33,000
Textile mill products						(S)	(S)	(S)	(S)	(S)
Apparel and other fabric products						4,800	6,000	7,600	11,100	19,800
Lumber products and furniture						8,300	9,800	11,600	15,500	25,400
Paper and allied products										
Printing and publishing						9,600	11,700	14,300	20,900	39,000
Chemicals and allied products						(S)	(S)	(S)	(S)	(S)
Petroleum refining						(S)	(S)	(S)	(S)	(S)
Primary metals						(S)	(S)	(S)	(S)	(S)
Fabricated metals and ordnance						5,900	6,800	7,900	10,400	17,000
Machinery, excluding electrical						15,700	20,300	26,100	38,500	72,200
Electrical machinery and supplies						10,400	13,200	16,800	26,200	52,400
Motor vehicles and equipment						2,300	2,500	2,700	3,100	4,600
Transportation equip., excl. mtr. vehs.						17,400	20,100	23,300	29,700	44,800
Other manufacturing						19,200	24,300	30,800	45,800	85,800
Trans., comm. and public utilities	20,460	44,388	51,946	55,350	61,171	89,200	106,800	127,900	183,500	337,000
Railroad transportation						5,600	5,300	4,900	4,400	3,700
Trucking and warehousing						22,600	27,100	32,500	46,300	82,700
Other transportation and services						12,600	14,900	17,700	24,100	40,100
Communications						37,400	46,400	57,600	87,700	174,900
Utilities (elec., gas, sanitary)						10,800	12,800	15,100	20,800	35,500
Wholesale and retail trade	49,850	105,713	135,858	142,619	155,054	224,000	262,800	308,300	428,900	733,300
Finance, insurance and real estate	16,008	36,728	46,273	48,677	53,041	86,600	107,200	132,700	199,900	391,600
Services	34,618	160,491	206,155	214,238	218,151	358,400	438,600	536,700	797,400	1,514,300
Lodging places and personal services						18,000	19,700	21,500	26,100	36,600
Business and repair services						169,800	212,000	264,700	402,300	773,900
Amusement and recreation services						5,900	7,100	8,500	11,900	20,600
Private households						4,300	4,500	4,600	5,100	6,200
Professional services						160,300	195,000	237,200	351,800	676,900
Government	63,464	129,726	209,538	218,715	229,346	309,700	369,900	441,700	628,800	1,186,300
Federal government	28,999	64,412	88,878	94,388	97,410	124,900	146,800	172,500	236,200	442,800
State and local government	8,070	32,215	79,677	82,484	88,311	137,900	169,900	209,300	315,800	617,400
Armed forces	26,395	33,100	40,983	41,844	43,625	46,700	52,900	59,900	76,700	126,100

*Employment is for 1960.

a—represents 80.0 to 99.9 percent of the true value
b—represents 60.0 to 79.9 percent of the true value
c—represents 40.0 to 59.9 percent of the true value
d—represents 20.0 to 39.9 percent of the true value
e—represents zero to 19.9 percent of the true value

* Bernalillo County only.

APPENDIX E

Land Use

TABLE 1

SUMMARY OF CLASSIFICATION NUMBER AND VALUE OF PROPERTIES IN RIO GRANDE FLOOD PLAIN

Category		Number of Properties								
						Agriculture				
		Residential[a]	Commercial	Industrial	Public	Pasture	Alfalfa	Fruit	Equipment & Misc. Items	Irrigation Facilities
Units		Each	Each	Each	Each	Acres	Acres	Acres	--	Miles
Survey Year 1975	Bank to SPF	37,913	4,039	102	672	10,281.0	26,160.8	675.7	--	500.8
Base Year 1980	Bank to SPF	41,368	4,382	109	655	9,778.0	25,669.8	647.2	--	500.8
1990	Bank to SPF	46,718	4,857	122	694	8,545.0	24,665.3	594.7	--	500.8
2000	Bank to SPF	49,727	5,062	148	720	7,639.5	23,879.8	546.2	--	500.8
2010	Bank to SPF	52,446	5,220	153	747	6,710.5	23,103.8	504.2	--	500.8
2020	Bank to SPF	55,369	5,361	159	769	5,797.5	22,434.3	460.7	--	500.8
2030	Bank to SPF	56,882	5,431	167	780	5,239.5	22,008.8	430.7	--	500.8
2080	Bank to SPF	56,882	5,431	167	780	5,239.5	22,008.8	430.7	--	500.8

NOTE: Continuation of this table follows.

TABLE 1 (Cont'd)

Category		Value of Properties ($1,000)									
						Agriculture					
		Residential*	Commercial	Industrial	Public	Pasture	Alfalfa	Fruit	Equipment & Misc. Items	Irrigation Facilities	Total
Survey Year 1975	Bank - SPF	1,130,563.0	563,318.8	44,971.3	732,811.2	13.3	784.8	84.6	18,549.9	14,568.0	2,505,664.9
Base Year 1980	Bank - SPF	1,243,157.6	610,456.4	54,237.9	787,091.4	12.6	770.1	81.1	17,938.9	14,568.0	2,728,314.0
1990	Bank - SPF	1,413,725.7	681,282.4	67,773.8	861,594.9	11.0	740.0	74.5	16,280.5	14,568.0	3,056,050.8
2000	Bank - SPF	1,532,563.8	704,687.1	86,844.2	903,527.8	9.8	716.2	68.5	14,672.4	14,568.0	3,257,057.8
2010	Bank - SPF	1,646,316.0	719,462.9	101,301.2	939,617.5	8.6	693.1	63.3	13,053.4	14,568.0	3,435,084.0
2020	Bank - SPF	1,745,812.9	732,030.7	118,649.6	974,118.9	7.4	673.0	57.9	11,505.5	14,568.0	3,597,423.9
2030	Bank - SPF	1,797,193.1	737,575.7	141,780.8	988,981.3	6.7	660.2	54.1	10,167.0	14,568.0	3,690,986.9
2050	Bank - SPF	1,797,193.1	737,575.7	141,780.8	988,981.3	6.7	660.2	54.1	10,167.0	14,568.0	3,690,986.9

TABLE 2

Land Use in the Three-County Area (in acres)
N.M.I.S.C. 1974 County Profiles - Sandoval, Bernalillo, and Valencia Counties

	Sandoval		Bernalillo 10/	Valencia		Totals	
	Total Area in County	County Area in Rio Grande Basin	County Area in Rio Grande Basin	Total Area in County	County Area in Rio Grande Basin	Total for Counties	Total for Counties in Rio Grande Basin
Total area 9/	2,378,880	2,112,640	748,160	3,621,120	2,714,880	6,748,160	5,575,690
Inland waters 1/	0	0	0	1,946	1,816	1,946	1,816
Urban & built-up 2/	22,960	22,930	86,180	73,000	72,680	182,140	181,790
Roads 3/	12,482	11,885	8,084	16,035	13,022	36,601	32,991
Cropland (total)	18,850	18,850	17,040	67,280	44,280	103,170	80,170
Irrigated	(17,050)	(17,050)	(13,240)	(44,680)	(44,280)	(78,970)	(74,570)
Dry	(1,800)	(1,800)	(3,800)	(22,600)	0	(28,200)	(5,600)
Defense 4/	0	0	54,537	0	0	54,537	54,537
Parks, FWS 5/	22,743	22,743	0	6,143	5,183	28,886	27,926
Commercial timber 6/	317,522	317,522	55,622	372,418	313,326	745,562	286,470
Grazing lands (total)	1,984,323	1,718,710	526,697	3,084,298	2,264,573	5,595,318	4,509,980
Noncommercial timber 7/	(893,581)	(865,750)	(168,108)	(1,182,284)	(831,815)	(2,243,973)	(1,865,673)
Rangelands 8/	(1,090,742)	(852,960	(358,589)	(1,902,014)	(1,432,758)	(3,351,345)	(2,644,307)

1/ Inland water areas in New Mexico include only lakes and reservoirs with 40 surface acres or more. There are no streams in the state that meet census criteria of 660 feet or more in width.

2/ Urban and built-up areas include land subdivided for residential and industrial areas as well as cities, villages, and other built-up areas of more than 10 acres.

3/ The area for roads does not include roads in parks, military reservations, fish and wildlife refuges, or urban and built-up areas.

4/ Some of the defense lands are also used for grazing.

5/ The areas for parks and fish and wildlife include state and national parks and lands administered by the Fish and Wildlife Service and the New Mexico Department of Game and Fish.

6/ Commercial timber areas include land capable of producing saw timber not withdrawn from timber utilization (e.g., wilderness areas) and is economically available. Practically all of the commercial timber areas are also used for grazing and recreational purposes.

7/ Noncommercial forest and woodlands include productive-reserved (as excluded from commercial timber, footnote 6); unproductive nonreserved (incapable of yielding crops of industrial wood because of adverse site conditions, also, pinon-juniper areas); and unproductive-reserved (such as unproductive forests and woodlands in wilderness areas).

8/ Rangeland areas include grass, shrubs, and brush but does not include cropland that may be used for grazing.

9/ Includes land and inland water areas.

10/ All of county in Rio Grande Basin.

TABLE 3

Land Ownership and Administration in the Three-County Area (in acres)
N.M.I.S.C. 1974 County Profiles - Sandoval, Bernalillo, and Valencia Counties

	Sandoval		Bernalillo 5/	Valencia		Totals	
	Total Area in County	County Area in Rio Grande Basin	County Area in Rio Grande Basin	Total Area in County	County Area in Rio Grande Basin	Total for Counties	Total for Counties in Rio Grande Basin
Total area 1/	2,378,880	2,112,640	748,160	3,621,120	2,714,880	6,748,160	5,575,680
Indian lands 2/	650,380	502,530	222,527	849,551	695,251	1,722,458	1,420,308
Federal lands (total)	987,297	896,097	154,590	700,034	643,252	1,841,921	1,693,939
Forest Service	(371,228)	(371,228)	(76,860)	(284,451)	(266,009)	(732,539)	(714,097)
BLM	(588,449)	(497,249)	(17,225)	(381,293)	(342,953)	(986,967)	(857,427)
Defense	0	0	(54,537)	0	0	(54,537)	(54,537)
Miscellaneous 3/	(27,620)	(27,620)	(5,968)	(34,290)	(34,290)	(67,878)	(67,878)
State lands 4/	80,192	73,792	32,201	251,746	161,358	364,139	267,351
Private and other miscellaneous	661,011	640,221	338,842	1,819,789	1,215,019	2,818,642	2,194,082

1/ Includes land and inland water areas.
2/ Includes Federal land withdrawn by the Bureau of Indian Affairs (administrative and tribal uses).
3/ Includes national parks, monuments, land administered by the Fish and Wildlife Service, Bureau of Reclamation, etc.
4/ Includes trust lands and lands deeded to specific state agencies.
5/ All of county in Rio Grande Basin.

APPENDIX F

Air Quality Standards

and Water Quality Data

Air Quality Standards

a. Carbon Monoxide.

National Standards:

Primary. 10 milligrams per cubic meter (9 ppm) - maximum 8-hour concentration not to be exceeded more than once per year.

Secondary. 40 milligrams per cubic meter (35 ppm) - maximum 1-hour concentration not to be exceeded more than once per year.

New Mexico Standards:

Primary. 8-hour average, 8.7 ppm.

Secondary. 1-hour average, 13.1 ppm.

b. Particulates.

National Standards:

Primary. (a) 75 micrograms per cubic meter - annual geometric mean; (b) 260 micrograms per cubic meter - maximum 24-hour concentration not to be exceeded more than once per year.

Secondary. (a) 60 micrograms per cubic meter - annual geometric mean, as a guide for achieving a 24-hour standard; (b) 150 micrograms per cubic meter - maximum 24-hour concentration not to be exceeded more than once per year.

New Mexico Standards: Maximum concentrations are:

24-hour average	150 ug/m^3
7-day average	110 ug/m^3
30-day average	90 ug/m^3
Annual geometric mean	60 ug/m^3

TABLE 1: Stream Quality Compared to Stream Standards
Middle Rio Grande Basin

STORET Parameter No.	NO.		00060	00010	00300	00095	00070	70300	00940	00945	00310	00335	00680	00400	31616	00665	71886	00625	0061	00620	00610
	Gaging	Period of	Flow	Temp.	DO	Conductivity	Turbidity	Residue (TDS)	Chloride	Sulfate	BOD	COD	TOC	pH	Fecal	Phosphorus		Nitrogen			
STATION NAME	Station #	Sampling	cfs	°C	mg/l	MICROMHO	JTU	Total Filt mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	SU	Coliform[1] org/100ml	Total mg/l	PO_4 mg/l	Total (Kjel) mg/l	NO_3 mg/l	NH_3 mg/l	
Rio Grande below Cochiti Dam	08317400	11/3/71-11/12/74	777.4	10.4	8.3	370.5								8.3							
SEGMENT STANDARD				32.2	>6.0									6.6 to 9.0	1000						
Jemez River below Jemez Dam	08329000	2/3/66-5/27/75	159.3	10.2		1371.10	729.0	845.9	182.7	236.2				7.8							
Piedra Lisa Arroyo near Bernalillo	08329100	7/19/56-8/29/67	12.4	19.6		340.3								7.03							
Rio Grande at Albuquerque	08330000	5/8/69-12/17/73	1400.4	14.95		614.0		448.0	37.0	150.0				7.85							
Rio Grande at Isleta	08331000	7/2/70-6/20/74	1686.8	15.8	7.64	461.5	621.5	300.1	17.8	81.2			11.04	7.7	349.8	1.27		2.03			0.83
Rio Grande Conveyance Channel at Bernardo	08331990	11/22/64-2/20/75	750.0	13.0		613.8	400.0	384.8	22.2	129.9				7.7		0.66					
Rio Grande Floodway near Bernardo	08332010	3/5/60-6/11/75	986.0	13.7	9.80	511.0	50.0	317.7	17.0	98.1				7.7		0.66		1.40			0.50
Rio Puerco near Bernardo	08353000	10/19/60-5/30/75	355.4	19.8		2287.2		1672.3	105.0	957.2				7.6							
Rio Salado near San Acacia	08354000	6/21/66-10/8/74	302.5	21.9		1351.7		990.2	98.8	357.4				7.5							
Rio Grande Conveyance Channel at San Acacia	08354800	10/18/60-12/31/73	807.7	15.0		1820.0							201.0	7.85							
Rio Grande Floodway at San Acacia	08354900	10/2/60-12/31/73	803.6	17.2		1219.5		699.0	28.0	260.0			88.0	7.5							
Rio Grande Conveyance Channel at San Marcial	08358300	10/23/59-9/29/75	673.7	13.6	8.58	935.3	3301.8	530.4	60.9	186.5	4.0	12.3	204.1	7.8	556.9	1.38	0.72	3.13			0.36
Rio Grande Floodway at San Marcial	08358400	11/4/59-2/18/75	565.6	17.9	8.3	817.8	7665.7	507.5	32.9	208.4	2.0	49.75	34.8	7.7	1382.6	2.4	0.34	5.4			0.26
SEGMENT STANDARD				<32.2	>4.0			<1500[2]	<250[2]	<500[2]				6.0 to 9.0	1000[2]						

1/ Geometric mean for period of sampling.
2/ See Table 2, Surface Water Standards, for detailed standards.
Note: All data are means for period of record.
Source: Middle Rio Grande Basin Plan, New Mexico Water Control Commission

Table 2: Surface Water Standards
Middle and Upper (in part) Rio Grande Basins

(00010)		(00030)	(31616)		(00400)	(00680)	(00665)	(70301)	(00945)	(00940)	(00070)
Temperature		Dissolved Oxygen	Fecal Coliform Bacteria[1]		pH	Total Org. Carbon	Total Phosphorus	TDS	Sulfate	Chloride	Turbidity
Maximum °C	Maximum Increase °C	mg/l	100/ 100ml	1000/ 100ml	SU	mg/l	mg/l	mg/l	mg/l	mg/l	FTU
The main stem of the Rio Grande from the headwaters of Elephant Butte upstream to the Angostura Diversion Works, including any flow below the perennial reaches of the Rio Puerco and Jemez River which enters the main stem of the Rio Grande.											
32.2	2.7	> 4.0		X	6.0 to 9.0			2/ <1,500	2/ <500	2/ <250	
The main stem of the Rio Grande from Angostura Diversion Works upstream to Cochiti Dam.											
32.2	2.7	> 6.0		X	6.6 to 9.0						
Cochiti Reservoir											
	1.7	> 6.0	X		6.6 to 9.0						

1/ Monthly logarithmic mean and, based on a minimum of 5 measurements per 30-day period, no more than 10% of the samples shall exceed 200/100 ml or 2,000/100 ml, respectively.
2/ At mean monthly flows above 100 c.f.s.
3/ The open water shall be free of algae in concentrations which cause nuisance conditions or gastrointestinal or skin disorders.
Source: Middle and Upper Rio Grande Basin Plans, Water Control Command

APPENDIX G

Summation of U.S. Fish and Wildlife and U.S. Corps of Engineers Recommendations for Compensation of Fish and Wildlife Resources

Summation of U.S. Fish and Wildlife
and U.S. Corps of Engineers Recommendations
for Compensation of Fish and Wildlife Resources

In accordance with the provision of the Fish and Wildlife Coordination Act, the U.S. Fish and Wildlife Service prepared and submitted to the Corps a Coordination Act Report addressing the anticipated impact that the initially considered SPF flood protection plan would have on fish and wildlife resources. This report accompanied the Draft Interim Feasibility Report. Twelve recommendations pertaining to fish and wildlife preservation, study, and mitigation measures were stated. Major items recommended to mitigate or compensate for project-induced degradation of wildlife resources consisted of (1) drain habitat improvements, (2) revegetation, (3) acquisition of 750 acres of fallow land to be managed to a comparable habitat value of existing riparian woodlands, (4) conversion of 300 acres of borrow pits to palustrine-type wetlands (marshes), and (5) that compensation land be acquired at project cost and made available to the New Mexico Department of Game and Fish with appropriate operation and maintenance funds.

The Corps conducted a similar analysis to determine mitigation and compensation measures. This analysis demonstrated that the development of 125 acres of marsh and construction of recreational trails as project purposes would more than mitigate for project-induced losses to consumptive recreational activities; i.e., hunting, fishing, sightseeing, bicycling, and horseback riding. It also found that impairments to the riparian woodland and dependent wildlife could be compensated by the (1) creation of the previously mentioned 125 acres of marsh, (2) management of approximately 2,800 acres of riparian woodland, and (3) the acquisition of about 250 acres of contiguous cottonwood woodland. Development of drain habitat features would be accomplished where possible and would be

compatible with proper functioning of the drains. The selection of compensation measures was made on the basis of present and future needs required to preserve the quality of the riparian ecosystems, the restoration of previously lost marshes, and the need to maintain the present amount of woodland for dependent wildlife. Since the degree of protection has been modified, no discussion of the differences in compensation measures and their determination will be presented.

As the recommended degree of flood protection was reduced from SPF protection to 270-year protection following field-level coordination of the Draft Interim Feasibility Report, the Fish and Wildlife Service was asked to reevaluate the need for mitigation based on reduced project impacts. During the subsequent reanalysis, several options were evaluated including (1) purchase and management of fallow fields, (2) purchase and management of privately owned riparian woodland habitats, (3) management of Middle Rio Grande Conservancy District (MRGCD) administered riparian woodlands, and (4) creation of wetland habitat. Required acreages include 200, 425, 1,000, and 75 acres, respectively. The Service recommended a combination of options 2, 3, and 4, acquisition and management of 200 acres of privately owned riparian woodland, management of 1,000 acres of riparian woodland, and creation of 75 acres of marsh.

Correspondingly, the Corps did a reanalysis of mitigation and compensation needs. As before, the analysis demonstrated that the development of marshes (approximately 75 acres) and the possible construction of recreational trails as project purposes would more than mitigate for consumptive and nonconsumptive recreational activities impaired as a consequence of project construction. A reanalysis of compensation measures for intangible impairments to the riparian woodland and dependent wildlife

utilized the same options evaluated by the Service. It is mutually believed that these options would best benefit the riparian ecosystem. A combination of options was also recommended by the Corps, consisting of the creation and management of 75 acres of marsh habitat, the management of contiguous woodland, and the acquisition and management of about 200 acres of fallow land and/or cottonwood woodland. As stated, a substitution of the various options would probably have to be made as more intensive investigations are made. The substitution of increased management for acquired land is a probable substitution. The remainder of the 12 recommendations made in the Coordination Act Report and retained in the reanalysis are generally concurred with. Realizing that more planning and investigation are necessary, the Service and the Corps are in general agreement as to compensation measures at this time.

D.E.R.
Revised March 1980
(for Eddie Natter's Use

United States Army
Corps of Engineers
Albuquerque District
MAY 1979

MIDDLE RIO GRANDE FLOOD PROTECTION BERNALILLO TO BELEN, NEW MEXICO

INTERIM FEASIBILITY REPORT

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APPENDIX A

PROBLEM IDENTIFICATION

APPENDIX A

TABLES

TABLES (cont'd)

PLATES

PLATES (Cont'd)

The purpose of this appendix is to identify the problems and needs of the study area. In order to fully understand these problems, it is first necessary to recognize the existing environmental, social, and economic characteristics of the area and then to project the growth and changes which are anticipated to take place within the project life. Finally, an assessment of the impacts on these existing and future conditions of "doing nothing" culminates in the identification of specific problems and needs.

SECTION A

AUTHORITY

The need for water resource and related land use development has long been recognized, and numerous Congressional resolutions have authorized studies on the Rio Grande, particularly in the report study area. The basic authority and the authorizing resolutions are given in the subsequent paragraphs.

Public Law No. 228, 77th Congress, 1st Session, H.R. 4911, dated 18 August 1941.

> Sec. 4. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys for flood control, to be made under the direction of the Chief of Engineers, in drainage areas of the United States and its Territorial possessions, which include the following-named localities:
>
> Rio Grande and tributaries, New Mexico

Senate Resolution, dated 2 August 1950.

> RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby, requested to review the report on Rio Grande and tributaries, New Mexico, published in House Document Numbered 243, Eighty-first Congress, First Session, with a view to determining whether any modification should be made in the recommendations contained therein at this time with respect to works for local flood protection along the main stem and tributaries of the Rio Grande at and in the vicinity of Albuquerque, New Mexico.

House of Representatives Resolution, dated 11 June 1952.

RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, UNITED STATES, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the report on the Rio Grande and tributaries, New Mexico, submitted in House Document No. 243, 81st Congress, 1st Session, and prior reports, with a view to determining whether any modification should be made in the recommendations contained therein at this time with respect to works for local flood protection along the main stem and tributaries of the Rio Grande at and in the vicinity of Albuquerque, New Mexico.

Senate Resolution, dated 28 June 1956.

RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby requested to review the report of Rio Grande and tributaries, New Mexico, published in House Document Numbered 243, Eighty-first Congress, First Session, with a view to determining whether any additional modification should be made in the recommendations contained therein at this time.

Senate Resolution, dated 17 July 1969.

RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby requested to review the report of the Chief of Engineers on the Rio Grande and tributaries, New Mexico, published as House Document Numbered 243, Eighty-first Congress, and other pertinent reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at the present time, with particular reference to providing improvements in the interest of flood control and allied purposes in that part of the drainage basin extending from Los Lunas to the vicinity of Belen, New Mexico.

House of Representatives Resolution, dated 11 April 1974.

RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, UNITED STATES, That the Board of Engineers for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on the Rio Grande and tributaries, New Mexico, published in House Document Numbered 243, Eighty-first Congress, First Session, with a view to determining whether any modifications of the recommendations contained therein are advisable at the present time, with particular reference to providing a plan for development, utilization and conservation of water and related land resources of "the metropolitan region of the Rio Grande from Cochiti Lake to Elephant Butte Reservoir, with due consideration for the metropolitan planning activities in the six-county area, consisting of Santa Fe, Sandoval, Bernalillo, Valencia, Socorro and Sierra Counties." Such studies to include appropriate consideration of the needs for protection against floods with particular emphasis on the levee system of the Middle Rio Grande Conservancy District, wise use of flood-plain lands, regional water supply and waste management facilities system, general recreation facilities, enhancement and control of water quality, enhancement and conservation of fish and wildlife and other measures for environmental enhancement, economic and human resources development, and shall be harmonious components of comprehensive development plans formulated by various planning agencies and other interested Federal agencies.

SECTION B

STUDIES & REPORTS

Prior studies have been made which impact on the study area. Specific problems investigated include flooding of the valley in Albuquerque from flows originating on the eastern uplands, and main stem flooding along the Rio Grande caused by snowmelt and general storms originating in the upper basin. These studies were reported in the following documents.

Rio Grande and Tributaries, Albuquerque, New Mexico and Vicinity, Review Report on Survey for Flood Control, dated June 1953. This report recommended that channels be constructed to intercept runoff from the east mesa and mountains and divert it around the populated valley of Albuquerque into the Rio Grande. Public Law 780, dated 3 September 1954, authorized the project. Construction of the diversion channels was initiated in 1965 and completed in 1972, at which time they were turned over to the Albuquerque Metropolitan Arroyo Flood Control Authority to operate and maintain.

Rio Grande and Tributaries, New Mexico, Review Survey for Flood Control, Interim Report on Main Stem of the Rio Grande Above Elephant Butte Dam, dated December 1958. This interim report recommended the inclusion of Cochiti Dam on the Rio Grande and Galisteo Dam on Galisteo Creek in the comprehensive plan for the basin to provide additional flood protection to the Middle Valley. Galisteo Dam was completed in 1970 and Cochiti Dam began operation in 1975.

SECTION C

BASE CONDITION

THE STUDY AREA

The Albuquerque Greater Urban Area is located in the Middle Rio Grande Valley of Central New Mexico and is defined by the uncontrolled Rio Grande watershed boundaries from Cochiti Dam to the mouth of the Rio Puerco. The areas specifically addressed in this interim report are those urbanizing valley areas subject to flooding by the Rio Grande between Bernalillo, New Mexico and Belen, New Mexico. Although the study area, authorized in the latest House Resolution, extends from Cochiti Dam to Elephant Butte Reservoir, this flood control study has been limited to the reaches within the Rio Grande flood plain where development now exists or can reasonably be expected to exist within the near future. It is also the reach about which the New Mexico State Engineer and others have repeatedly expressed grave concern. The area is approximately 60 miles long and encompasses approximately 70,000 acres. Major developed areas include the municipalities of Bernalillo, Corrales, Los Ranchos de Albuquerque, Los Lunas, Belen, and a large portion of Albuquerque, including the downtown business district. The urban study area and the flood plain addressed by this report are shown on Plate A-1. The study area is defined for the purpose of problem identification only. Formulation of alternatives considered all possible solutions regardless of geographic location. Also, impact assessment was not confined to the study area but addressed all social, economic, and environmental effects of each alternative regardless of geographic location.

CLIMATE

The climate of the study area is classified as arid, continental; characterized by fairly hot summers and mild winters, with short, temperate spring and fall seasons. The average annual precipitation for the area ranges from 8 inches in the valley to 30 inches on the mountain peaks bounding the eastern side of the study area. About two-thirds of the average annual precipitation in the valley occurs from May to October with almost one-third of the annual amount falling during July and August. Most rainfall during this period is the result of brief but intense thunder showers. During the winter months, most precipitation occurs as snowfall. The average monthly snowfall in the valley is less than 2 inches with the average annual snowfall recorded at 7.26 inches.

GEOLOGY

The study area lies within the Santo Domingo-Albuquerque-Belen Basin, the largest of a series of complex structural basins which collectively form the Rio Grande Trough, a depression that extends from the northern end of the San Luis Valley in Colorado to near El Paso, Texas. The Basin, extending west of the study area, and recognized as a graben, is about 90 miles long and is approximately 30 miles in maximum width. The Basin was formed probably during upper Tertiary (Miocene and Pliocene) time, the occurrence being coincidental with the uplifting of the Sandia-Manzano-Los Pinos easterly tilted fault block range. Nothing is known of the sedimentary rocks under much of the Basin, but likely they are of Cretaceous age and older although some early Tertiary deposits may be present. The Basin narrows and shallows in the Santo Domingo area, and the early Tertiary Galisteo formation and Espinaso volcanics are exposed. In the Albuquerque-Belen area, the Sandia-Manzano-Los Pinos range forms the eastern boundary of the Basin. Pennsylvanian and Mississippian limestone layers that form the caprock of the mountains are

underlain by Precambrian igneous and metamorphic rocks. Throughout most of the Basin, the western boundary is formed by a series of north-south trending high angle and parallel normal faults that step down eastward into the Basin. Generally, the western boundary of the study area is sporadically marked by volcanoes and fissure flows that erupted during Tertiary time.

As the uplifting occurred during upper Tertiary time, detritus from the highlands was washed into the Basin to comprise what is now a complex sequence of gravel, sand, silt, clay, caliche, and volcanic deposits known as the Santa Fe formation. Much of the Santa Fe formation is overlain by a mantle of unconsolidated Quaternary alluvium and locally thick piedmont detritus. The thickness of the Tertiary deposits in the deeper parts of the Basin has been estimated to total about 15,000 feet.

TOPOGRAPHY

The study area varies in topography from precipitous mountains to broad, relatively featureless plains. Land forms found in the study area include plateaus, buttes, mesas, volcanos, lava flows, canyons, and a broad river valley. Elevations range from 4,800 feet m.s.l. at the mouth of the Rio Puerco to 10,673 feet m.s.l. at Sandia Crest.

That portion of the Rio Grande valley between Bernalillo and Belen addressed by this report varies in width from 1 to 3 miles. The flood plain is extremely flat and its outer limits are readily identified by an abrupt change in elevation. Presently, the Rio Grande floodway is confined between levees generally 1,000 feet apart. Approximately 400 to 600 feet of the floodway are occupied by a cleared and maintained channel. The remainder is covered with various densities and types of vegetation.

LAND USE

Historically, the Rio Grande flood plain has been intensively farmed because of the availability of surface water for irrigation. Today an extensive network of canals, laterals, and ditches administered by the Middle Rio Grande Conservancy District interlaces the valley to supply irrigation water to residents. The Soil Conservation Service, USDA, are surveying the land of the State of New Mexico so as to designate and set apart those lands considered "prime farmland". "Prime farmland" is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses. In the flood control study area, all of the "prime farmland" designated is located in the flood plain. However, in keeping with a recent nationwide trend of outward migration from urban areas, many of the larger farm tracts, exclusive of Indian land, have been subdivided into smaller parcels for rural and suburban type of development thus decreasing the amount of farmland. The valley within the limits of Albuquerque is protected by the levee reconstructed by the Corps in 1958 and is densely populated. The residents between the southern city limits of Albuquerque and the Isleta Indian Reservation on the west bank of the river are presently considering incorporation, which would make them the second largest city in the State.

The strips of land between the levee and the channel remain in their natural state for the most part. Only on the Isleta and Sandia Indian Reservations is the area used for grazing. In all other areas, the abundance of large trees, together with dense undergrowth, provides food and habitat for a myriad of wildlife. Riverside drains inside the levees support several species of warmwater fishes and, during winter months, the State of New Mexico stocks rainbow trout to provide an additional fishery for area residents.

Consequently, the area is a popular recreation spot for hunting, where permitted, fishing, and picnicking. The area also serves as excellent bridle paths for the numerous horse owners residing in the valley. It is the policy of the Middle Rio Grande Conservancy District, upon whose right-of-way much of this land and all access to it lies, to allow continued use of the area by the public so long as its operations for flood control and irrigation water supply are not jeopardized.

CULTURAL SETTING

The Rio Grande Valley is said to be the oldest continuously settled region in the United States. As early as 1100 A.D., numerous Indian pueblos were supported by irrigated agriculture along the Rio Grande and its tributaries. The first-known settlement in the vicinity of Albuquerque was in 1598, located on the west bank of the river. About 1693, the Spanish established settlements at Santa Fe, Santa Cruz, Los Cerrillos and Bernalillo. The Acting Governor of Bernalillo sent 30 families to the site of the present city of Albuquerque and in 1706 the city was founded. The plaza and some of the structures of this period still remain in an area known locally as Old Town on the east side of the river. The area grew slowly until the coming of the railroad in 1880. What happened many times before, happened to Albuquerque. The railroad brought immigrants and health seekers who started new enterprises and established ranches in the area. Albuquerque became a shipping point for cattle, sheep, hides, wool and ore and by 1881, the town qualified as the first city in New Mexico.

The area has been under four flags: Spanish, Mexican, the Confederate for about a month, and the United States; however, the

Pueblo Indians of the region remained independent under each governing entity. This lineage makes Albuquerque and the region a unique cultural melting pot. The people are very proud of their Indian, Spanish, and Anglo-American heritage.

ARCHEOLOGICAL AND HISTORICAL RESOURCES

While the occupation of the Rio Grande valley is evidenced by an abundance of archeological and historical remains, little of this evidence can be found within the flood plain itself. The lower areas of the flood plain were not extensively occupied until the coming of the Spanish, since the earlier peoples generally preferred to farm the flood plain and live on the adjacent bluffs and terraces. Remains of early Indian settlements on the terraces and near confluences of tributaries are relatively common. In addition the meandering and flooding of the river, intensive farming and urban development, and construction of flood control and irrigation works have altered the entire flood plain. Hence, only historical sites resulting from the later Spanish culture still exist within the limits of the flood plain. A list of such sites was obtained from the State of New Mexico's Historic Preservation Officer and are presented in the accompanying Environmental Impact Statement. A reconnaissance of the area found no archeological or historical sites within the physical limits of alternatives considered for detailed evaluation.

POLITICAL SETTING

While the boundaries of the urban study area encompass most of Bernalillo County and portions of Sandoval, Valencia, Torrance, and Santa Fe Counties, no portions of the Rio Grande flood plain are found in the latter two. Incorporated municipalities within the

flood plain are Albuquerque, Belen, Bernalillo, Los Lunas, Corrales, Bosque Farms, and Ranchos de Albuquerque. Municipal, county and regional planning boundaries are depicted on Plate A-2. Plate A-3 depicts the boundaries of State lands in the area and those lands that are under Federal jurisdiction. Portions of the Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia, and Isleta Indian Reservations are affected by the investigation covered in this report. Plate A-4 shows the location of these Indian reservations.

TRANSPORTATION

Albuquerque was served by four major airlines which posted a combined total of 840,000 passenger boardings in 1976. Air service to the city is presently undergoing expansion with the addition of five other major airlines stopping in Albuquerque. Passenger boardings in 1971 totaled 578,000. As shown on Plate A-1, the area is served by U.S. Interstate Highway 40 which provides east-west access and Interstate 25, which traverses the entire length of the study area, providing north-south access. Continental Trailways, Greyhound, and I.C.T.L., Inc. provide the area with excellent intercity bus transportation. East-west and intercity passenger rail service is provided by Amtrak, and the Santa Fe Railroad provides freight service. Belen is considered the rail center for the area.

SOCIOECONOMIC PROFILE

A socioeconomic profile was developed as a prerequisite to the evaluation of the potential impacts that a flood control program may have on that area. The following text and series of tables was compiled from the most recent census information available for the Middle Rio Grande Valley SPF flood plain. Because a large urban center, the city of Albuquerque, separates two lesser developed areas, the plain has been divided into three reaches: the Albuquerque Reach,

the reach upstream or North Reach, and the South Reach, downstream. Occasionally, comparisons are made between the reaches and the Albuquerque SMSA[1], in order to put the three flood plain reaches into their proper perspective as parts of a larger geographic region.

Population

Looking first at the urban-rural distribution of the flood plain population shown in Table A-1: over 84 percent of the total population is urban; however, the only urban area outside Albuquerque is the Belen area - which comprises only 24.3 percent of the South Reach population. Urban areas are those having population in excess of 2,500. Among the rural residents of the North and South Reaches, the South Reach has a higher proportion of actual farm population, 11 percent, than the North Reach, which has 4.6 percent.

The racial/ethnic distribution of the SPF flood plain population depicted in Table A-2 is relatively uniform throughout the reaches - although the North and South Reaches have a higher proportion of Indians due to the inclusion of the reservations. Notable is the high proportion of Spanish-Americans, 66.3 percent of the total population, in the flood plain. By comparison, only 40.5 percent of the SMSA population is Spanish-American.

Age-sex distributions for each of the reaches are given in Table A-3. With the exception of the North Reach, the age-sex distributions manifest few differences among the residents of the SPF flood plain - or from the SMSA. In the North Reach, the median age for both males and females indicates a slightly younger population.

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1 Albuquerque SMSA as redefined in 1973 to include all of Bernalillo and Sandoval Counties.

TABLE A-1
URBAN/RURAL DISTRIBUTION

Urban/Rural Distribution	North Reach		Albuquerque Reach		South Reach		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Urban	0	0.0	105,742	100.0	4,823	24.3	110.565	84.2
Rural	5,657	100.0	0	0.0	15,063	75.7	20,720	15.8
Farm	258	4.6	0	0.0	1,659	11.0	1,917	9.3
Non-Farm	5,399	95.4	0	0.0	13.404	89.0	18,803	90.7
Total Population	5,657	100.0	105,742	100.0	19,886*	100.0	131,285	100.0

*Does not include the inmates at Los Lunas Hospital and Training School. All other tables do include the inmates.

Source: U.S. Bureau of the Census, 1970 Census of Population and Housing, PHC(1)5, HC(3)-154, First Count Summary Tapes for New Mexico.

TABLE A-2
RACE/ETHNIC DISTRIBUTION

Race/Ethnic Group	North Reach		Albuquerque Reach		South Reach		Total	
	Number	Percent[1]	Number	Percent[1]	Number	Percent[1]	Number	Percent[1]
White	5,410	95.6	101,209	95.7	18,589	91.7	125,208	95.1
Negro	19	0.3	1,870	1.8	69	0.3	1,958	1.5
Indian	190	3.4	1,803	1.7	1,494	7.4	3,487	2.6
Spanish-American[2]	3.497	61.8	70,995	67:1	12,801	63.2	87,293	66.3
Other	38	0.7	860	0.8	116	0.6	1,014	0.8
Total Population	5,657		105,742		20,268		131,667	

[1] Percents do not total 100% because both race and ethnicity are indicated.
[2] Based on Spanish speakers and non-Spanish speakers with Spanish surname.
Source: U.S. Bureau of the Census, 1970 Census of Population and Housing, PHC(1)-5, First, Second and Fifth Count Summary Tapes for New Mexico

TABLE A-3
AGE/SEX DISTRIBUTION

Age/Sex	North Reach		Albuquerque Reach		South Reach		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total Population	5,667	100.0	105,749	100.0	20,279	100.00	131,695	100.0
All Males*	2,806	49.5	51,245	48.5	10,193	50.3	64,244	48.8
Under 5 years	276	9.8	5,425	10.6	986	9.7	6,687	10.4
5 - 14 years	691	24.6	13,151	25.7	2,686	26.4	16,528	25.7
15 - 24 years	557	19.9	8,855	17.3	1,736	17.0	11,148	17.4
25 - 34 years	310	11.0	6,262	12.2	1,137	11.2	7,709	12.0
35 - 44 years	329	11.7	5,317	10.4	1,159	11.4	6,805	10.6
45 - 54 years	291	10.4	4,904	9.6	958	9.4	6,153	9.6
55 - 64 years	182	6.5	3,738	7.3	816	8.0	4,736	7.4
65 - 74 years	107	3.8	2,267	4.4	479	4.7	2,853	4.4
75 years and older	63	2.2	1,326	2.6	236	2.3	1,625	2.5
Median Age	21.4		22.4		22.1		22.1	

* Percent of "All Males" and "All Females" given as percent of total population.
Source: U.S. Bureau of the Census, 1970 Census of Population and Housing, PHC(1)-5, First Count Summary Tapes for New Mexico

TABLE A-3 Continued

AGE/SEX DISTRIBUTION

Age/Sex	North Reach		Albuquerque Reach		South Reach		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
All Females*	2,861	50.5	54,504	51.5	10,086	49.7	67,451	51.2
Under 5 years	274	9.6	5,377	9.9	890	8.8	6,541	9.7
5 - 14 years	676	23.6	12,489	22.9	2,530	25.1	15,695	23.3
15 - 24 years	605	21.1	10,504	19.3	1,741	17.3	12,850	19.1
25 - 34 years	329	11.5	6,838	12.5	1,278	12.7	8,445	12.5
35 - 44 years	360	12.6	5,766	10.6	1,137	11.3	7,263	10.8
45 - 54 years	263	9.2	5,207	9.6	1,010	10.0	6,480	9.6
55 - 64 years	181	6.3	4,143	7.6	824	8.2	5,148	7.6
65 - 74 years	121	4.2	2,622	4.8	435	4.3	3,178	4.7
75 years and older	52	1.8	1,558	2.9	241	2.4	1,851	2.7
Median Age	21.7		23.2		23.6		23.2	

* Percent of "All Males" and "All Females" given as percent of total population.

Source: U.S. Bureau of the Census, 1970 Census of Population and Housing, PHC(1)-5, First Count Summary Tapes for New Mexico

General Social Characteristics

Household Composition. Characteristic of the historical trend, the household distribution in the urban Albuquerque Reach, shown in Table A-4, varies from the household composition of the rural reaches. Average household size is smaller, 3.45, in the Albuquerque Reach than in either the North Reach, 3.73, or the South Reach, 3.64. The difference is due primarily to a higher proportion of single-person households, but there are also proportionately fewer households with children under 18 years old in the Albuquerque Reach.

Residential Mobility. Residential mobility is indicated in Table A-5 as the difference in residence between 1965 and 1970 for the population 5 years old and over. Of course, this measure does not distinguish the number of moves which may have been made in the five-year interval; however, it does demonstrate the relative residential stability of the SPF flood plain. Almost 58 percent of the population did not move from 1965 to 1970 - compared to less than 48 percent of the SMSA population. Among the residents who moved into the SPF flood plain, the point of origin varied by reach. Most of the in-migrants to the Albuquerque Reach moved from another residence in the same county. In-migrants from another state comprised only 7.3 percent of the total population of the Albuquerque Reach - compared to 11.9 percent of the North Reach population and 16.5 percent of the SMSA population.

Education. Whether median school years completed or the percent of high school graduates is used as a measure, the educational attainment achieved by persons (25 years old and over) in the North Reach surpassed the rest of the SPF flood plain population. The median number of school years completed by the North Reach population was 11.6 in 1970 - with 51.9 percent of the population high

TABLE A-4
HOUSEHOLD DISTRIBUTION

Household Distribution	North Reach		Albuquerque Reach		South Reach		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Households	1,453		30,284		5,442		37,179	
Families	1,266	87.1	24,824	82.0	4,723	86.8	30,813	82.9
Husband/wife	1,093	86.3	20,194	81.3	4,123	87.3	25,410	82.5
with children under 18	758	69.4	12,603	62.4	2,717	65.9	16,078	63.3
Other male head	55	4.3	851	3.4	174	3.7	1,080	3.5
with children under 18	33	60.0	322	37.8	93	53.4	448	41.5
Female head	118	9.3	3,779	15.2	426	9.0	4,323	14.0
with children under 18	78	66.1	2,603	68.9	295	69.2	2,976	68.8
Primary individuals	187	12.9	5,460	18.0	719	13.2	6,366	17.1
In group quarters*	244	4.3	1,392	1.3	440	2.2	2,076	1.6
Average household size	3.73		3.45		3.64		3.49	

*Percent "In group quarters" given as percent of Total Population.
Source: U.S. Bureau of the Census, 1970 Census of Population and Housing, PHC(1)-5, HC(3)-154, First and Second Count Summary Tapes for New Mexico.

TABLE A-5
RESIDENTIAL MOBILITY

Residence In 1965	North Reach		Albuquerque Reach		South Reach		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Same house	3,065	58.0	54,013	56.9	11,416	62.7	68,494	57.8
Different house	1,945	36.8	35,788	37.7	5,952	32.7	43,685	36.9
In same county	746	14.1	24,318	25.6	2,584	14.2	27,648	23.3
In other county in New Mexico	572	10.8	4,494	4.7	2,314	12.7	7,380	6.2
In different state	627	11.9	6,976	7.3	1,054	5.8	8,657	7.3
North East	99	1.9	710	0.7	46	0.3	855	0.7
North Central	151	2.9	863	0.9	265	1.5	1,279	1.1
South	122	2.3	2,043	2.2	274	1.5	2,439	2.1
West	255	4.8	3,360	3.5	469	2.6	4,084	3.4
Abroad	39	0.7	531	0.6	46	0.3	616	0.5
Moved, residence not reported	238	4.5	4,633	4.9	795	4.4	5,666	4.8
Totals	5,287		94,965		18,209		118,461	

Sources: U.S. Bureau of the Census, 1970 Census of Population and Housing, Fourth Count (Population, File A) and Fifth Count Summary Tapes for New Mexico

school graduates. In the rest of the SPF flood plain, the median was 10.8 years, and high school graduates represented less than 45 percent of the population. By comparison, the median in Bernalillo County was 12.5 years, and high school graduates comprised 66.2 percent of the population. Educational attainment of the flood plain population is given in Table A-6.

Housing. A summary of 1970 housing data for the flood plain is presented in Table A-7. Housing tenure indicates the predominance of owner-occupied housing, 67.7 percent of all occupied housing units, in the flood plain - although the proportion of owner-occupied units is greater in the North and South Reaches. Vacancy rates vary more within the SPF flood plain: 7.9 percent in the North Reach, 5.3 percent in the Albuquerque Reach, and 10.1 percent in the South Reach. Not only is the total vacancy rate highest in the South Reach, but the proportion of units vacant six months or more is also highest at 51.0 percent of all vacancies - compared to 29.5 percent in the Albuquerque Reach and 40.8 percent in the North Reach. Length of vacancy is often employed as an indicator of housing condition. The high proportion of units vacant 6 months or more in the South and North Reaches suggests a high proportion of sub-standard or deteriorating units in the housing inventory.

To analyze the condition of occupied housing units, overcrowding (defined as 1.01 or more persons per room) and the lack of one or more plumbing facilities are generally used. The percentage of overcrowded units is approximately the same, 17 to 20 percent, for all three reaches - compared to only 11.4 percent in the SMSA. Employing the lack of plumbing facilities as a measure of condition, there is more variance. The Albuquerque Reach has a much lower proportion of houses lacking some plumbing facilities (5.3 percent)

TABLE A-6
EDUCATIONAL ATTAINMENT

Years of School Completed	North Reach		Albuquerque Reach		South Reach		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
None	65	2.5	1,115	2.2	350	3.7	1,530	2.5
Elementary 1-8	797	30.7	15,458	31.0	2,846	29.7	19,101	30.8
High school 1-4	1,027	39.5	25,471	51.0	5,022	52.4	31,520	50.7
College 1-3	315	12.1	4,245	8.5	780	8.1	5,340	8.6
4 or more	396	15.2	3,643	7.3	581	6.1	4,620	7.4
Population 25 years and older	2,600	100.0	49,932	100.0	9,579	100.0	62,111	100.0
Median School Yrs.	11.6		10,8		10.8		10.8	
High School Grads.	1,349	51.9	22,326	44.7	4,270	44.6	27,945	45.0

Source: U.S. Bureau of the Census, 1970 Census of Population and Housing, PHC(1)-5, Fifth Count Summary Tapes for New Mexico.

TABLE A-7
HOUSING

	North Reach		Albuquerque Reach		South Reach		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total Housing Units	1,575	100.0	31,956	100.0	6,050	100.0	39,581	100.0
Occupied Units	1,450	92.1	30,252	94.7	5,438	89.9	37,140	93.8
Owner*	1,147	79.1	19,645	64.9	4,358	80.1	25,150	67.7
Renter*	303	20.9	10,607	35.1	1,080	19.9	11,990	32.3
Vacant Units	125	7.9	1,704	5.3	612	10.1	2,441	6.2
Vacant 6 months or more	51	40.8	503	29.5	312	51.0	866	35.5
Units Lacking Some or All* Plumbing Facilities	236	16.3	1,590	5.3	693	12.7	2,519	6.8
Units with 1.01 or More Persons* Per Room	265	18.3	5,345	17.7	1,073	19.7	6,683	18.0
Median Value (Owner-Occupied)	$14,100	--	$12,400	--	$12,100	--	$12,400	--

* Percentages are expressed as a percent of all occupied units.
Sources: U.S. Bureau of the Census, 1970 Census: PHC(1)-5, HC(3)-154, First Count Tapes.

than either the North Reach (16.3 percent) or the South Reach (12.7 percent), but it has a slightly higher proportion than the SMSA (4.4 percent).

General Economic Characteristics

Employment Profile. The employment status of each of the reaches is given in Table A-8. The South Reach had a somewhat lower unemployment rate in 1970 (4.2 percent) than either the North Reach (5.8 percent) or Albuquerque Reach (6.4 percent). In the SMSA, the unemployment rate was 5.6 percent.

Detailed breakdowns for the employed population, 14 years and older, are indicated by industry in Table A-9. The majority of workers in each area were employed by the service or trade industries, but there is some variation in employment among the reaches for the other industries.

Income. Family income in 1969 is given for the SPF flood plain in Table A-10. All three reaches showed a lower median income, $6,755 to $7,587, than the SMSA median of $8,866. As suggested by the lower median incomes, a higher proportion of families in the SPF flood plain, 22.1 percent, reported incomes below the poverty level of $3,388. In the SMSA, only 14.2 percent of all families had incomes below poverty level.

TABLE A-8
EMPLOYMENT STATUS

Employment Status	North Reach		Albuquerque Reach		South Reach		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Armed Forces	9	0.2	130	0.2	24	0.2	163	0.2
Civilian Labor Force	1,870	51.1	35,569	49.6	6,170	49.4	43,609	49.6
Employed	1,761	94.2	33,284	93.6	5,910	95.8	40,955	93.9
Unemployed	109	5.8	2,285	6.4	260	4.2	2,654	6.1
Not in Labor Force	1,784	48.7	36,057	50.2	6,303	50.4	44,144	50.2
Total Population 14 Years and Older	3,663	100.0	71,756	100.0	12,497	100.0	87,916	100.0

Sources: U.S. Bureau of the Census, 1970 Census of Population and Housing, PHC(1)-5, Fourth Count (Population, File A) and Fifth Count Summary Tapes for New Mexico.

TABLE A-9
EMPLOYMENT BY INDUSTRY

Employment by Industry	North Reach		Albuquerque Reach		South Reach		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Construction	160	9.1	3,229	9.7	648	11.0	4,037	9.9
Manufacturing	217	12.3	2,884	8.7	512	8.7	3,613	8.8
Transportation, Communication & Utilities	84	4.8	2,724	8.2	832	14.1	3,640	8.9
Trade	314	17.8	7,473	22.5	913	15.5	8,700	21.2
Finance, Insurance and Real Estate[1]	148	8.4	2,871	8.6	550	9.3	3,569	8.7
Services	490	27.8	8,228	24.7	1,295	21.9	10,013	24.5
Government	178	10.1	3,001	9.0	502	8.5	3,681	9.0
Other Industries[2]	174	9.9	2,866	8.6	653	11.1	3,693	9.0
Total Employed 14 Years and Older	1,765	100.0	33,276	100.0	5,905	100.0	40,946	100.0

[1] Includes business and repair.
[2] Includes agriculture and mining.
Sources: U.S. Bureau of the Census, 1970 Census of Population and Housing, Fourth Count (Population, File A) and Fifth Count Summary Tapes for New Mexico.

TABLE A-10
FAMILY INCOME

Income in 1969	North Reach		Albuquerque Reach		South Reach		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
All Families	1,289	100.0	24,888	100.0	4,652	100.0	30,829	100.0
Less than $3,000	185	14.4	4,363	17.5	753	16.2	5,301	17.2
$3,000-$4,999	218	16.9	4,083	16.4	701	15.1	5,002	16.2
$5,000-$6,999	178	13.8	4,499	18.1	834	17.9	5,511	17.8
$7,000-$8,999	197	15.3	3,847	15.5	752	16.2	4,796	15.6
$9,000-$11,999	148	11.5	3,953	15.9	830	17.8	4,931	16.0
$12,000-$14,999	85	6.6	1,947	7.8	400	8.6	2,432	7.9
$15,000-$24,999	235	18.2	1,833	7.4	326	7.0	2,394	7.8
$25,000-$49,999	39	3.0	304	1.2	48	1.0	391	1.2
$50,000 and over	4	0.3	59	0.2	8	0.2	71	0.2
Median	$7,587		$6,755		$7,089		$6,846	
Percent below poverty level	19.6		22.5		20.6		22.1	

Sources: U.S. Bureau of the Census, 1970 Census: PHC(1)-5, HC(3)-154, First and Fifth Count Summary Tapes.

SECTION D

MOST PROBABLE FUTURE CONDITIONS

A range of reasonably probable alternative future projections for population and employment was developed for the urban study area by the Bureau of Business and Economic Research, (BBER), Univeristy of New Mexico, and is considered indicative of the future conditions of the SPF flood plain addressed in this interim report. Each component of population change-- birth rate, death rate, and migration-- was projected on an age-sex specific basis. Variations in migration were dictated by economic changes. Population and employment projections for a "pessimistic" scenario, an "optimistic" scenario, and an "expected" scenario are shown in Tables A-11 and A-12, respectively. The scenarios and resultant projections were furnished to state, city, and local planning agencies for review and comment. All concurred in the methodology and selection of the "expected" scenario as the most probable future condition. BBER has adjusted its AGUA population projections to represent the projections for the three county area of Bernalillo, Sandoval, and Valencia for the medium series and the high series. These projections are shown in Table A-13 and are compared with the OBERS Series E projections for the same three county area. The medium series average annual growth rate from 1970 to 1980 is 2.79 percent according to the BBER projections. Bureau of the Census population estimates for 1 July 1975 show an annual growth rate of 2.88 percent from 1970. By comparison for the same period of time, the OBERS Series E projection shows a growth rate of 1.42 percent. The BBER projection is much nearer the census rate of

TABLE A-11
ESTIMATES AND PROJECTIONS OF TOTAL POPULATION: 1970-2030

Year	Albuquerque Greater Urban Area*			United States** (most probable)
	Optimistic Series	Expected Series	Pessimistic Series	
Estimates				
1970	347,000	347,000	347,000	203,235,000
1975	412,800	412,800	412,800	213,600,000
Projections				
1980	478,300	463,700	450,500	223,532,000
1985	548,400	509,700	475,600	234,785,000
1990	632,300	563,100	504,800	246,039,000
1995	722,800	619,700	536,600	254,935,000
2000	813,500	675,700	569,500	263,830,000
2005	900,200	733,300	609,500	272,599,000
2010	999,900	802,800	661,400	281,368,000
2015	1,116,700	885,200	724,600	289,257,000
2020	1,246,000	977,500	798,400	297,146,000
2025	1,389,000	1,080,500	886,900	305,473,000
2030	1,546,400	1,193,100	996,600	313,800,000

All totals rounded to nearest hundred.
* Source: BBER (1976)
** Source: Census Population, Current Population Reports, Series P-26, No. 76-16, 1972 OBERS Series E Projections.

TABLE A-12
PROJECTIONS OF TOTAL EMPLOYMENT: 1975-2030

Year	Albuquerque Greater Urban Area*			United States**
	Optimistic Series	Expected Series	Pessimistic Series	
1975	161,100	161,100	161,100	85,900,000
1980	191,300	186,100	181,100	96,100,000
1985	217,100	205,300	193,800	102,000,000[1]
1990	246,700	226,700	207,900	106,400,000
1995	280,400	250,700	223,700	112,200,000[1]
2000	318,200	277,100	241,300	117,900,000
2005	352,000	303,400	262,100	123,500,000[1]
2010	389,600	332,900	285,800	128,000,000
2015	432,100	365,900	312,600	129,700,000[1]
2020	479,600	402,500	343,500	130,500,000
2025	532,600	443,200	380,700	131,200,000[2]
2030	591,800	488,400	428,700	131,700,000[2]

All figures rounded to the nearest hundred.

* Source: BBER (1976)

[1] Interpolation

[2] Extrapolation

** Source: Census of Population. "Social and Economic Characteristics" and OBER Series E for employment/population ratios. Employment/population ratios applied to most probable population projections to derive projected employment.

TABLE A-13

ALTERNATIVE POPULATION PROJECTIONS
THREE COUNTY AREA[1/]

YEAR	OBERS SERIES E POPULATION	OBERS SERIES E AVERAGE ANNUAL % CHANGE	BBER[2/] MEDIUM SERIES POPULATION	BBER[2/] MEDIUM SERIES AVERAGE ANNUAL % CHANGE	HIGH SERIES POPULATION	HIGH SERIES AVERAGE ANNUAL % CHANGE
1970	373,805		373,805		373,805	
		1.42		2.79		3.12
1980	430,200		492,000		508,200	
		1.24		1.88		2.71
1990	486,800		592,800		663,800	
		0.81		1.76		2.46
2000	527,900		706,100		846,000	
		0.54		1.68		2.02
2010	557,000		833,900		1,033,500	
		0.54		1.93		2.17
2020	587,900		1,009,300		1,280,700	
		0.54		1.96		2.14
2030	620,200		1,225,400		1,582,300	
1970-2030		0.85		2.00		2.43

FACTORS OF CHANGE FROM 1970

1970	1.000	1.000	1.000
1980	1.151	1.316	1.360
1990	1.302	1.586	1.776
2000	1.412	1.889	2.263
2010	1.490	2.231	2.765
2020	1.573	2.700	3.426
2030	1.659	3.278	4.233

1/ Bernalillo, Sandoval, and Valencia Counties.

2/ Bureau of Business and Economic Research, University of New Mexico data used to derive three-county totals.

TABLE A-15

EMPLOYMENT BY INDUSTRY: 1975-2030
Albuquerque Greater Urban Area
Expected Series

Series/Industry	1975	1980	1985	1990	1995	2000	2010	2020	2030
Agriculture	2,100	1,900	1,800	1,700	1,600	1,500	1,300	1,200	1,000
Mining	100	100	100	100	100	200	200	200	200
Construction	12,600	14,600	16,300	18,100	20,200	22,500	27,200	32,900	39,700
Manufacturing	14,900	17,600	19,100	20,600	22,300	24,100	27,600	31,500	36,100
Transportation/Communication/Utilities	9,900	11,100	12,200	13,300	14,500	15,900	18,700	22,000	26,000
Trade	34,400	40,500	45,300	50,700	56,700	63,500	77,700	95,000	116,200
Finance/Insurance/Real Estate	8,500	10,100	11,300	12,600	14,000	15,600	19,000	23,100	28,000
Services	37,800	45,400	51,500	58,500	66,500	75,500	95,100	119,800	150,900
Government	40,900	44,700	47,700	51,000	54,700	58,300	66,200	76,900	90,200
TOTAL	161,100	186,100	205,300	226,700	250,700	277,100	332,900	402,500	488,400

All figures rounded to the nearest hundred. Detail may not sum to totals due to rounding differences.

Source: BBER (1976)

c. The total fertility rate for the AGUA Study area will gradually approach the projected national rate, varying between 1.7 and 2.4 during the decade 1970-1980 and between 1.7 and 2.7 during the 1980 to 2030 span, according to optimistic, expected, and pessimistic outlooks.

d. Survival rates will be assumed to approximate nationally trended rates to 2000 and will be assumed constant to 2030.

e. The AGUA area will remain as an attractive retirement area within optimistic, expected, and pessimistic outlooks. Retired persons will continue to in-migrate to the area without regard to economic opportunity.

f. Lands controlled by Indians will not be subject to in-migration.

Expected Scenario

Agriculture. About 90 percent of the presently irrigated cropland acreage in the AGUA area has severe limitations for maintaining economic agriculture. It is expected that the need for housing and other urban land uses will gradually absorb marginal agricultural land through the year 2000, reducing cropland acreage available for production. This will in turn reduce the role of agriculture as a source of employment in the AGUA area (Table A-15). Farm land in the area will continue to be subdivided in size, resulting in farms operated on a non-commercial part-time basis and resulting in low density semirural residential development.

Commercial agriculture will continue in farm dairy products, poultry, feed crops, vegetables, orchards, greenhouses, and plant

nurseries to serve the local market. Annual gross output is expected to increase slowly during the decade 1970 to 1980. The continued encroachment of urban land uses on existing agricultural land will strongly contribute to rather slight reduction in annual gross output, despite advances in agricultural technology and growth in greenhouse agriculture, and plant nurseries between 1980 and 2030.

Mining. Mining activities in the vicinity of the AGUA area are expected to increase to 1980 and decrease slightly thereafter to 2030. Construction expansion anticipated throughout the area will induce continued growth in sand, gravel, limestone and gypsum operations.

Consistent with the national goal for development of domestic energy resources, coal and uranium reserves in New Mexico are expected to support steady growth in the mining industry in the decade prior to 1980, with growth at a moderate level beyond 1980. Coal exploration and mining can be anticipated to continue in northwestern New Mexico beyond 2000. But, because of prohibitive travel distance between the AGUA area and the area of potential coal mining operation, influence on employment in the AGUA area is expected to be limited to establishment and expansion of mining company offices in the city of Albuquerque.

Uranium exploration and mining is expected to continue in the Grants Uranium Belt to the year 2000, as economic uranium reserves are presently appraised at a 25-year production life, based on deposits deemed commercial at a market price of $15 per pound. Beyond this period, production will decline as areas are mined out and as the grade of uranium ore becomes lower and less economic to mine.

Uranium operations in the eastern portion of the uranium belt, because of their reasonable proximity, will provide mine personnel employment opportunities for the AGUA area. It is expected that mining company offices will be maintained and expanded in the AGUA area.

Construction. As the AGUA area is expected to continue experiencing more rapid growth than average for the nation, residential and non-residential construction output will remain above the national rate, but at a moderate level during the period 1980-2030. Certain federal policies affecting residential construction, such as lower interest rates and mortgage subsidies, are not expected to be aggressively pursued.

Manufacturing. Manufacturing activity in the AGUA area will remain significantly above the national rate during the period 1970-2030. Impediments to growth in the manufacturing sector, such as small local markets and great distances to market concentrations and sources of supply, will somewhat dampen the attractiveness of the AGUA area for major manufacturing in early years. But as the manufacturing sector growth rate improves, the effect is expected to attract more ancillary activities which, in turn, will make the area more attractive to industry in general.

Certain manufacturing industries, such as printing, baking, and bottling, will grow in proportion to population growth. Increasing tourism in the area will generate additional tourism-related manufacturing. Uranium milling operations in the eastern portion of the uranium belt will contribute to growth in employment in the manufacturing sector.

Growth in manufacturing will take place mainly in the city of Albuquerque and Bernalillo County with some growth in the communities of Belen, Los Lunas, Bernalillo, Rio Rancho, and the pueblos of Cochiti, Sandia, and Isleta.

Transportation, Communication, Utilities (T.C.U.). The AGUA area, and in particular the city of Albuquerque, will remain the center of commerce for much of the state, maintaining a greater rate of growth between 1970 and 2000 in T.C.U., than will the nation. Above average growth will be experienced particularly in motor freight transportation and warehousing, air transportation, and electric and gas utilities. During the period 2000-2030, the rate of growth of T.C.U. will be moderate.

Trade. Retail and wholesale trade will reflect an annual rate of growth greater than the national average for the decade 1970-1980. The city of Albuquerque is expected to maintain its position as wholesale center for most of the state and will attract an increasing number of wholesale outlets. Wholesale trade will grow more rapidly than retail trade. Generally, between 1980 and 2030, trade sector output will remain significantly above the national average rate.

Finance, Insurance, Real Estate (F.I.R.E.). The average annual growth rate in output for F.I.R.E. sector is expected to remain above the national average rate during the period 1970-1980 and between 1980 and 2030 as growth in other sectors remains favorable.

Services. Demand for services generated by moderately increasing population will generate an increase in output of this sector significantly above national rates in the AGUA area for the periods between 1970 and 2030.

Government. State and local government employment in the AGUA area will grow in general proportion to population increase during the periods from 1970 to 2030. Bernalillo County will maintain its function as a regional center for numerous federal agencies, as well as an important component of the federal government's research and development complex. However, competition for federal installations by other states will result in this area getting a smaller share of future federal increases. Federal government employment in the AGUA area during 1970-1980 will moderate in the proportion of workers government employed. Federal government employment will increase at a lesser rate beyond 1980.

MOST PROBABLE FUTURE FOR THE RIO GRANDE FLOOD PLAIN

The most probable future conditions for the SPF flood plain were derived from those developed for the urban study area.

Population. Population projections for the flood plain for the most probable future condition are given in Table A-16. The population projections provided for the SPF flood plain area were computed using a housing component. Detailed maps delineating the flood plain were compared to 1970 Census enumeration district maps. These maps indicate the location of housing units. Visual inspection of growth since the maps were produced was also made. From this information estimated percentage of population of the enumeration districts lying within the flood plain was determined. These percentages were used to allocate population as of the 1970 Census date.

In order to determine present and future population, persons per household had to be computed. However, it should be noted that all persons residing within an area do not necessarily reside

TABLE A-16

Projected Population in Standard Project Flood Plain

Year	Valley North of Albuquerque	Albuquerque Unit	Valley South of Albuquerque
1970[1]	5,650	105,700	19,900
1975[2]	7,150	121,200	23,800
1980	8,250	131,200	26,950
1990	10,150	147,800	32,900
2000	12,300	164,600	39,650
2010	14,800	181,600	47,300
2020	18,050	205,200	57,600
2030	21,950	232,400	70,200

Source: BBER (1976)

1 Derived from 1970 Census, First Count Tapes for New Mexico.

2 Derived from houshold size and housing estimates.

within households. In certain enumeration districts household population varied from the proportioned population due to the location of institutions or group quarters. After some investigations, adjustments were made to compensate for such occurrances.

In computing population using analysis and component methods it is important to note that not all housing units are occupied. Those housing units which are vacant, for sale or rent, or vacant for other reasons, or are seasonal units must be counted. For this count 1970 Census information was used by enumeration district in accordance with the previously established proportional procedure. Thus, seasonally vacant or other vacant housing units were extracted from the total housing count assuming that the quantity of these units did not change between 1970 and 1975. No basis for assuming a change in the quantity of vacant housing units could be determined.

The average household size used to compute the population was determined by 1970 Census and reduced by 9 percent according to national projections as derived from Current Population Reports No. 607, Series P-25.

Having established the 1970 and 1975 population figure for the area, a proportionalization procedure using projected figures completed under the AGUA study analysis was employed to arrive at the projected population figures in the SPF flood plain area.

Indian population figures for certain geographic areas were extracted from the 1970 and 1975 information and treated separately from the remaining population figures. The reason was that the geographic area controlled by the Indians was not expected to receive the quantity of in-migration that is expected at the other

areas in the flood plain. The Indian population figures were completed separately using converging birth rates to the year 2010 with rates based upon birth rates occurring in areas of the State which have heavy populations of Indian people. The expected populations in the remaining geographic areas within the flood plain were computed using a proportional procedure based upon a 1975 proportion of population residing in that geographic area. At the completion of this process the expected Indian population and expected non-Indian population were added together for a final figure.

Land Use. In order to accommodate this growing population, as projected by BBER, much of the existing farmland and vacant land must be converted to urban, suburban, and semi-rural residential homesteads. Proper resource programs would include flood protection for these new residents and their property. No change in land use patterns is forecast for valley areas within the Indian reservations. Flood plain zoning, in which no new development would take place within the 100-year floodway, was assumed in order to produce a conservative economic analysis of structural alternatives. The 70,649 acres in the standard project flood plain of the entire study area were comprised of 22,733 urban and suburban acres, 37,118 agricultural acres, and 10,798 vacant acres in 1975. Using the BBER population projections and current land use patterns and zoning restrictions, the flood plain land use projections were made to accommodate the growing population in the three reaches. The most probable future for the different land uses of the flood plain are shown in Tables A-17 to A-22. A summary of these land use projections for the entire standard project flood plain of the study area is illustrated on Figure A-1.

TABLE A-17
PROJECTED RESIDENTIAL LAND USE IN THE STANDARD PROJECT FLOOD
Plain (in acres)

Year	Valley North of Albuquerque	Albuquerque Unit	Valley South of Albuquerque
1975	1,220.1	11,836.5	4,954.6
1980	1,337.3	12,977.5	5,380.6
1990	1,464.3	14,814.0	6,031.6
2000	1,543.8	16,212.0	6,174.1
2010	1,638.8	17,574.0	6,347.6
2020	1,681.3	19,122.0	6,379.6
2030	1,681.3	20,016.0	6,379.6

TABLE A-18
PROJECTED COMMERCIAL LANDUSE IN THE STANDARD PROJECT
Flood Plain (acres)

Year	Valley North of Albuquerque	Albuquerque Unit	Valley South of Albuquerque
1975	148.2	1753.5	570.4
1980	159.7	1935.5	588.4
1990	175.7	2223.0	608.4
2000	191.7	2402.5	633.4
2010	211.7	2561.0	658.4
2020	214.7	2764.0	658.4
2030	214.7	2937.5	658.4

TABLE A-19
PROJECTED INDUSTRIAL LANDUSE IN STANDARD PROJECT FLOOD
Plain (acres)

Year	Valley North of Albuquerque	Albuquerque Unit	Valley South of Albuquerque
1975	3.9	187.5	9.0
1980	4.9	211.5	9.0
1990	4.9	242.5	25.0
2000	4.9	258.5	25.0
2010	5.9	272.5	25.0
2020	5.9	289.0	25.0
2030	5.9	310.0	25.0

TABLE A-20
PROJECTED PUBLIC LANDUSE IN STANDARD PROJECT FLOOD
Plain (acres)

Year	Valley North of Albuquerque	Albuquerque Unit	Valley South of Albuquerque
1975	123.4	1346.5	579.6
1980	133.9	1470.0	602.6
1990	146.4	1641.0	623.6
2000	160.9	1750.0	633.6
2010	175.9	1817.5	647.6
2020	184.9	1924.5	647.6
2030	184.9	1997.0	647.6

TABLE A-21
PROJECTED AGRICULTURAL LANDUSE IN STANDARD PROJECT
Flood Plain (acres)

Year	Valley North of Albuquerque	Albuquerque Unit	Valley South of Albuquerque
1975	4,724.5	7,743.0	24,650.0
1980	4,627.5	7,137.5	24,330.0
1990	4,499.5	5,495.5	23,810.0
2000	4,404.0	3,998.5	23,663.0
2010	4,288.0	2,562.5	23,468.0
2020	4,243.0	1,013.5	23,436.0
2030	4,243.0	0	23,436.0

TABLE A-22
PROJECTED VACANT LANDUSE IN STANDARD PROJECT FLOOD
Plain (acres)

Year	Valley North of Albuquerque	Albuquerque Unit	Valley South of Albuquerque
1975	3,198.8	2,393.5	5,205.8
1980	3,155.3	1,528.5	5,058.8
1990	3,127.8	844.5	4,870.8
2000	3,113.3	639.0	4,840.3
2010	3,098.3	473.0	4,822.8
2020	3,088.8	147.5	4,822.8
2030	3,088.8	0	4,822.8

STANDARD PROJECT FLOOD PLAIN
1975 TO 2030 LAND USE

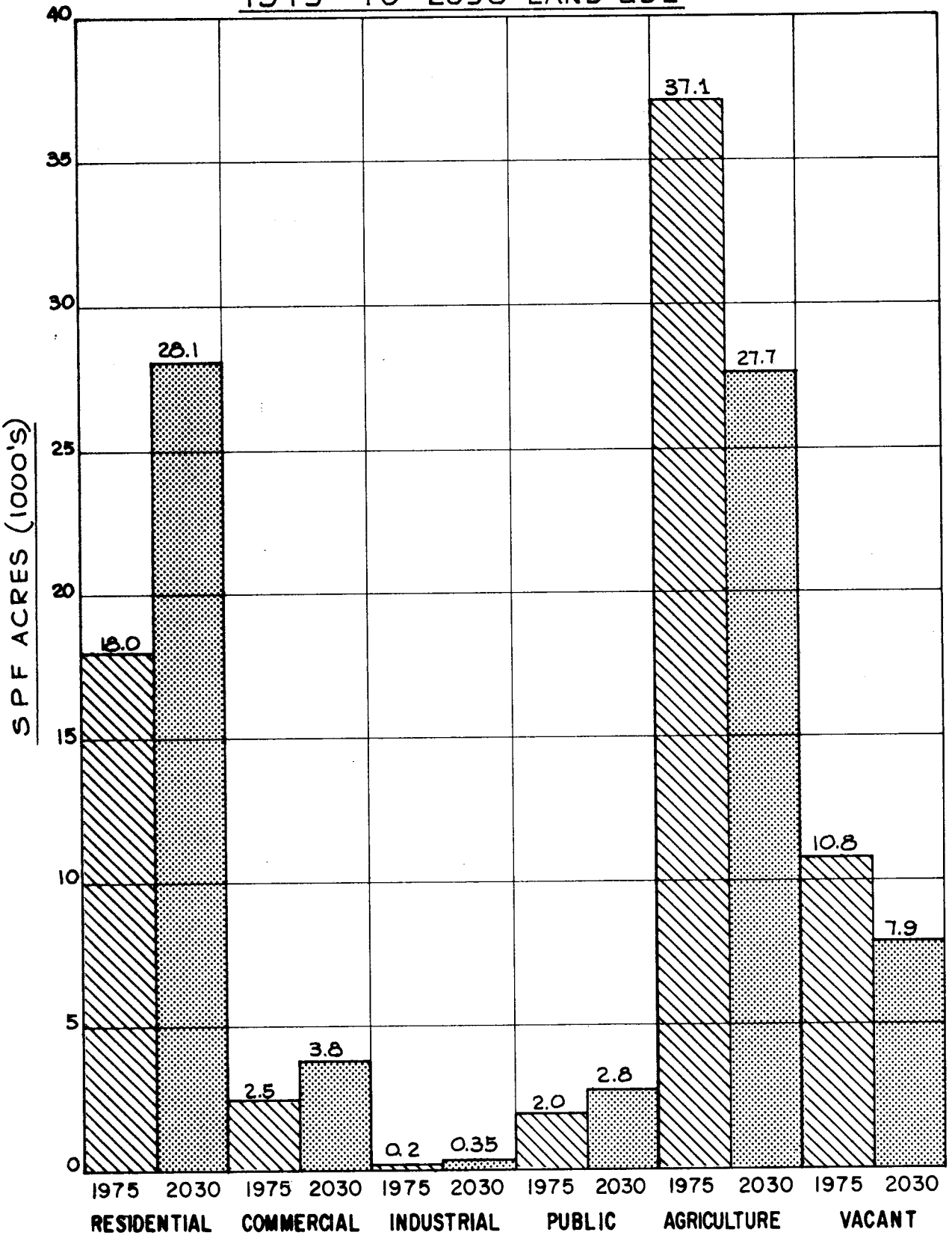


FIGURE A-1

SOCIOECONOMIC RESOURCES

As previously stated, 66 percent of the population in the flood plain is Spanish-American, and the median income is less than that for the SMSA. Future in-migration into the flood plain is expected to be largely middle-class to upper middle-class Anglos, resulting in a greater racial mix and higher income level. This population increase and higher income level will stimulate the economy of the area and provide a greater tax base to fund improvements and services.

A flood protection program would help enhance property value and tax revenues, eliminate flood relief and clean-up efforts and their associated costs, and release these monies to other programs of improvement.

ENVIRONMENTAL RESOURCES

Increasing public concern for the preservation and enhancement of plant and animal communities and for expanded recreational opportunities is reflected in current city and state planning documents and efforts. Future plans for the Rio Grande and its contiguous riparian woodland bounded by the riverside drains are aimed primarily at a continued use for flood control and irrigation purposes, conservation or enhancement of its "natural" features and wildlife, and its development for recreational and educational purposes. Previously utilized almost solely for flood control and irrigation purposes, current use objectives include compatible multipurpose use that considers nature preservation and recreation as legitimate and equal uses.

These objectives seek to establish a nature preserve system and compatible recreational development and opportunities. This includes the protection of the riparian woodland; development of nature centers; limiting of access points to the river, beyond that which is needed for channel maintenance by river officials, to a few non-vehicular sites thereby preserving the intrinsic values of the riparian woodland and associated wildlife; and the development of recreational facilities that will be compatible with the essential wild nature of the riverine environment, and land use patterns in the immediate area.

In essence, planning efforts associated with the environmental resources of the Rio Grande are aimed at its preservation, enhancement and compatible utilization for both immediate and long-term use.

SECTION E

WITHOUT CONDITION

The "without" condition is the future condition which can be expected to prevail in the absence of new programs for resource management. It is consistent with the most probable future in that it considers base conditions, public desires, and historical trends. These historic trends indicate that development of the flood plain has been affected primarily by influences other than adequate flood protection. In accordance with existing regulations, projections for the "without" condition assumed enforcement of flood plain zoning such that there would be no new development taking place within the 100-year flood plain.

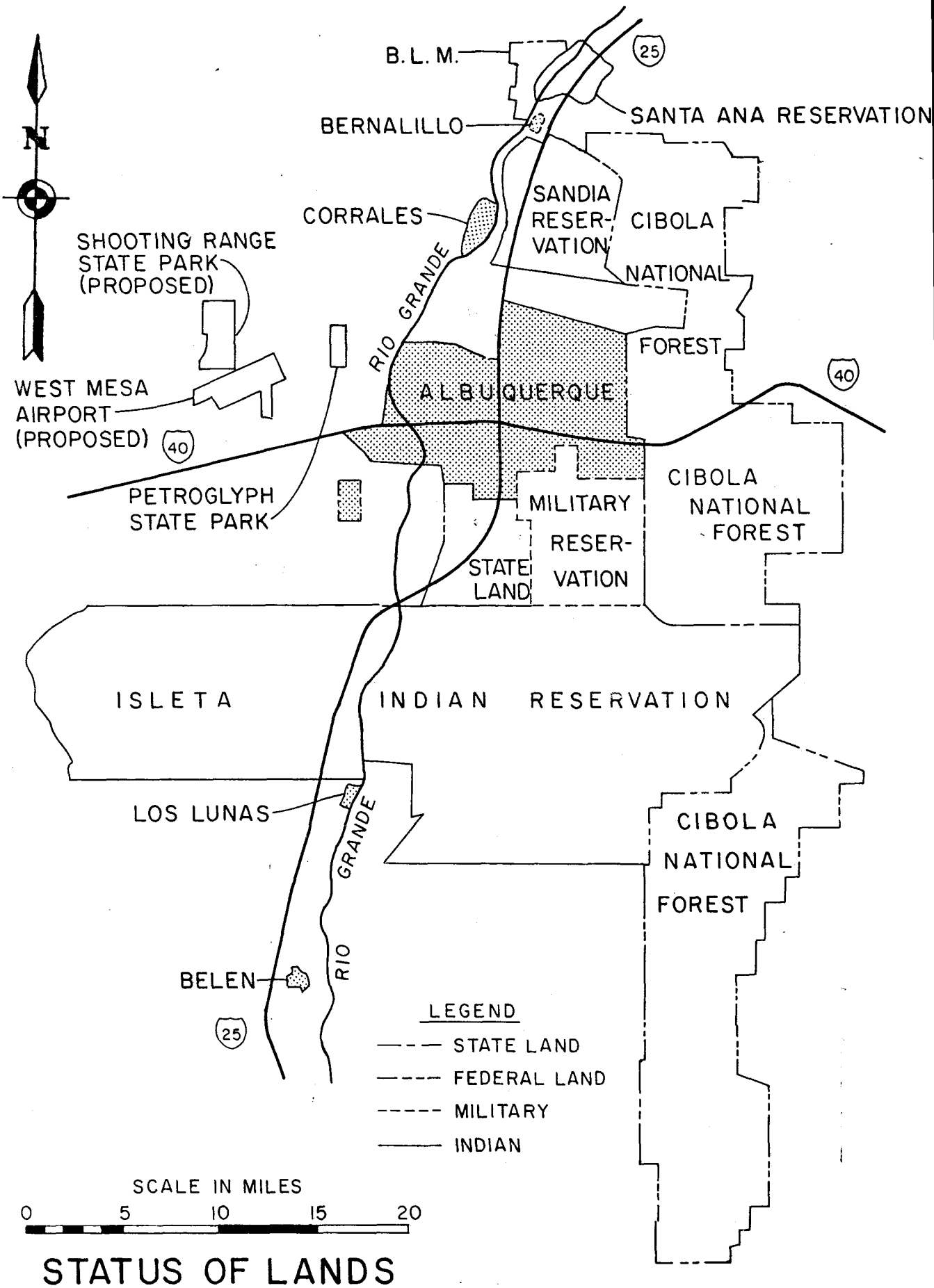
Land use patterns are a direct function of population trends. In order to accommodate this growing population much of the existing farmland must be converted to urban, suburban, and semirural residential homesteads. The larger private tracts within the flood plain presently used for agriculture will be divided into smaller residential parcels and the service and trade establishments necessary to accommodate the increased population. No significant change in land use is foreseen for valley areas within the Indian reservations.

Factors which enhance development in the river valley rather than on the mesa overlooking the valley are many. The city of Albuquerque east of the Rio Grande is bounded by Federal and State lands on the

south and east as shown on Plate 2a. Development has currently extended north to the limits of the Sandia Indian Reservation. Early future growth will probably be directed to in-filling remaining vacant areas within these boundaries. Once this area has been developed, the next potential area of growth would appear to be the uplands on the west side of the river. The predominant factor in relegating the west mesa north of Interstate 40 to secondary development is limited access across the river. Presently, only two bridges service the north valley--the Corrales bridge at the southern edge of Corrales and Interstate 40 bridge. In the south valley between the Interstate 25 and Interstate 40 bridges, there are three other river crossings. Consequently, the south valley and adjoining west mesa are in a more advanced stage of development.

Much of the area on the west mesa north of Interstate 40 is or will be converted to public facilities as noted on Plate 2a. The existing Petroglyph State Park occupies approximately 1,500 acres, and the proposed new airport and proposed Shooting Range State Park will occupy 4,600 acres and 5,500 acres, respectively. Neither of these facilities would be conducive to residential development in the area. In fact portions of the west mesa north of Interstate 40 has been set aside for industrial and warehouse types of development. Further limiting the amount of development in the area would be the presence of volcanic cones and fissure flows not protected by the State Park. This type of ground material is not readily suitable for good foundations for many types of structures and does not provide good soil for trees and other agricultural plants.

In addition, attempts to obtain water by drilling wells on the west mesa have met with little success. Some wells encountered mineralized and hot water, probably associated with the volcanic activity of recent geologic time, and others found no water at all. Arsenic content in some wells has been found to be above acceptable



STATUS OF LANDS

PLATE A-2A

levels. If well water is obtained, it is at a greater depth than that found in the valley making well water on the mesa more expensive than in the valley. Since the mesa property owners are located above the ditches and canals conveying irrigation water, they have no way to irrigate their property with energy efficient (gravity flow) river water provided by the Middle Rio Grande Conservancy District. In contrast, the irrigation system is extensively developed in the valley areas with a series of canals, ditches, laterals and drains all conveying water diverted from the Rio Grande. Because of the availability of surface water, close proximity of ground water, and the presence of alluvial soils rather than the more inorganic sand and pumic materials found on the mesa, orchards, gardens, and other vegetation is more easily established and abundant in the flood plain. Extensive development of the west mesa will be dependent upon import water supplied by pipe from the city of Albuquerque whose well fields are largely on the east side of the Rio Grande. While this supply may be economically viable as a residential, commercial and light industry source it is not competitive with flood plain surface irrigation water for lawns, gardens, and agricultural uses.

The terrain of the west mesa is characterized by a wide, gently rising plain consisting of sand, rock, numerous vegetation-stabilized sand dunes, and an area of volcano cones with adjacent lava flows which form steep cliffs paralleling the river. Excepting these volcanic cliffs there are no topographic features to break the prevailing north-south wind which produces dust and sand storms at various times during the year. This situation is expected to prevail until sufficient development occurs on the mesa, to provide windbreaks in the form of houses and fences to significantly reduce the intensity of these storms. Presently, housing dvelopments are spread over the mesa in separate unincorporated communities. The distance between these communities is such that the sand and dust

storms still plague the residents. The heavily vegetated, sheltered and shaded flood plain area is therefore considered by most residents, long term as well as recent immigrants to be highly desirable for residential development. Increased demand for the limited flood plain property available has increased property value to the point that some flood plain property is presently selling for $20,000 per acre.

No data can be found to support the hypothesis that flood risk has any significant impact on property values for development in the flood plain area. A comparison of property values in Albuquerque which has 270 year flood protection with nearby Corrales which has 19 year flood protection shows no substantial difference.

Since Albuquerque is the major marketing center for the study area, close proximity to places of work, recreation, and commercial outlets provides flood plain areas with a locational advantage for residential development.

In summary, the valley flood plain areas offer strong locational, environmental and developmental advantages which indicate that the present trend of intense development without regard to flood hazard or protection will continue.

(1) Socioeconomic conditions. The without-the-project alternative future is suggested by the fact existing development in the flood plain is extensive e.g. within the 42,000 c.f.s. (270 year) flood plain there are 8,805 residences, 809 commercial, 22 industrial and 147 public structures. Also there are extensive transportation, irrigation and utility facilities. Total average annual flood damages within the flood plain are estimated to be $4,474,000 in October 1978 price levels. Because inadequate flood protection would not deter migration and pressure for development in the valley,

flood damage potential would increase. Federal funding for construction would be available for future development within the flood plain only when the development and construction conforms to the specifications contained in the Federal Flood Insurance Program such as being elevated above the 100-year flood plain. All of the study area communities are participating in the emergency phase of the Program. The Federal Flood Insurance Program however cannot be expected to effectively prevent future development on the flood plain as the effectiveness depends on the zoning ordinances adopted by the participating communities and their degree of enforcement. No flood prevention benefits have been claimed for future development during economic evaluations. Existing development and future development could be expected to occur even in the absence of adequate flood protection, assures that severe socioeconomic impacts could be expected as a result of flooding. In addition to monetary damage large non-monetary impacts such as loss of life, health hazards through contamination and sanitation problems, disruption of family and community activities, anxiety and mental and physical stress could be expected to occur.

(2) Environmental conditions. Without management programs to preserve and enhance the environment, there would be no safeguard to insure that the unique and somewhat fragile riparian woodland would not continue to be subjected to pressure for utilization and development with resulting environment degradation. Unless human activity in the area is controlled, the essential wild condition of the bosque and associated wildlife could be destroyed. Management of the two remaining wetlands in the project would likewise control human activity and could retard the natural aging process through periodic burning and perhaps dredging.

SECTION F

PROBLEMS AND NEEDS

Through an intensive public involvement program described in Appendix F, most of the problems, needs, and concerns of the study area were determined in Stage 1 and reassessed periodically throughout the duration of the study. Problem identification is a continuing task throughout the planning process, and the investigation of many problems sequentially uncover related needs and concerns. This problem identification task has culminated in the determination of planning objectives stated at the conclusion of this section.

WATER SUPPLY NEEDS

The major source of municipal and industrial water supply for Albuquerque and most of the surrounding communities is the Santa Fe formation. There appears to be a sufficient quantity of water in this deep aquifer. Fresh, good quality water extends to a depth of 3,500 feet in the Albuquerque basin. Some communities in the adjacent uplands of the study area have unreliable wells drilled into fractures and perched water tables. Many of these areas experience water quality problems and quantity problems. Most rural residences in the valley rely on individual shallow wells for water supply. These shallow wells are subject to contamination from septic tanks and inundation.

Surface waters in the study area are used to irrigate agricultural lands in the valley. These irrigation waters are under the administration of the Middle Rio Grande Conservancy District. The amount of water available for irrigation varies from growing season to growing season, as it is largely dependent on winter snowfall in the upper Rio Grande and San Juan River basins.

Water supply for the study area is further expounded upon in the Albuquerque Greater Urban Area study report and the reallocation of storage in Abiquiu Reservoir study report, both forthcoming.

WASTEWATER MANAGEMENT PROBLEMS

Identification of wastewater problems and needs and their resolution are being carried out for area-wide waste treatment under the planning guidelines set forth in Section 208, PL 92-500. The Environmental Improvement Division of the Health and Environment Department of the State of New Mexico has been designated the planning agency for the study. Results of these wastewater studies will be summarized in the urban studies report and are available in the New Mexico Statewide Water Quality Management Plan (January 1979).

RECREATION, FISH AND WILDLIFE NEEDS

In recent years, the riverine environment and its flow regime have been significantly altered. Farming and urbanization have essentially limited the "natural" riparian woodland to a narrow strip of vegetation paralleling the river channel, confined by bordering levees. Within the confines of the levees the channel has been straightened, and an extensive network of Kellner jetty fields installed to stabilize and protect bank areas and to confine the river

to the center of the floodway. Portions of the remaining riparian woodland are in a seral stage of succession with some intrusion by two major exotic species, Russian olive and tamarisk. Significant water withdrawals are made for irrigation purposes, and periods of heavy runoff are partially controlled by tributary and main-stem reservoirs. Riverside and interior drains have lowered the water table and, in doing so, have decreased the number of marsh-type areas.

As many of the original features of the river valley have been modified, reduced, or eliminated; so has the wildlife that was attracted to and was dependent on these areas for habitat. While some species have benefitted from these actions, many have been adversely affected. The prime factors in reducing the original species and the numbers of species have been urbanization, resulting in increased human activity and the elimination or severe reduction of aquatic or marsh-type habitat. Today, reduced or only remnant populations of many species remain. Conversely, species such as quail, doves, sparrows, crows and starlings have benefitted. Within the confines of the Rio Grande Valley, in which the study area is located, species such as Brewster's egret, American egret, Mexican duck, shovelnose sturgeon, American eel, and the river otter have declined to dangerous levels or become extinct.

The most significant species of wildlife to be found in the study area is the endangered whooping crane, North America's tallest bird. The recent presence of the whooping crane in New Mexico is the result of a unique experiment conducted by the U.S. Fish and Wildlife Service to establish a second population of whooping cranes in the wild. The experiment began in 1975 when four young whooping

cranes were hatched by greater sandhill cranes at Gray's Lake National Wildlife Refuge in Idaho. These young "whoopers" then migrated with their "foster parents" to their wintering grounds at Bosque del Apache National Wildlife Refuge on the Rio Grande south of the study area. These young whooping cranes were the first of their kind to be found in New Mexico since the 1850's. The winter of 1976-77 found three of the original four "whoopers" returning, joined by three additional young from the 1976 spring hatch. These young cranes occasionally venture into the study area from the refuge.

A joint proposal by the Bureau of Reclamation, State of New Mexico, and Middle Rio Grande Conservancy District for removal of some vegetation in the Oxbow area along the Rio Grande aroused concern from local interests and environmental organizations that existing wetlands may be destroyed. The Bureau has since withdrawn from the proposal. In 1975, the city of Albuquerque completed a study of the environmental aspects and recreation potential of the Rio Grande in the vicinity of the city, known as the "City Edges" study. General proposals of the plan are nature preservation and human recreation.

Until now the river has been used and managed primarily for flood control, irrigation, drainage, and water conservation. Much has been accomplished in these areas and current planning is in progress to maintain and improve the safety and efficiency of the systems developed to serve these purposes. Historically these were the major concerns associated with the river. The city's "City Edges" study very aptly describes the situation.

> "The system of control as it presently exists largely excludes recreation, aesthetic values, wildlife habitat and nature preservation as legitimate uses or purposes. The only exception in the study area are these: (1) the

Conservancy District has leased areas for park purposes to the city of Albuquerque at the Conservancy Lagoon and Tingley Drive, and at San Gabriel State Park; (2) the District has permitted some use of water at the "oxbow nature site;" and (3) the District has permitted some limited access to the ditch banks for wood gathering, hunting, and fishing. The New Mexico Department of Game and Fish for years stocked some of the drainage ditches.

Nevertheless, the river is basically not available for the purposes mentioned. This exclusion is not based on inalterable necessity. Rather, it seems based only on historical circumstances: if the concern that existed thirty or forty years ago was with flooding and irrigation and not with recreation and nature, it was only because at that time our society and economic conditions were not what they are today. A concern for recreation and nature did not exist with the same urgency and importance that it does today. Hence, many of the agencies, patterns of control and situations that we have inherited from past years are not geared to new demands and needs.

However, there is no logical need for new purposes to be excluded. The necessities of controlling the river do not necessarily conflict with other possibilities in the same area."

At the present time, there is no management of either the areas along the Rio Grande or the access thereto for purposes of recreation or fish and wildlife enhancement. Many areas suffer from overuse and abuse. Examples of such abuse include destruction of flood control structures, indiscriminate littering and garbage dumping, cutting trees, reckless discharging of firearms, and setting fires. Other areas are unavailable for recreation activities because access is denied. There is an immediate need to manage the human activities which threaten this unique environment and associated wildlife.

Of specific concern are the two remaining wetlands in the study area. The first of these, known as the "oxbow" is immediately east of the University of Albuquerque along the west bank of the river

and encompasses about 40 acres. The other area, approximately 120 acres in size, is located on the west bank of the river approximately 2 miles downstream from Isleta Pueblo. Locations of these two sites are shown on Plates A-5 and A-7. All possible alternatives should be explored to preserve these wetlands unique to the study area and to create additional areas, if feasible.

FLOOD PROBLEMS

The Rio Grande valley within the study area is subject to two types of flooding, flooding and ponding caused by runoff from the adjacent uplands via arroyos and sheet flow and inundation by Rio Grande flows which exceed the capacity of the existing levee protection.

RIO GRANDE FLOODING

Floods that occur on the Rio Grande are of two general types. One type is the spring flood which occurs during the period April through June as the result of snowmelt, often augmented by general precipitation. The other type is the summer flood or flash flood which occurs from May through October as a result of rainfall. The spring floods are characterized by a gradual rise to a comparatively moderate rate of discharge which is usually maintained for about two months, producing a large volume of runoff. Summer floods rise sharply to a peak, recede rapidly, and are of small volume. Cochiti Dam, completed in 1974, together with Jemez Dam, Galisteo Dam, and Abiquiu Dam, located as shown on Plate A-1, provide complete protection to the Middle Rio Grande valley from spring snowmelt and general storms occurring in the upper basin. However, there are still approximately 1100 square miles of uncontrolled drainage below these dams capable of generating high discharge, relatively low volume floods of short duration from intense summer storms. It is this

summer storm hydrology which has been developed and used to identify the flood problems for the urban and suburban valley areas extending from Bernalillo to Belen.

Meteorological Influences. The Rio Grande Basin lies in a transitional zone between the Gulf and Pacific rainfall provinces, with attendant complex meteorological conditions further complicated by the presence of extensive mountainous areas. The major portion of the precipitation in the watershed is derived from the tropical Gulf source region.

Characteristics of Winter and Summer Precipitation. No major flood-producing storm has occurred in the Rio Grande Basin above Elephant Butte Dam during the winter months because precipitation from winter storms is mostly in the form of snow and a semipermanent winter high pressure area over the Great Basin inhibits the inflow of moist air. Occasional inflow of moist Pacific air occurs during the presence of a low-pressure area over southern California and Arizona; but by the time this air arrives over the Rio Grande watershed it has usually been substantially reduced in precipitable moisture. During the summer months tropical Pacific air seldom invades the watershed, the major source of moisture being intermittent inflow of tropical Gulf air. Precipitation usually occurs as the result of thunderstorm activity caused by convective or orographic lifting, although frontal activity may produce light to moderate storms of several days' duration. The relative weakness of polar air intrusions limits the occurrence of general storms of major importance during the summer.

Dominating Influences on Normal and Extraordinary Runoff Producing Storms. Major flood-producing storms have been experienced

most often during the transitional periods between spring and summer, and summer and fall. During these periods the strong intrusions of polar air associated with winter are still apparent and the weakening of the Great Basin high allows deeper and stronger penetrations of moist Gulf air. In addition, hurricane activity in the Gulf of Mexico is often effective in introducing large masses of unstable moist Gulf air over New Mexico. The violent interaction of these air masses of greatly different character produces intense and widespread storms over the watershed. The storm of September 20-23, 1929, might be considered typical of the meteorological conditions which cause a major autumn storm over the watershed. During this storm an intense anticyclone moving across the Great Lakes region was accompanied by polar air moving into the Southwestern states. A following trough and cold front from the Pacific resulted in the establishment of a quasi-stationary front through Colorado and Utah. Rainfall action was initiated when disturbances over the Gulf of Mexico stimulated the inflow of moist Gulf air which was lifted over the shallow polar air. The lifting of this moist air, plus convergence and orographic lifting, produced intense and widespread rainfall over the Rio Grande basin above Elephant Butte Dam. Santa Fe recorded 4.81 inches in a 60-hour period with maximum 1-, 2- and 3-hour amounts of 0.98, 1.44 and 1.68 inches. About 2,500 square miles received precipitation in excess of 4 inches during the storm.

Major Summer Floods of Record. Descriptions of summer floods which have occurred in the Rio Grande Basin are given in the following paragraphs, and typify the kind of flooding to which this study is addressed. Besides those floods described in the following paragraphs, other floods have occurred in the study area which have been documented. These other floods, though, are the result of heavy snow melt runoff originating in the mountains of northern New Mexico and southern Colorado. In recent years dams have been constructed for flood control on the Rio Grande (Cochiti), Rio Chama (Abiquiu), Galisteo

Creek (Galisteo), and Jemez River (Jemez Canyon) which provides a reasonable degree of protection for the study area from snowmelt. However, in the spring of 1979, runoff from a record mountain snowpack exceeded the storage capacity of upstream reservoirs. Fortunately, the runoff was gradual allowing passage of flows downstream at no damage stages. Operation of these projects saved in excess of 80 million dollars in flood damages. This capability to control snowmelt runoff was the reason this study was restricted to consideration of floods which could result from summer type thunderstorm activity downstream from the reservoir.

Flood of October 1911. An unusual rainstorm was experienced over western New Mexico and southwestern Colorado on October 4-5, 1911. The following statement was made by the U.S. Weather Bureau in regard to this storm:

"It resulted from two interacting disturbances. An extratropical cyclone either developed over the Great Basin or moved into that region from California about October 1, 1911. At the same time, a dissipated tropical Pacific cyclone appeared off the west coast of Mexico. The circulation pattern associated with the extratropical cyclone tended to draw up a moist air supply remaining from the tropical cyclone, which moved across Arizona on October 4, 1911. It entered the southwest corner of Colorado on October 5, where it was condensed by convergence and orographic uplifting by the San Juan Mountains."

Over 2 inches of rainfall occurred over much of the western half of New Mexico. It is probable that the incoming moist air was unstable and that convergence and orographic lifting prevailed at many points in the Rio Grande basin in New Mexico.

Precipitation for the month of September 1911 was about 0.50 inch above normal over the upper Rio Grande watershed. The total

amount varied in Colorado from 0.69 inch at Garnett to 5.63 inches at Cumbres Pass; and in New Mexico from 0.82 inch at Rincon, to 3.68 inches at Glorieta Ranch near San Marcial. In October, most of the precipitation occurred on the 4th and 5th, although in some portions of the watershed the rain began on October 3 and continued through October 6. The heaviest precipitation was in the mountain areas of Colorado and New Mexico, and the greatest flood damages occurred in Colorado.

The runoff from this rainfall produced the highest momentary peak of record at Del Norte, 18,000 c.f.s. on October 5. The maximum mean daily discharge was 14,000 c.f.s. on October 6. The discharge was reduced by extensive overflow to 7,510 c.f.s. at Lobatos on October 10. Contributions below Lobatos increased the discharge to a maximum of 15,600 c.f.s. at Otowi Bridge on October 8. At San Marcial discharges of 11,780 and 11,530 c.f.s. occurred on October 7 and October 10, respectively. The latter peak corresponds to the October 8 peak at Otowi Bridge. This flash flood was the greatest flood of record in the San Luis Valley. In the Middle Rio Grande Valley, it was only moderate. Recorded runoff volumes in acre-feet were as follows: Del Norte, October 5 through 8, 70,630; Lobatos, October 6 through 13, 93,710; Otowi, October 7 through 16, 183,700; and San Marcial, October 6 through 16, 203,000. Cochiti Reservoir would have controlled this summer flood.

Flood of August 1929. During the period August 6 through 11, 1929, a general storm occurred in northern and western New Mexico and southern Colorado. Rainfall on August 6 and 7 did not cause important runoff. From August 8 through 11, however, much of the area received over 2 inches of rain: 3.57 inches fell at Bluewater, 3.44 inches fell at Tierra Amarilla, and 2.35 inches of rain was recorded at Kingston, New Mexico. The mountainous area throughout the watershed received excessive precipitation. The heavier rainfall centered over the Rio Chama, Rio Puerco, and Rio Salado basins, as well as the side arroyo drainage below these tributaries. Adequate data

were not available to make a comprehensive meteorological study of the storm. It appears, however, that maritime air from the Gulf of Mexico entered New Mexico and was forced to flow above shallower air of polar origin which had been transported into the southwestern states by a northern anticyclone. A weak cold front between these air masses lay approximately east-west in an undulous line from South Carolina to Arizona, remaining nearly stationary. Orographic lifting and convergence took place above the shallow polar air in the valleys and, upon passage of an upper air cold front, fairly intense rain occurred.

The flood from Rio Chama produced a momentary peak of 15,600 c.f.s. at Chamita on August 12, the highest of record at that station. The momentary peak at Otowi Bridge was 11,240 c.f.s. Moving downstream, the flood attained momentary peaks of 16,000 c.f.s. at Cochiti and 11,700 c.f.s. at the San Felipe gaging station. On the evening of August 12, a flood of large proportions passed San Acacia and reached its peak at midnight of August 13. Since this was somewhat earlier than the time at which the Rio Grande peak could have reached this station, it apparently was caused by flows from Rio Puerco and Rio Salado. The momentary peaks from the two tributaries were estimated from high water marks. The estimated peak discharge from Rio Puerco was 30,600 c.f.s. and from Rio Salado was 27,400 c.f.s. The two peak flows did not synchronize with the Rio Grande peak or with each other, as indicated by the momentary peak of 24,000 c.f.s at San Marcial.

Flood of August 20-23, 1935. A series of local rains fell over the central Rio Grande watershed during the late afternoon and night of August 20, 1935. In the vicinity of La Bajada and the lower reaches of Galisteo Creek the rainfall was of cloudburst proportions. Other centers of heavy precipitation occurred in the upper reaches of Rio Santa Cruz and Rio Pojoaque, in the vicinity of Cochiti near San Ysidro, and over the headwaters of Rio Puerco and Rio San Jose. Rainfall at San Mateo between 7:00 p.m. and 11:00 p.m., August 20, was estimated to be 4.0 inches.

Rio Grande was at flood stage August 20 through 23 from Espanola downstream to San Marcial. Rio Santa Cruz and Rio Pojoaque overflowed their banks at the bridges on the highway between Santa Fe and Espanola. The momentary peak of the flood in Rio Grande was 21,900 c.f.s. at Otowi Bridge on August 20. There was considerable inflow between Otowi Bridge and Cochiti, because the momentary peak of the flood at Cochiti was 20,500 c.f.s. and occurred less than one hour after the peak at Otowi Bridge. Another peak, which occurred at Cochiti five and one-half hours later, reflected the Otowi Bridge peak. Galisteo Creek attained flood proportions, as indicated by an estimated momentary peak of 24,300 c.f.s. at Domingo. Minor tributaries to Rio Grande near Cochiti contributed high momentary peaks, two of which were estimated at 4,100 and 2,000 c.f.s. A record peak of 42,100 c.f.s. passed San Felipe on the Rio Grande. No data on the discharge of Jemez River are available. Galisteo and Cochiti Reservoirs would have significantly reduced the effects of this flood.

Rio Puerco attained momentary peaks of about 20,400 c.f.s. at the U.S. Highway 66 bridge west of Albuquerque, and 28,000 c.f.s. at Rio Puerco station on August 21. Rio San Jose, tributary to Rio Puerco between these two points, discharged an estimated 10,300 c.f.s. The peaks did not synchronize. Rio Salado did not contribute during this flood. The momentary peak at San Marcial was 15,000 c.f.s. on August 22, indicating a considerable amount of overflow between Rio Puerco and this station.

Evaluation of the Existing Levee System. The existing flood control system, a levee, originally provided protection for flows up to 20,000 c.f.s. to the primarily rural environment of the study area. In 1958, the Albuquerque unit was reconstructed through a joint effort of the Corps of Engineers and the Bureau of Reclamation to protect the valley in the vicinity of Albuquerque from flows up to 42,000 c.f.s. Operation and maintenance of the levees and their riverside drains is the responsibility of the Middle Rio Grande Conservancy District.

The first step in analyzing the flooding potential for the reach of river under study was to evaluate the present capacity and condition of the levee system. Initial evaluation of the system consisted of a field inspection to detect apparent weaknesses; such as settlement, seepage, and inadequate cross section. Then, representatives of the Corps of Engineers and the Conservancy District experienced in levee inspection and flood-fighting within the study area were interviewed to determine types and locations of recurring problems. One of the more prevalent problems identified was that of landside sloughing due to inadequate seepage control. This information was then correlated with the known discharges and stages of particular floods. Finally, the existing levee system was hydraulically evaluated by comparing the levee crown profile to computed water surface profiles of various discharges. Freeboard of 3 feet was allowed in determining this hydraulic capacity. All data were then analyzed, and various segments of the levee system were categorized in accordance with their rated capacity. Results of the evaluation are as follows.

a. The reconstructed Albuquerque unit has maintained its design capacity of 42,000 c.f.s.

b. The left bank levee which extends upstream from the Albuquerque unit to Las Huertas Creek is rated at 30,000 c.f.s.

c. The right bank levee upstream from the Albuquerque unit to high ground above Corrales has a safe capacity of 7,500 c.f.s.

d. Both the right and left bank levees downstream from the Albuquerque unit to Isleta have an estimated capacity of 10,000 c.f.s.

e. The levee system on both sides of the river downstream from the Isleta unit to the end of the study area below Belen have a rated capacity of 7,500 c.f.s.

By combining the capacities determined in the preceding evaluation with natural and manmade tiebacks, the study area was divided

into independent units for analysis in accordance with Corps criteria for incremental justification. These nine individual units are shown on Plate A-11, and their existing conditions and specific problems are discussed later in this appendix.

Degree of Protection Provided. The second step in determining the flood problems was to determine the degree of protection afforded each unit by its existing levee. Using the discharge-frequency relationships described in Appendix E, the following degrees of protection were determined for each unit.

TABLE A-23

PROTECTION PROVIDED BY

EXISTING LEVEE SYSTEM

Unit	Protection Provided (c.f.s.)	Exceedance Frequency (years)
Bernalillo	30,000	133
Corrales	7,500	19
Albuquerque - East	42,000	270
Albuquerque - West	42,000	270
Mountainview	10,000	34
Isleta - East	10,000	34
Isleta - West	10,000	34
Belen - East	7,500	26
Belen - West	7,500	26

Standard Project Flood. The Standard Project Flood discharge was calculated to be 75,000 c.f.s. at the upstream end of the project, attenuating to approximately 67,000 c.f.s. at the downstream end. This far exceeds any of the existing levee capacities. The Standard Project Flood is the discharge used in plan formulation in accordance with EC 1105-2-47 and the directive of SWD at the Checkpoint Conference held on 18 August 1976. Development of the Standard Project Flood and its discharge at specific locations within the study reach are presented in Appendix E. The limits of the Standard Project and 100-year flood plains are shown on Plates A-5 through A-8.

Problems and Needs of Each Unit. Because formulation and evaluation of alternatives were required for each individual unit, the existing conditions and problems of each unit had to be identified.

Bernalillo Unit. The Bernalillo unit extends 14.3 miles along the east bank of the Rio Grande from Las Huertas Creek to the outlet of the North Diversion Channel at the upstream end of the Albuquerque unit. Most of the unit is composed of portions of the Sandia and Santa Ana Indian Reservations. The town of Bernalillo constitutes almost all of the private land holdings and 75 percent of the damageable property within the unit. The levee has adequate cross section and offers protection from flows up to 30,000 c.f.s., having an exceedance frequency of once in 133 years. The levee has no toe drains or other positive means of seepage control. New Mexico State Highway 44 spans the river at Bernalillo, but has sufficient opening to pass the Standard Project Flood. Public access to the river for recreation purposes is limited because most of the unit is on reservation land. Table A-24 provides a description of property and potential flood losses in the flood plain for the Bernalillo unit.

Corrales Unit. The Corrales unit extends from high ground at the Corrales main canal siphon to the bluff at the University of Albuquerque, a distance of 12.6 miles. Included within the flood plain are the village of Corrales, the Southwestern Indian Polytechnic Institute, and numerous small farms and suburban developments. Highway 46 crosses the river in this unit and will pass the Standard Project Flood. The existing levee protecting this unit is the worst of all levees within the study reach. In most areas, the levees are little more than spoil banks of inadequate cross-section with little or no crown. No methods of seepage control are provided. Large trees are growing in the levee, making maintenance a difficult task. Figure A-2 shows a typical portion of much of this

TABLE A-24
BERNALILLO UNIT
DESCRIPTION OF PROPERTY AND POTENTIAL FLOOD LOSSES
JANUARY 1977 PRICES

	Residential	Commercial	Indus-trial	Public	Crop	Equip-ment	Sedi-ment	Irri. Facil	Busin. Losses	Total
Number of Improvements (1980 Base Year Estimates)										
100-year Floodplain	0	0	0	0	--	--	--	--	--	0
270-year Floodplain	999	73	5	23	--	--	--	--	--	1,100
Standard Project Floodplain	1,186	87	6	27	--	--	--	--	--	1,306
Land Use (Acres) (1980 Base Year Estimates)										
100-year Floodplain	0	0	0	0	0	--	--	--	--	0
270-year Floodplain	437	85	2	61	2,573	--	--	--	--	3,158
Standard Project Floodplain	519	101	3	73	3,054	--	--	--	--	3,750
Value of Property ($1,000) (1980 Base Year Estimates)										
100-year Floodplain	0	0	0	0	0	0	--	0	--	0
270-year Floodplain	29,781	4,957	459	12,675	43	763	--	1,378	--	50,056
Standard Project Floodplain	35,351	5,887	546	15,046	51	907	--	1,637	--	59,423
Single Occurrence Flood Damages ($1,000) (1980 Base Year Estimates)										
100-year Flood	0	0	0	0	0	0	0	0	0	0
270-year Flood	6,771	523	6	1,674	43	95	107	189	101	9,509
SPF	11,042	966	26	2,781	50	109	149	353	112	15,588
Average Annual Flood Damages ($1,000)* (By Decade)										
1980	46.0	4.0	0.1	11.3	0.4	0.7	0.8	1.2	0.3	64.8
1990	59.1	5.0	0.1	14.7	0.4	0.7	1.1	1.5	0.4	83.0
2000	68.0	6.0	0.1	16.7	0.4	0.7	1.0	1.7	0.5	95.2
2010	80.4	7.2	0.1	19.2	0.4	0.7	1.1	1.9	0.7	111.7
2020	90.3	7.7	0.1	21.6	0.4	0.7	1.0	1.9	0.8	124.5
2030	90.3	7.7	0.1	21.6	0.4	0.7	1.0	1.9	0.8	124.5

*Not Discounted
Revised April 1980

Fig. A-2

TYPICAL LEVEE SECTION, CORRALES UNIT (January 1977)

levee. Safe capacity of this levee is estimated to be 7,500 c.f.s., having an exceedance frequency of once in 19 years. The bosque area between the levee and the cleared channel is a popular recreation spot for local residents, and the entire length of river is easily accessible. The New Mexico Department of Game and Fish periodically stocks trout in the riverside drain during the winter months attracting many local fishermen. At the lower end of the Corrales unit immediately upstream from the University of Albuquerque is an area known as the "oxbow nature preserve", a wetland whose source of water is discharge from the Corrales Main Canal. Figures A-3 and A-4 show this existing marsh-type area. The Middle Rio Grande Conservancy District proposes to connect the Corrales main canal with the Arenal canal downstream, thereby eliminating the "oxbow's" water supply. Local conservationists and environmental groups are attempting to preserve this unique riverine environment. Table A-25 gives pertinent facts about the unit's development and flood damage potential.

Albuquerque Unit - East. That portion of the Albuquerque unit on the east bank of the Rio Grande, reconstructed in 1958, extends for 17.1 miles between the outlets of the North and South Diversion Channels. Much of the city of Albuquerque, including the downtown business district, lies within the Standard Project Flood plain. Four bridges span the river within this unit. The Interstate 40 bridge and the Rio Bravo bridge have sufficient openings to pass the Standard Project Flood, but the U.S. Highways 66 and 85 bridges will not. The reconstructed levee, offering protection up to its design capacity of 42,000 c.f.s., is in excellent condition. The levee system includes a toe drain which has performed well during periods of high flow. The Middle Rio Grande Conservancy District has normally permitted public access to the river area via its maintenance roads. Table A-26 lists pertinent information relative to potential losses for floods having frequencies in excess of once in 270 years.

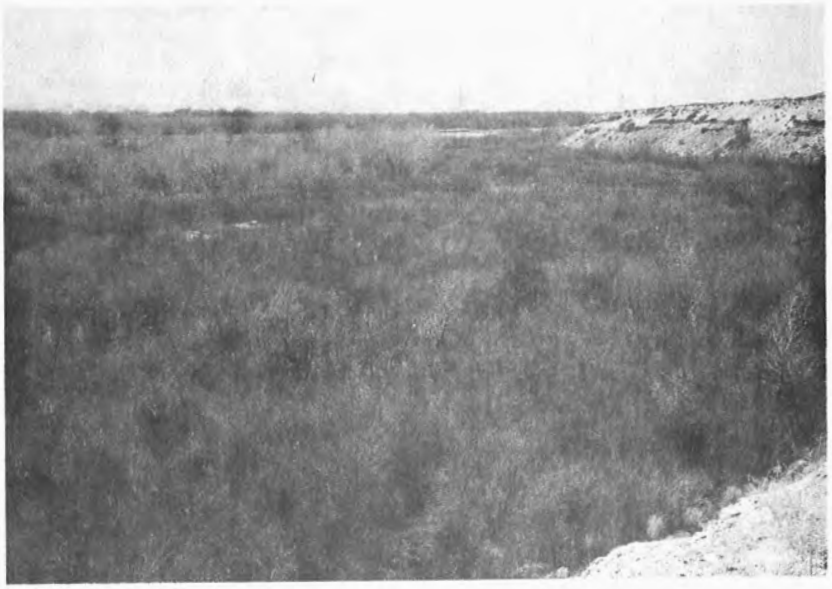


Fig. A-3

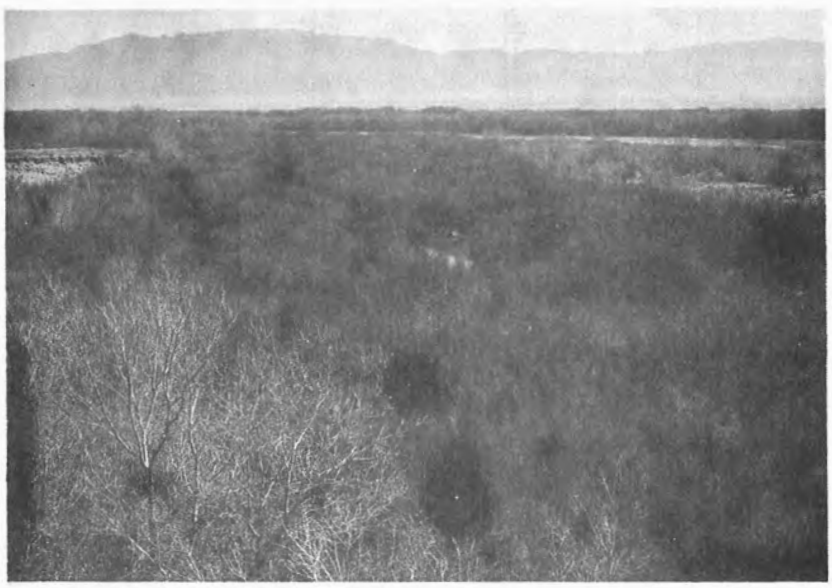


Fig. A-4

"OXBOW" NATURE AREA

TABLE A-25
CORRALES UNIT
DESCRIPTION OF PROPERTY AND POTENTIAL FLOOD LOSSES
JANUARY 1977 PRICES

	Residential	Commercial	Industrial	Public	Crop	Equipment	Sediment	Irri Facil	Busin. Losses	Total
Number of Improvements (1980 Base Year Estimates)										
100-year Floodplain	839	34	3	13	--	--	--	--	--	889
270-year Floodplain	920	35	3	14	--	--	--	--	--	972
Standard Project Floodplain	1,059	37	3	17	--	--	--	--	--	1,116
Land Use (Acres) (1980 Base Year Estimates)										
100-year Floodplain	645	55	2	55	1,508	--	--	--	--	2,265
270-year Floodplain	709	57	2	57	1,531	--	--	--	--	2,356
Standard Project Floodplain	818	59	2	61	1,574	--	--	--	--	2,514
Value of Property ($1,000) (1980 Base Year Estimates)										
100-year Floodplain	31,382	2,874	457	38,079	47	884	--	825	--	74,548
270-year Floodplain	34,533	2,936	457	38,587	47	904	--	828	--	78,292
Standard Project Floodplain	39,944	3,048	457	39,513	48	942	--	833	--	84,785
Single Occurrence Flood Damages ($1,000) (1980 Base Year Estimates)										
100-year Flood	10,245	516	232	9,258	35	166	58	101	129	20,740
270-year Flood	11,760	678	238	9,333	38	242	60	113	136	22,598
SPF	14,861	1,041	257	10,168	39	300	62	146	144	27,018
Average Annual Flood Damages* (By Decade)										
1980	319.3	22.7	5.8	218.6	1.1	6.4	1.2	2.9	5.8	583.8
1990	319.9	22.8	5.8	219.0	1.1	6.4	1.2	2.9	5.8	584.9
2000	319.9	22.8	5.8	219.0	1.1	6.4	1.2	2.9	5.8	584.9
2010	319.9	22.8	5.8	219.0	1.1	6.4	1.2	2.9	5.8	584.9
2020	319.9	22.8	5.8	219.0	1.1	6.4	1.2	2.9	5.8	584.9
2030	319.9	22.8	5.8	219.0	1.1	6.4	1.2	2.9	5.8	584.9

*Not Discounted
Revised April 1980

TABLE A-26
ALBUQUERQUE UNIT-EAST
DESCRIPTION OF PROPERTY AND POTENTIAL FLOOD LOSSES
JANUARY 1977 PRICES

	Residential	Commercial	Industrial	Public	Crop	Equipment	Sediment	Irri Facil	Busin. Losses	Total
Number of Improvements (1980 Base Year Estimates)										
100-year Floodplain	0	0	0	0	--	--	--	--	--	0
270-year Floodplain	0	0	0	0	--	--	--	--	--	0
Standard Project Floodplain	19,778	2,837	69	399	--	--	--	--	--	23,083
Land Use (Acres) (1980 Base Year Estimates)										
100-year Floodplain	0	0	0	0	0	--	--	--	--	0
270-year Floodplain	0	0	0	0	0	--	--	--	--	0
Standard Project Floodplain	7,189	1,620	212	1,183	3,181	--	--	--	--	13,385
Value of Property ($1,000) (1980 Base Year Estimates)										
100-year Floodplain	0	0	0	0	0	0	--	0	--	0
270-year Floodplain	0	0	0	0	0	0	--	0	--	0
Standard Project Floodplain	634,336	490,875	49,268	527,926	48	5,219	--	2,370	--1,710,042	
Single Occurrence Flood Damages ($1,000) (1980 Base Year Estimates)										
100-year Flood	0	0	0	0	0	0	0	0	0	0
270-year Flood	0	0	0	0	0	0	0	0	0	0
SPF	234,135	83,695	5,844	100,979	42	572	0	436	13,516	439,219
Average Annual Flood Damages*($1,000) (By Decade)										
1980	436.3	156.9	10.7	188.7	0	0.8	0	0.8	27.0	821.2
1990	481.3	172.3	12.1	208.1	0	0.8	0	0.9	29.7	905.1
2000	521.7	183.9	15.6	223.9	0	0.8	0	1.0	31.6	978.4
2010	561.1	193.3	20.0	239.0	0	0.8	0	1.0	33.4	1048.6
2020	585.1	198.8	24.9	249.7	0	0.8	0	1.1	34.4	1094.8
2030	608.1	203.9	34.5	259.2	0	0.8	0	1.1	35.4	1143.0

*Not Discounted
Revised April 1980

Albuquerque Unit - West. This unit begins at the bluff upstream from the Interstate 40 bridge and extends 11.4 miles downstream to the Interstate 25 bridge. Included within this unit are portions of Albuquerque and the unincorporated communities of Armijo, Atrisco, and Los Padillas. These unincorporated communities are presently considering joining together to form the second most populous city in the state. All but the lower 2 miles of this unit were reconstructed in 1958, and the entire unit is in good condition. Also, all but the lower 2 miles have a toe drain for seepage control. The levee was evaluated to have maintained its design capacity of 42,000 c.f.s. Most of the bosque area throughout the unit is accessible by the public. Pertinent facts relative to the number and value of properties in this unit are shown in Table A-27.

Mountainview Unit. The Mountainview unit extends for about 4.4 miles along the east bank of the Rio Grande between the outlet of the South Diversion channel and Interstate 25. Included within the area is the community of Mountainview, plus agricultural and vacant land considered as prime areas for future development. The levee in this reach has no means of positive seepage control and is rated to have a safe capacity of 10,000 c.f.s. This will provide protection up to the 34-year flood. The public has access to the river throughout this unit. Table A-28 lists the number and types of property in the Mountainview unit and its estimated damage potential from flooding.

Isleta Unit - East. This narrow strip of flood plain lies between the Interstate 25 bridge and a point just upstream from the New Mexico Highway 47 bridge at Isleta Pueblo. This entire unit lies within the Isleta Indian Reservation and contains almost no improvements. A park-recreation area immediately downstream from the Interstate 25 bridge would be the only development susceptible to flood damage. The Atchison, Topeka, and Santa Fe Railroad bridge spans the river within this unit. Both the railroad bridge and the

TABLE A-27
ALBUQUERQUE UNIT-WEST
DESCRIPTION OF PROPERTY AND POTENTIAL FLOOD LOSSES
JANUARY 1977 PRICES

	Residential	Commercial	Industrial	Public	Crop	Equipment	Sediment	Irri Facil	Busin Losses	Total
Number of Improvements (1980 Base Year Estimates)										
100-year Floodplain	0	0	0	0	--	--	--	--	--	0
270-year Floodplain	0	0	0	0	--	--	--	--	--	0
Standard Project Floodplain	11,685	685	16	95	--	--	--	--	--	12,481
Land Use (Acres) (1980 Base Year Estimates)										
100-year Floodplain	0	0	0	0	0	--	--	--	--	0
270-year Floodplain	0	0	0	0	0	--	--	--	--	0
Standard Project Floodplain	5,789	316	0	288	3,957	--	--	--	--	10,350
Value of Property ($1,000) (1980 Base Year Estimates)										
100-year Floodplain	0	0	0	0	0	0	--	--	--	0
270-year Floodplain	0	0	0	0	0	0	--	--	--	0
Standard Project Floodplain	331,615	50,958	2,461	131,976	71	2,379	--	2,043	--	521,503
Single Occurrence Flood Damages ($1,000) (1980 Base Year Estimates)										
100-year Flood	0	0	0	0	0	0	0	0	0	0
270-year Flood	0	0	0	0	0	0	0	0	0	0
SPF	108,609	18,608	721	31,761	26	592	0	360	1453	163,130
Average Annual Flood Damages* ($1,000) (By Decade)										
1980	199.0	34.1	1.2	60.2	0	1.2	0	0.6	3.0	299.3
1990	230.7	38.8	1.4	69.3	0	1.3	0	0.7	3.4	345.6
2000	260.0	42.2	1.5	77.6	0	1.4	0	0.8	3.7	387.2
2010	294.7	35.3	1.6	86.7	0	1.3	0	0.9	3.9	434.6
2020	337.4	47.6	1.8	97.7	0	1.2	0	0.8	4.3	491.8
2030	358.9	50.0	1.9	102.6	0	1.2	0	0.8	4.5	519.9

*Not Discounted
Revised April 1980

TABLE A-28
MOUNTAINVIEW UNIT
DESCRIPTION OF PROPERTY AND POTENTIAL FLOOD LOSSES
JANUARY 1977 PRICES

	Residential	Commercial	Industrial	Public	Crop	Equipment	Sediment	Irri Facil	Busin Losses	Total
Number of Improvements (1980 Base Year Estimates)										
100-year Floodplain	59	3	0	0	--	--	--	--	--	62
270-year Floodplain	67	3	0	0	--	--	--	--	--	70
Standard Project Floodplain	73	3	0	0	--	--	--	--	--	76
Land Use (Acres) (1980 Base Year Estimates)										
100-year Floodplain	54	0	0	0	1,340	--	--	--	--	1,394
270-year Floodplain	61	0	0	0	1,347	--	--	--	--	1,408
Standard Project Floodplain	67	0	0	0	1,351	--	--	--	--	1,418
Value of Property ($1,000) (1980 Base Year Estimates)										
100-year Floodplain	1,941	6,452	0	183	34	1,588	--	491	--	10,689
270-year Floodplain	2,277	6,452	0	225	34	1,601	--	491	--	11,080
Standard Project Floodplain	2,530	6,452	0	246	34	1,608	--	491	--	11,361
Single Occurrence Flood Damages ($1,000) (1980 Base Year Estimates)										
100-year Flood	446	5,199	0	52	32	108	34	61	978	6,910
270-year Flood	530	5,255	0	67	32	142	35	64	978	7,103
SPF	687	5,708	0	82	34	189	35	78	979	7,792
Average Annual Flood Damages* ($1,000) (By Decade)										
1980	11.1	91.5	0	1.4	0.5	3.0	0.6	1.2	26.7	136.0
1990	11.2	91.5	0	1.4	0.5	3.0	0.6	1.2	26.7	136.1
2000	11.2	91.5	0	1.4	0.5	3.0	0.6	1.2	26.7	136.1
2010	11.2	91.5	0	1.4	0.5	3.0	0.6	1.2	26.7	136.1
2020	11.2	91.5	0	1.4	0.5	3.0	0.6	1.2	26.7	136.1
2030	11.2	91.5	0	1.4	0.5	3.0	0.6	1.2	26.7	136.1

*Not Discounted
Revised April 1980

Interstate bridge will pass the Standard Project Flood. The levee system is rated at 10,000 c.f.s., the 34-year flood. Because the unit lies wholly within Indian land, access to the river is not available to the general public. Physical characteristics of this unit are given in Table A-29.

Isleta Unit - West. This unit is 4.8 miles long and extends along the west bank from Interstate 25 bridge to a point about 1-1/2 miles downstream from the State Highway 47 bridge. All the unit lies within the Isleta Indian Reservation and includes the main part of the Pueblo itself. The remainder of the land is in agriculture with a few scattered homesteads. The levee with its rated capacity of 10,000 c.f.s. and no seepage control measures provides protection from flows up to the 34-year flood. Access to the river and adjacent bosque is restricted because it lies within the reservation. Table A-30 shows the types and values of property in this unit.

Belen Unit - East. This unit begins at high ground just upstream from the highway bridge at Isleta and extends for 22.1 miles to a point about 3,700 feet below the Santa Fe Railroad bridge downstream from Belen. Included within this portion of the study area are a part of the Isleta Reservation and the communities of Bosque Farms, Peralta, Valencia, and Tome. Much of the area could be described as suburban with the remainder consisting of small, irrigated farms. The two highway bridges spanning the river at Los Lunas and Belen and the railroad bridge below Belen will pass the Standard Project Flood. The Isleta Diversion Dam, the principle structure in the irrigation system for this and the Belen Unit - West, is located at the Isleta Pueblo. The existing levee system is rated at 7,500 c.f.s., having an exceedance frequency of once in 26 years. Type and value of property within this unit together with flood damage potential are shown in Table A-31. The entire river except for the reservation is accessible to the public and is extensively used for hunting, fishing, and other outdoor activities.

TABLE A-29

ISLETA UNIT-EAST

DESCRIPTION OF PROPERTY AND POTENTIAL FLOOD LOSSES

JANUARY 1977 PRICES

	Residential	Commercial	Industrial	Public	Crop	Equipment	Sediment	Irri Facil	Busin Losses	Total
Number of Improvements (1980 Base Year Estimates)										
100-year Floodplain	0	0	0	13	--	--	--	--	--	13
270-year Floodplain	0	0	0	13	--	--	--	--	--	13
Standard Project Floodplain	0	0	0	13	--	--	--	--	--	13
Land Use (Acres) (1980 Base Year Estimates)										
100-year Floodplain	0	0	0	165	31	--	--	--	--	196
270-year Floodplain	0	0	0	165	31	--	--	--	--	196
Standard Project Floodplain	0	0	0	165	31	--	--	--	--	196
Value of Property ($1,000) (1980 Base Year Estimates)										
100-year Floodplain	0	0	0	1,418	0	16	--	81	--	1,515
270-year Floodplain	0	0	0	1,418	0	16	--	81	--	1,515
Standard Project Floodplain	0	0	0	1,418	0	16	--	81	--	1,515
Single Occurrence Flood Damages ($1,000) (1980 Base Year Estimates)										
100-year Flood	0	0	0	224	1	3	6	10	0	244
270-year Flood	0	0	0	286	1	6	6	14	0	313
SPF	0	0	0	318	2	12	6	18	0	356
Average Annual Flood Damages* ($1,000) (By Decade)										
1980	0	0	0	5.8	0	0.3	0.1	0.4	0	6.6
1990	0	0	0	5.8	0	0.3	0.1	0.4	0	6.6
2000	0	0	0	5.8	0	0.3	0.1	0.4	0	6.6
2010	0	0	0	5.8	0	0.3	0.1	0.4	0	6.6
2020	0	0	0	5.8	0	0.3	0.1	0.4	0	6.6
2030	0	0	0	5.8	0	0.3	0.1	0.4	0	6.6

*Not Discounted
Revised April 1980

TABLE A-30
ISLETA UNIT-WEST
DESCRIPTION OF PROPERTY AND POTENTIAL FLOOD LOSSES
JANUARY 1977 PRICES

	Residential	Commercial	Industrial	Public	Crop	Equipment	Sediment	Irri Facil	Busin Losses	Total
Number of Improvements (1980 Base Year Estimates)										
100-year Floodplain	213	4	0	0	--	--	--	--	--	217
270-year Floodplain	250	6	0	0	--	--	--	--	--	256
Standard Project Floodplain	293	8	0	0	--	--	--	--	--	301
Land Use (Acres) (1980 Base Year Estimates)										
100-year Floodplain	121	2	0	0	1,398	--	--	--	--	1,521
270-year Floodplain	140	3	0	0	1,398	--	--	--	--	1,541
Standard Project Floodplain	161	5	0	0	1,398	--	--	--	--	1,564
Value of Property ($1,000) (1980 Base Year Estimates)										
100-year Floodplain	5,781	179	0	659	37	319	--	404	--	7,379
270-year Floodplain	6,800	314	0	790	37	319	--	405	--	8,665
Standard Project Floodplain	7,986	461	0	933	37	319	--	408	--	10,144
Single Occurrence Flood Damages ($1,000) (1980 Base Year Estimates)										
100-year Flood	1,923	51	0	277	29	100	43	45	4	2,472
270-year Flood	2,428	63	0	350	33	125	44	56	8	3,107
SPF	3,667	140	0	508	37	201	45	68	11	4,677
Average Annual Flood Damages* ($1,000) (By Decade)										
1980	50.6	1.9	0	7.1	0.5	2.7	0.6	1.0	0.1	64.5
1990	50.6	1.9	0	7.1	0.5	2.7	0.6	1.0	0.1	64.5
2000	50.6	1.9	0	7.1	0.5	2.7	0.6	1.0	0.1	64.5
2010	50.6	1.9	0	7.1	0.5	2.7	0.6	1.0	0.1	64.5
2020	50.6	1.9	0	7.1	0.5	2.7	0.6	1.0	0.1	64.5
2030	50.6	1.9	0	7.1	0.5	2.7	0.6	1.0	0.1	64.5

*Not Discounted
Revised April 1980

TABLE A-31
BELEN UNIT-EAST
DESCRIPTION OF PROPERTY AND POTENTIAL FLOOD LOSSES
JANUARY 1977 PRICES

	Residential	Commercial	Indus-trial	Public	Crop	Equip-ment	Sedi-ment	Irri Facil	Busin Losses	Total
Number of Improvements (1980 Base Year Estimates)										
100-year Floodplain	2,997	124	6	31	--	--	--	--	--	3,158
270-year Floodplain	3,318	127	6	32	--	--	--	--	--	3,483
Standard Project Floodplain	3,397	128	6	33	--	--	--	--	--	3,564
Land Use (Acres) (1980 Base Year Estimates)										
100-year Floodplain	2,693	212	2	64	14,293	--	--	--	--	17,264
270-year Floodplain	2,984	218	2	68	14,465	--	--	--	--	17,737
Standard Project Floodplain	3,055	221	2	69	14,537	--	--	--	--	17,884
Value of Property ($1,000) (1980 Base Year Estimates)										
100-year Floodplain	79,717	13,239	782	18,909	404	4,303	--	4,125	--	121,479
270-year Floodplain	88,280	13,532	782	20,102	408	4,376	--	4,125	--	131,605
Standard Project Floodplain	90,394	13,656	782	20,603	410	4,407	--	4,125	--	134,377
Single Occurrence Flood Damages ($1,000) (1980 Base Year Estimates)										
100-year Flood	17,209	6,863	75	3,932	271	343	308	423	423	29,847
270-year Flood	23,081	8,034	99	4,799	320	1,274	324	559	323	38,813
SPF	32,001	9,199	137	6,655	447	1,768	343	774	447	51,771
Average Annual Flood Damages* ($1,000) (By Decade)										
1980	626.6	184.2	3.1	132.8	9.2	35.0	8.2	15.4	14.9	1,029.4
1990	627.9	184.5	3.1	131.1	9.2	35.1	8.2	15.5	14.9	1,031.5
2000	627.9	184.5	3.1	131.1	9.2	35.1	8.2	15.5	14.9	1,031.5
2010	627.9	184.5	3.1	131.1	9.2	35.1	8.2	15.5	14.9	1,031.5
2020	627.9	184.5	3.1	131.1	9.2	35.1	8.2	15.5	14.9	1,031.5
2030	627.9	184.5	3.1	131.1	9.2	35.1	8.2	15.5	14.9	1,031.5

*Not Discounted
Revised April 1980

Belen Unit - West. The cities of Belen and Los Lunas comprise the major population centers in this unit, which extends for about 22 miles from a point about 1-1/2 miles below the bridge at Isleta past the more populated area below the railroad bridge at Belen. In addition, there are several new subdivisions and a correctional institution, the Los Lunas Honor Farm. The remainder of the flood plain is composed of irrigated farms. The levee system, like its counterpart on the opposite bank, was elevated to provide protection against floods up to 7,500 c.f.s., having an exceedance frequency of once in 26 years. It is in this unit that the most severe problems of landside sloughing due to lack of seepage control have occurred in the past. The area along the river is extensively used for a variety of outdoor activities, including hunting and fishing. At the upper end of this unit on the Isleta Reservation is one of two remaining marshes in the study area, about whose existence naturalists and others have expressed much concern. Figures A-4 and A-5 show the aquatic nature of the area. Table A-32 shows the types and value of property for this reach of flood plain and the potential flood damages to existing properties.

Summary of Rio Grande Flood Problems. Evaluation of the existing flood control system determined that the degree of protection provided by the levees varies from 7,500 c.f.s. to 42,000 c.f.s. As a comparison the Standard Project Flood is 74,000 c.f.s. at Bernalillo, attenuating to 67,000 c.f.s. at Belen. The study area has been divided into nine separate units in accordance with their rated capacity and existing physical and political features which require individual analysis. In addition to these obvious deficiencies in hydraulic capacities, there are no seepage control measures throughout the levee system except for the reconstructed Albuquerque unit. Consequently, the levees in several areas are susceptible to landside sloughing at flows of 5,000 c.f.s. or greater. Also, because of the proximity of the main channel to the levee and lack of vegetation cover, portions of the levee are exposed to attack by high

Fig. A-5

Fig. A-6

ISLETA MARSH

TABLE A-32
BELEN UNIT-WEST
DESCRIPTION OF PROPERTY AND POTENTIAL FLOOD LOSSES
JANUARY 1977 PRICES

	Residential	Commercial	Indus-trial	Public	Crop	Equip-ment	Sedi-ment	Irri Facil	Busin Losses	Total
Number of Improvements (1980 Base Year Estimates)										
100-year Floodplain	2,624	515	7	55	--	--	--	--	--	3,201
270-year Floodplain	3,251	565	8	65	--	--	--	--	--	3,889
Standard Project Floodplain	3,664	597	9	71	--	--	--	--	--	4,341
Land Use (Acres) (1980 Base Year Estimates)										
100-year Floodplain	1,482	317	6	272	5,809	--	--	--	--	7,886
270-year Floodplain	1,853	345	7	330	6,542	--	--	--	--	9,077
Standard Project Floodplain	2,097	362	8	368	7,014	--	--	--	--	9,849
Value of Property ($1,000) (1980 Base Year Estimates)										
100-year Floodplain	71,585	33,676	641	33,536	134	1,755	--	2,456	--	143,783
270-year Floodplain	89,323	36,985	693	43,206	153	1,991	--	2,532	--	174,883
Standard Project Floodplain	101,002	39,119	726	49,430	166	2,143	--	2,581	--	195,167
Single Occurrence Flood Damages ($1,000) (1980 Base Year Estimates)										
100-year Flood	10,696	8,714	180	6,602	43	73	261	246	846	27,661
270-year Flood	15,685	10,861	182	8,075	73	182	271	292	876	36,497
SPF	26,145	15,965	247	11,561	127	399	290	452	954	56,140
Average Annual Flood Damages*($1,000) (By Decade)										
1980	429.2	262.9	3.8	191.2	1.9	6.6	4.7	7.5	30.2	938.0
1990	434.8	266.0	3.8	193.5	1.9	6.7	4.8	7.6	30.4	949.5
2000	435.4	266.3	3.9	193.7	1.9	6.7	4.8	7.6	30.3	950.1
2010	436.1	266.6	3.9	193.9	1.9	6.7	4.8	7.6	30.5	952.0
2020	436.2	266.7	3.9	194.0	1.9	6.7	4.8	7.6	30.4	952.2
2030	436.2	266.7	3.9	194.0	1.9	6.7	4.8	7.6	30.4	952.2

*Not Discounted
Revised April 1980

floodflow velocities. Of the 13 bridges spanning the river within the study area, only two, the U.S. Highway 85 and U.S. Highway 66 bridges at Albuquerque, will not pass the Standard Project Flood. However, all of the bridges will pass the 270-year flood.

Damage Potential. Over 70,000 acres are threatened with inundation by the Standard Project Flood within the total study area. In comparison, over 43,000 acres and approximately 36,000 acres would be inundated by the 270-year and 100-year floods respectively. Concentrations of population within the Standard Project Flood plain include all or parts of Bernalillo, Corrales, Los Ranchos de Albuquerque, Albuquerque, Bosque Farms, Los Lunas, and Belen. The 270-year flood plain contains the same population concentrations as the Standard Project Flood with the exception of Albuquerque. Also, parts of the Sandia and Isleta Indian Reservations lie within the study area. The major concern of this investigation is the potential loss of life due to a sudden levee failure. Approximately 153,000 people reside in the Standard Project Flood plain and this number is projected to increase to 325,000 by the year 2030. In addition, all types of property damage would be incurred; including residential, commercial, industrial, public, and agricultural. Agricultural damages would consist of crop damages, equipment losses, dead livestock, land reclamation, and damage to the extensive irrigation network. Table A-33 summarizes the types and values of properties within the various flood plains for the entire study area and provides an indication of the flood damage potentials.

Other major impacts include health hazards from inundation of wells and septic tanks, community disruption, interruption to transportation, and emergency demands on Federal, State, and local agencies.

TABLE A-33
SUMMARY OF ENTIRE STUDY AREA
DESCRIPTION OF PROPERTY AND POTENTIAL FLOOD LOSSES
JANUARY 1977 PRICES

	Residential	Commercial	Industrial	Public	Crops	Equipment	Sediment	Irrig Facil	Busin Losses	Total
Number of Improvements (1980 Base Year Estimates)										
100-year Floodplain	6,732	680	16	122	--	--	--	--	--	7,540
270-year Floodplain	8,805	809	22	147	--	--	--	--	--	9,783
Standard Project Floodplain	41,368	4,382	109	655	--	--	--	--	--	46,514
Land Use (Acres) (1980 Base Year Estimates)										
100-year Floodplain	4,995	586	10	556	24,379	--	--	--	--	30,526
270-year Floodplain	6,184	708	13	681	27,887	--	--	--	--	35,473
Standard Project Floodplain	19,694	2,684	227	2,205	36,097	--	--	--	--	60,907
Value of Property ($1,000) (1980 Base Year Estimates)										
100-year Floodplain	190,406	56,420	1,880	92,784	656	8,865	--	8,382	--	359,393
270-year Floodplain	250,994	65,176	2,391	115,338	722	9,970	--	9,840	--	454,431
Standard Project Floodplain	1,243,157	610,456	54,240	787,091	865	17,940	--	14,569	--	2,728,318
Single Occurrence Flood Damages ($1,000) (1980 Base Year Estimates)										
100-year Flood	40,519	21,343	487	20,345	411	793	710	886	2,380	87,874
270-year Flood	60,255	25,414	525	24,584	540	2,066	847	1,287	2,422	117,940
SPF	431,147	135,322	7,232	165,813	804	4,142	930	2,685	17,616	765,691
Average Annual FLood Damages*($1,000) (By Decade)										
1980	2118.1	758.2	24.7	817.1	13.6	56.7	16.2	31.0	108.0	3943.6
1990	2215.5	782.8	26.3	850.0	13.6	57.0	16.6	31.7	111.4	4106.8
2000	2294.7	799.1	30.0	876.3	13.6	57.1	16.5	32.1	113.6	4234.5
2010	2381.9	803.1	34.5	903.2	13.6	57.0	16.6	32.4	116.0	4370.5
2020	2458.6	821.5	39.6	927.4	13.6	56.9	16.5	32.4	117.4	4486.0
2030	2503.1	829.0	49.3	941.8	13.6	56.9	16.5	32.4	118.6	4563.2

*Not Discounted
Revised April 1980

ARROYO AND SHEET FLOW RUNOFF

Because of the historical aggradation of the Rio Grande, the streambed and stream banks upon which the existing levees rest are higher than the adjacent flood plains throughout most of the study reach. These low areas are natural ponding sites. In addition, the valley is interlaced with highway and railroad embankments and canals and drainage ditches with their accompanying spoil banks and levees which cut off former natural drainage to the river. Typical valley cross sections depicting the perched condition of the stream, the low areas, and the obstructions to flow are shown on Plate A-9. Location of the cross sections are shown on Plates A-5 through A-8. Flooding occurs when localized thunderstorms over the mountains, foothills, and mesas are of such intensity as to exceed infiltration rates, causing water to rush into the valley through existing watercourses and sheet flow. These flows then pond in the low areas and behind these embankments and spoil banks. Some of these ponding areas may be as far as two miles from the Rio Grande. Historic areas of ponding from this type of flooding compiled from District records are shown on Plates A-5 through A-8. The ponded water remains until it seeps into ground or is carried off by the system of canals and drains after these embankments and spoil banks are breached and eventually discharged into the Rio Grande. This irrigation and drainage network, administered by the Middle Rio Grande Conservancy District, and shown on Plate A-10, does not include capacity for storm runoff. Often the water in these conveyances is itself the source of flooding, as high discharges from the uplands deposit sediment and debris into the ditches forming a dam which forces the water out of the ditches and onto adjacent lands. Albuquerque District personnel have inspected the ditches and their outlets into the river, and have determined that the system is well maintained and functions as intended.

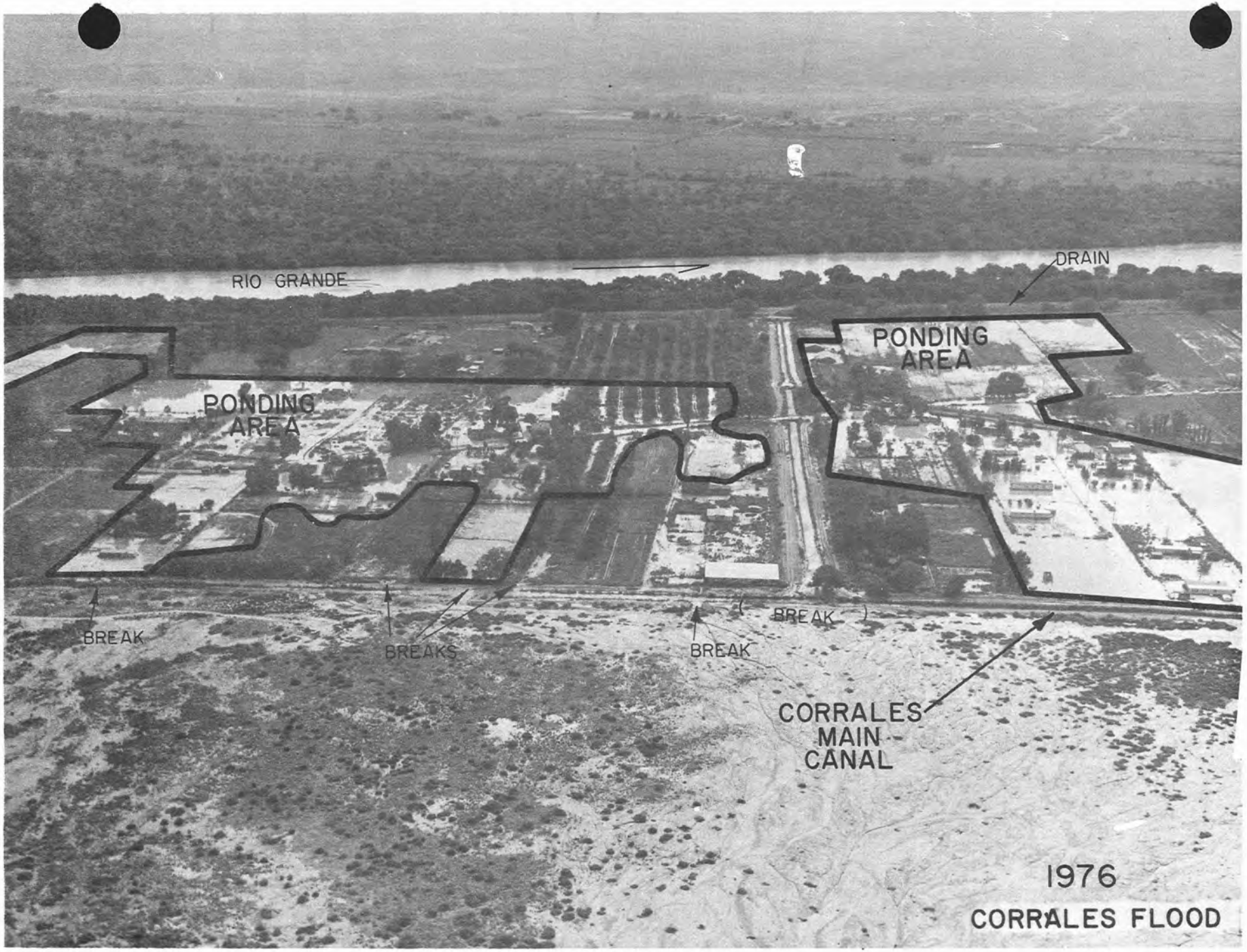
Flooding of this type occurs annually, usually during the summer thunderstorm season. Impacts from such storms range from short duration nuisance ponding to damages ranging in the millions of dollars. The most recent floods of consequence occurred in Corrales in 1975 and 1976, inflicting damages of $300,000 and $250,000, respectively. In 1969 sheet flow runoff from the west mesa inundated portions of Belen causing an estimated $2,100,000 in damages.

Figure A-7 illustrates the flooding which occurred in Corrales in 1976. As shown in the photograph and on Plate A-5, flood waters from this flood or the 1975 flood did not reach the main stem levee or accompanying riverside drain. The 1976 storm was estimated to equal the 1 percent flood and occurred over Arroyo de los Montoyas, having a drainage area of 67 square miles.

Figures A-8 and A-9 show the flooded area from the 1 percent storm which occurred in Belen in 1969. Note how the railroad acted as an effective barrier to pond the water. The relationship of the ponded area to the Rio Grande levee is illustrated on Plate A-8.

Because of the obvious threat posed by this type of flooding, numerous studies have been completed and others are underway by several Federal and local agencies. Some structures are already in operation as a result of these investigations. The areal extent of these studies is such as to cover almost all of the valley within the study reach. Following are brief descriptions of the studies.

a. The Soil Conservation Service, under authority of Public Law 566, prepared the "Sandia Mountains Tributaries Work Plan" in 1955 to protect the city of Bernalillo and surrounding area from runoff originating on the slopes east of the city. The watershed



1976 FLOOD IN CORRALES

Fig. A-

Fig. A-8

Fig. A-9

1969 FLOOD IN BELEN

studied is shown on Plate A-12. A cooperative effort to manage runoff of this watershed between the Soil Conservation Service and the National Forest Service resulted from this plan. The Soil Conservation Service constructed an earthen dam having a capacity of 250 acre-feet on Piedro Liza Arroyo. Higher in the watershed the Forest Service has limited grazing on its lands to increase the ground cover and has constructed and maintained a system of erosion control techniques. The methods employed and their magnitude include the construction of 410 stabilizing structures; revegetating 30 acres with woody plants; 54.5 miles of flat slope terracing; 6 miles of steep slope terracing; revegetating 80 acres with grasses; controlling 376 acres of gullies by placing impediments in them slowing the flow; pitting 1,153 acres; and chiseling 374 acres.

Although there was the possibility of constructing at least seven small flood control dams on the watershed, only one had the support of the public.

b. The "Corrales Watershed Work Plan" dated 1968 and supplemented in 1977, was developed by the Soil Conservation Service to protect valley residents in the vicinity of Corrales from runoff originating on the west mesa. The Watershed area studied is shown on Plate A-13. Part 1 of this plan, a structure to divert runoff from Black's Arroyo into Arroyo de las Calabacillas, has been constructed. It is designed to convey runoff from a 100-year storm. Part 2 is in final plan selection. The authorized plan for Part 2 is an earthen dam designed for the 100-year storm. But due to the lack of local support, the authorized plan is being changed to recommend a diversion channel carrying the runoff of a 100-year storm from Arroyo de los Montoyas, las Lomatas Negras Arroyo and the area in between them into the Rio Grande.

c. The "Belen-Los Lunas Watershed Work Plan" was developed by the Soil Conservation Service in 1974 to protect the city of Belen and surrounding area from sheet flow runoff from the adjacent uplands. The watershed studied is shown on Plate A-14. The recommended plan called for a combination of land treatment measures and structural measures. The land treatment measures, all on private land, included proper grazing use on 3,000 acres and for 2,000 other acres the measures included fencing, diversions, debris basins, net wire diversions, grade stabilization structures, revegetation with grasses and shrubs, and livestock exclusion. The structural improvements included a homogenous earthfill dam for retarding flood water located at Site 4 in the northern portion of the watershed. Also included was an enlargment of the Canal Dike. Both structures would be designed to carry the runoff from a 100-year storm. The plan, while economically justified, was not implemented due to lack of local financial support.

d. and e. The "Upper Rio Grande Basin, Water and Related Land Resources" prepared by the Soil Conservation Service in 1973 recommended that the Hell's Canyon and Canyon Sales watersheds be included in the 15-year early action plan to be implemented under authority of Public Law 566.

f. The city of Albuquerque is currently updating and revising its master drainage plan in light of latest growth trends. The city's interior flood control projects are jointly planned and coordinated with Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) and their projects. Currently, the city has constructed flood retardation dams on Bear Canyon Arroyo, North Arroyo de Domingo Baca, and Camino Arroyo.

g. The AMAFCA is presently implementing a plan of flood control for the drainages into the valley within Bernalillo County.

Several structures have been completed. The North and South Diversion channels were constructed for the Authority by the Albuquerque District of the Corps of Engineers. The alignment is shown on Plate A-6. Their function is to divert flows from arroyos originating east of the city and to carry them to the Rio Grande. The North Diversion channel begins at Lousiana Avenue - I-40 intersection where it collects the flows from Embudo Arroyo. It then follows the Interstate 40 west to Girard Avenue where the channel angles and runs north to the Rio Grande. The outflow capacity is 44,000 c.f.s. The South Diversion Channel originates at Stadium Avenue just east of Interstate 25 and follows the Interstate south till it joins Tijeras Arroyo and follows the arroyo to the Rio Grande. The outflow capacity of the South Diversion Channel is 37,000 c.f.s.

AMAFCA is presently considering various flood control alternatives for the West Mesa area of Albuquerque. The study area as outlined is shown on Plate A-15. The master plan by which to control arroyo flooding in the West Valley of Albuquerque consists of a system of diversion channels, detention infiltration structures and desilting basins. The layout of this plan is shown on Plate A-16. The Hubbell Diversion channel is already constructed. The other phases of the plan are awaiting appropriation at this time.

h. The middle Rio Grande Council of Governments has developed a storm drainage plan for the city of Bernalillo.

The following information is relevant to the level of detail to which interior runoff should be addressed in this report:

a. Problems associated with interior runoff have been studied extensively by Soil Conservation Service and other agencies. Additional study would be a duplication of effort and violate understandings with those agencies.

b. The only feasible and economic alternative identified in Stage 2 of the study was that of the rehabilitating the existing levee system. This alternative would neither create additional interior flooding nor interfere with existing and proposed facilities to control such flooding.

In summary, the problems of interior runoff have been extensively investigated by other Federal and local agencies, and their recommendations have been or are being acted upon. As evidenced by photos and cross sections of the study area the existing levee system along the channel of the Rio Grande have little to no impact on the magnitude of flooding caused by arroyo and sheet flow.

RIO GRANDE AGGRADATION

In recent years local residents have expressed grave concern over the continued aggradation of the Rio Grande. This aggradation has reduced channel capacity for flood flows and adversely affected the operation of the irrigation network at diversion structures and return wasteways.

There are about 3,570 square miles of drainage area in this 78-river-mile reach from Cochiti Dam to the Rio Puerco. There are generally three types of sediment producing areas in the drainage. These are as follows:

a. The High Mountain Areas. These usually have a good ground cover of coniferous trees, aspens, oak brush and grasses. Precipitation averages about 20 inches annually. The stream slopes are very steep and the headwaters of the major tributaries are in these areas. Sediment production is generally 0.2 acre-feet per square mile per year or less. Runoff intensity is modified by the vegetative cover.

b. The Mesa Portion. This area lies between the mountains and the valley bottoms. At the higher elevations pinon and juniper trees along with grasses provide a sparse ground cover which changes to mesquite, chamisa, and creosote bush as the elevations become lower. Rainfall is generally 10 to 15 inches. Sediment production of this area varies with the soils and geologic formations encountered and ranges from 0.2 to 0.5 acre-feet per square mile per year. There are some highly erodible areas, especially in the Santa Fe geologic formation, which produce 1.0 to 3.0 acre-feet per square mile per year of sediment, but the limited amount of rainfall and area precludes any large sediment contribution.

c. The Valley Portion. This portion of the drainage area is relatively flat and is composed of a variety of sedimentary deposits of predominantly fine materials. Sediment production rates are usually less than 0.2 acre-feet per square mile per year.

A study of the sparse sediment data available on the tributaries of the Rio Grande in this reach indicates that an average sediment production rate of 0.30 acre-feet per square mile per year for each tributary drainage area is a reasonably accurate estimate. Some sediment is prevented from reaching the Rio Grande on Galisteo

Creek by Galisteo Dam. The drainage area of Galisteo Creek is 692 square miles. The dam controls 596 square miles with an average annual sediment production of 390 acre-feet. The trap efficiency of the dam is estimated to average about 50 percent. The drainage area above the dam would contribute about 190 acre-feet of sediment to the Rio Grande and the area between the dam and the mouth would produce 28.8 acre-feet for a total from Galisteo Creek of 218.8 acre-feet. In the Jemez River, the Jemez Canyon Dam controls 1,034 square miles of drainage area of the total 1,038 square miles. The computed trap efficiency based on 21 years of operation is 63.4 percent. For that period, there are 521 acre-feet of sediment deposited and 301 acre-feet of sediment outflow. An average annual total of 302.2 acre-feet of sediment is carried into the Rio Grande by the Jemez River. Presently awaiting approval is a permanent pool to be established in Jemez Reservoir. This pool should increase the trap efficiency to about 90 percent.

Sediment is also prevented from reaching the Rio Grande by a network of roads, canals, ditches and drains in the valley. In only a few cases does the sediment production of a tributary enter the Rio Grande directly.

Table A-34 shows the drainage areas of each tributary, both sediment contributing and non-contributing; the amount of sediment presently produced by each drainage area; the estimated percent of sediment reaching the Rio Grande; and the volume of sediment entering the Rio Grande in the reach between Cochiti Dam and Belen from each tributary. The table reflects the impact of the proposed permanent pool in Jemez Reservoir. The suspended sediment sizes are fairly consistent throughout the reach, but the percent of the bed material in the gravel and larger sizes decreases from 33.1

TABLE A-34
Sediment Production - Rio Grande Tributaries
Cochiti Dam to Belén, New Mexico

Tributary	Drainage Area - Sq. Mi.			Sediment - Ac. Ft./Yr.[1]			Percent[2]	Volume-Ac/Ft.
	Sediment Contributing	Non-Contributing	Total	Drainage Area	Reservoir Spills	Total	Entering Rio Grande	Entering Rio Grande
Peralta Canyon	61		61	18.3		18.3	33	46.1[3]
Santo Domingo Canyon	43		43	12.9		12.9	33	4.3
Galisteo Creek	96	596	692	28.8	190.0	218.8	100	218.8
Borrego Canyon	107		107	32.1		32.1	75	24.0
Arroyo De Los Tanos	43		43	12.9		12.9	33	4.3
Tonque Arroyo	197		197	59.1		59.1	100	59.1
Las Huertas Creek	61		61	18.3		18.3	25	4.2
Jemez River	4	1034	1038	1.2	82.0	83.2	100	83.2
Arroyo Sarca	16		16	4.8		4.8	0	0
Santa Ana Mesa	70		70	21.0		21.0	75	15.6
Arroyo Agua	19		19	5.7		5.7	0	0
Arroyo Venada	44		44	13.2		13.2	100	13.2
Arroyo Montoyas	67		67	20.1		20.1	0	0
Arroyo Calabacillas	98		98	29.4		29.4	50	14.7
Sandia Wash	35		35	10.5		10.5	0	0
North Diversion	97		97	29.1		29.1	100	29.1
South Diversion	7		7	2.1		2.1	100	2.1
Tijeras Arroyo	135		135	40.5		40.5	100	40.5
Small Arroyos	370	370	740	111.0		111.0	100	111.0
Total	1,570	2,000	3,570	471.0	272.0	743.0		670.2

[1] Based on 0.30 Ac. Ft./Sq. Mi./Yr. - Sediment Production Rate

[2] Based on Inspection of U.S.G.S. Quad Sheets

[3] Includes 40 Ac. Ft. from Cochiti Releases

percent near Cochiti to 3.0 percent near Belen. This indicates that there is very little opportunity for the channel to armor in the further downstream reaches. Table A-35 shows the distribution of suspended sediment and the bed material.

Complete resurveys of this reach were made in 1962 and 1972, and another resurvey is scheduled for 1982. Table A-36 shows the observed aggradation for the three periods (1936-1962, 1936-1972, and 1962-1972). In addition to these surveys, the sediment load of the Rio Grande and its tributaries in this reach is being measured at the following gaging stations:

a. Rio Grande above Cochiti - since October 1947.
b. Rio Grande below Cochiti Dam - since July 1974.
c. Rio Grande at Albuquerque - since October 1969.
d. Galisteo Creek near Galisteo Dam - since July 1971.
e. Jemez River below Jemez Canyon Dam - since October 1953.

Under conditions prior to the beginning of operation of Cochiti Lake, the trend of the river was aggradation but the rate of aggradation has slowly decreased. With Cochiti Lake in full operation, degradation will slowly progress downstream and should reach the Albuquerque area in 20 to 25 years under average flow conditions. The river bed will be lowered about 2 feet near Cochiti to approximately 4 feet in the vicinity of Albuquerque. The basis for this prediction is as follows:

a. Galisteo, Jemez, and Cochiti reservoirs have reduced the sediment load entering the study area by about 3,100 acre-feet.

b. The clear water releases from Jemez and Cochiti will reconsitute their sediment load downstream from available bed materials which the flows are capable of transporting.

TABLE A-35

Sediment Sizes - Rio Grande and Tributaries
Cochiti Dam to Belen, New Mexico

Bed Material

Reach From	Reach To	Percent in Size: Silt and Clay 0.062mm	Sand 0.062 - 2.00mm	Gravel 2.00 - 16.0mm	Coarse Gravel 16.0 - 64.0mm
Cochiti	Galisteo Cr.	12.7	54.2	17.6	15.5
Galisteo Cr.	Angostura D.D.	9.6	59.7	15.8	14.9
Angostura D.D.	Bernalillo	11.9	73.3	8.0	6.8
Bernalillo	Albuquerque	11.7	80.0	5.8	2.5
Albuquerque	Isleta D.D.	12.7	80.3	5.4	1.6
Isleta D.D.	Belen	10.3	86.7	2.5	0.5

SUSPENDED SEDIMENT LOAD

Reach From	Reach To	Percent in Size: Clay 0.004mm	Silt 0.004 - 0.062mm	Sand 0.062mm
Cochiti	San Felipe	27.9	34.5	37.6
San Felipe	Bernalillo	29.9	33.0	37.1
Bernalillo	Albuquerque	30.6	31.7	37.7
Albuquerque	Belen	30.4	31.3	38.3

TABLE A-36

Albuquerque Division - Rio Grande
Aggradation

Period	Years	Aggradation Ft/Ft/Yr
1936 - 1962	25.4	0.043
1936 - 1972	35.4	0.036
1962 - 1972	10.0	0.018

Note: Flood Plain and Channel Combined

Summarily, degradation can be predicted if the past 50 years of record are indicative of future occurrences. Historic flows combined with the known bed materials shown in Table A-35 will degrade the different reaches to varying degrees, depending on the percentage of fine materials. Therefore, predictions of degradation from 2 to 4 feet at various locations based upon available date are considered reasonable.

SECTION G

PLANNING OBJECTIVES

Planning objectives stem from the national, state and local water and related land resource management needs specific to the Middle Rio Grande Valley from Bernalillo to Belen, New Mexico, which have been developed through problem analysis and an intensive public involvement program. The following planning objectives provided the basis for formulation of flood control alternatives, impact assessment, evaluation and selection of a recommended plan. These planning objectives are:

a. Eliminate threat to life posed by Rio Grande flooding.

b. Reduce inundation, scour, and sediment damages from Bernalillo to Belen caused by Rio Grande flood flows.

c. Preserve existing riparian woodlands and bosques along the Rio Grande.

d. Restore bosque areas along the Rio Grande which have been destroyed in the past.

e. Increase wildlife habitat in the flood plain.

f. Preserve existing wetlands.

g. Create new wetlands.

h. Provide increased recreational opportunities associated with a riparian environment; i.e., picnicking, nature trails, bridle paths, bicycle trails.

i. Increase water-based recreational opportunities along the Rio Grande for the people in the study area.

j. Reduce aggradation of Rio Grande streambed.

SECTION H

PLANNING CONSTRAINTS

The major planning constraints considered in addressing the previously identified objectives are principally legal in nature. These include the State of New Mexico's Prior Appropriation Doctrine of water rights, the Rio Grande Compact, and the treaty with Mexico, all of which identify the ownership of the basin's waters and place restrictions upon projects which may impeach or otherwise affect the delivery of such waters.

Environmental constraints of significance have to do with preservation of existing wetlands and creation of new wetlands. Executive Order 11990, Protection of Wetlands, issued 24 May 1977 states:

> "each agency shall provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for (1) acquiring, managing, and disposing of Federal lands and facilities; and (2) providing Federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities."

Another planning constraint considered in plan formulation is posed by the Indian pueblos, which comprise a portion of the study area. Both the Sandia and Isleta pueblos are partially located within the flood plain under investigation. The Pueblo Land Act of 1924 prohibits the selling of any Pueblo land; thereby, limiting alternatives for these areas to those which do not involve acquisition in fee. This limitation also restricts in-migration and was a major consideration in development of future projections. The pueblo council governs the affairs of the pueblo itself, and all decisions regarding water resources are made by them. Little control is realized by the political entity, i.e. county or state, in which the pueblo is located. A council member, usually the pueblo governor, is designated to coordinate with other agencies through the Bureau of Indian Affairs.

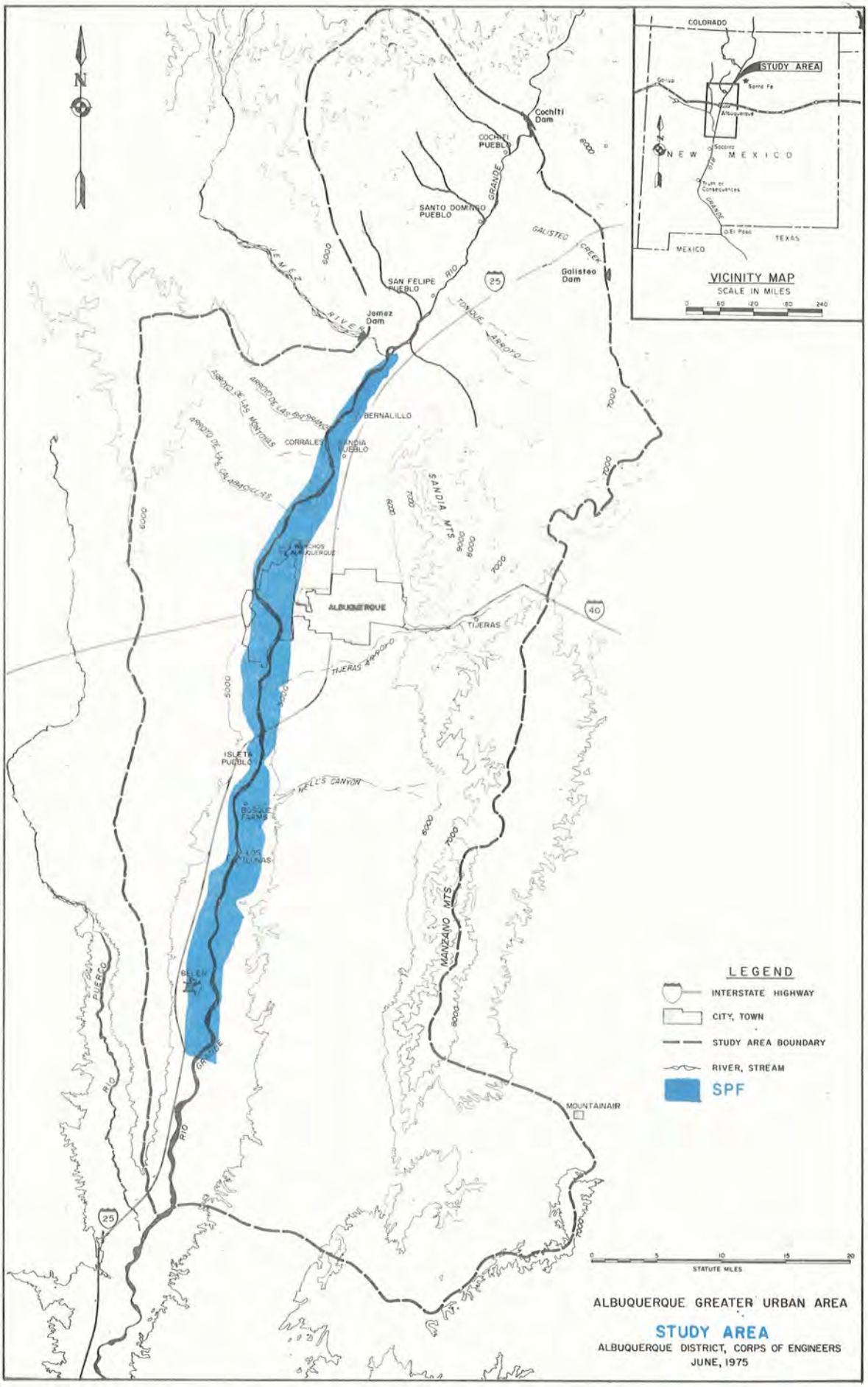

N
COLORADO
STUDY AREA
Santa Fe
Albuquerque
NEW MEXICO
Socorro
Las Cruces
El Paso
TEXAS
MEXICO
VICINITY MAP
SCALE IN MILES
0 60 120 180 240
Cochiti Dam
COCHITI PUEBLO
SANTO DOMINGO PUEBLO
GALISTEO CREEK
Galisteo Dam
SAN FELIPE PUEBLO
Jemez Dam
TONQUE ARROYO
ARROYO DE LAS HUERTAS
ARROYO DE LAS MONTOSAS
ARROYO DE LA CALABACILLAS
BERNALILLO
CORRALES
SANDIA PUEBLO
SANDIA MTS.
ALBUQUERQUE
TIJERAS
TIJERAS ARROYO
ISLETA PUEBLO
HELL'S CANYON
BOSQUE FARMS
LOS LUNAS
BELEN
MANZANO MTS.
MOUNTAINAIR
25
40
LEGEND
INTERSTATE HIGHWAY
CITY, TOWN
STUDY AREA BOUNDARY
RIVER, STREAM
SPF
0 5 10 15 20
STATUTE MILES
ALBUQUERQUE GREATER URBAN AREA
STUDY AREA
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
JUNE, 1975

PLATE A-1

SANTA FE COUNTY

SANDOVAL COUNTY

TORRANCE COUNTY

VALENCIA COUNTY

BERNALILLO COUNTY

SOCORRO COUNTY

Galisteo Dam

Cochiti Dam

COCHITI PUEBLO

SANTO DOMINGO PUEBLO

SAN FELIPE PUEBLO

Jemez Dam

BERNALILLO

SANDIA PUEBLO

CORRALES

ALBUQUERQUE

LOS RANCHOS DE ALBUQUERQUE

ISLETA PUEBLO

BOSQUE FARMS

LOS LUNAS

BELEN

TIJERAS

MOUNTAINAIR

SANDIA MTS.

MANZANO MTS.

RIO GRANDE

RIO PUERCO

GALISTEO CREEK

TONQUE ARROYO

ARROYO DE LAS MONTOYAS

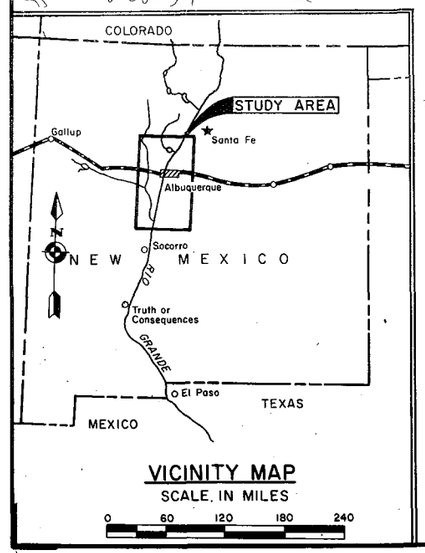
ARROYO DE LA CALABACILLAS

HELLS CANYON

JEMEZ RIVER

6000 7000 8000 9000 5000

40 25



VICINITY MAP

SCALE IN MILES

0 60 120 180 240

LEGEND

COUNTY LINES

AREA WIDE PLANNING JURISDICTION # 1

0 5 10 15 20

STATUTE MILES

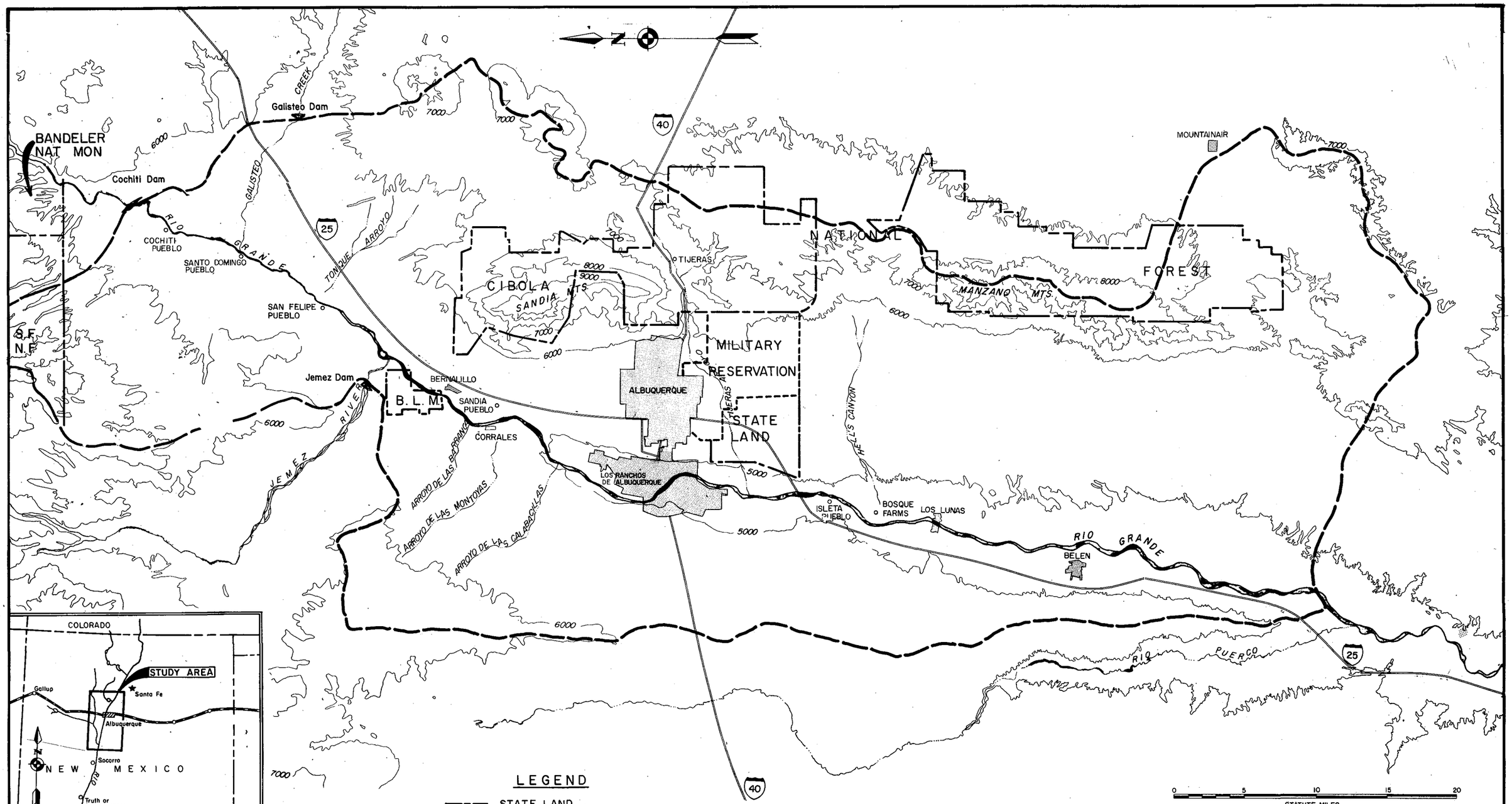
ALBUQUERQUE GREATER URBAN AREA

COUNTY & REGIONAL BOUNDARY LINES

ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS

JUNE, 1975

PLATE A-2



VICINITY MAP
SCALE IN MILES
0 60 120 180 240

LEGEND

- STATE LAND
- FEDERAL LAND
- MILITARY

ALBUQUERQUE GREATER URBAN AREA
STATE & FEDERAL LANDS

ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
JUNE, 1975

PLATE A-3

COCHITI PUEBLO

Galisteo Dam

GALISTEO CREEK

SANTA DOMINGO PUEBLO

Cochiti Dam

RIO GRANDE

COCHITI PUEBLO

SANTO DOMINGO PUEBLO

SAN FELIPE PUEBLO

TONQUE ARROYO

SAN FELIPE PUEBLO

JEMEZ PUEBLO

ZIA PUEBLO

Jemez Dam

JEMEZ RIVER

BERNALILLO

SANDIA PUEBLO

SANDIA PUEBLO

SANTA ANA PUEBLO

CORRALES

ARROYO DE LAS MONTOYAS

ARROYO DE LAS CALABACILLAS

LOS RANCHOS DE ALBUQUERQUE

ALBUQUERQUE

SANDIA MTS.

TIJERAS

TIJERAS ARROYO

ISLETA INDIAN RESERVATION

SEVILLETA CANYON

ISLETA PUEBLO

BOSQUE FARMS

LOS LUNAS

MANZANO MTS.

MOUNTAINAIR

BELEN

RIO GRANDE

RIO PUERCO

40

25

7000

6000

5000

8000

9000

0 5 10 15 20

STATUTE MILES

COLORADO

STUDY AREA

Gallup

Santa Fe

Albuquerque

NEW MEXICO

Socorro

RIO GRANDE

Truth or Consequences

El Paso

TEXAS

MEXICO

VICINITY MAP

SCALE IN MILES

0 60 120 180 240

LEGEND

INDIAN LANDS

CITY, TOWN

STUDY AREA BOUNDARY

RIVER, STREAM

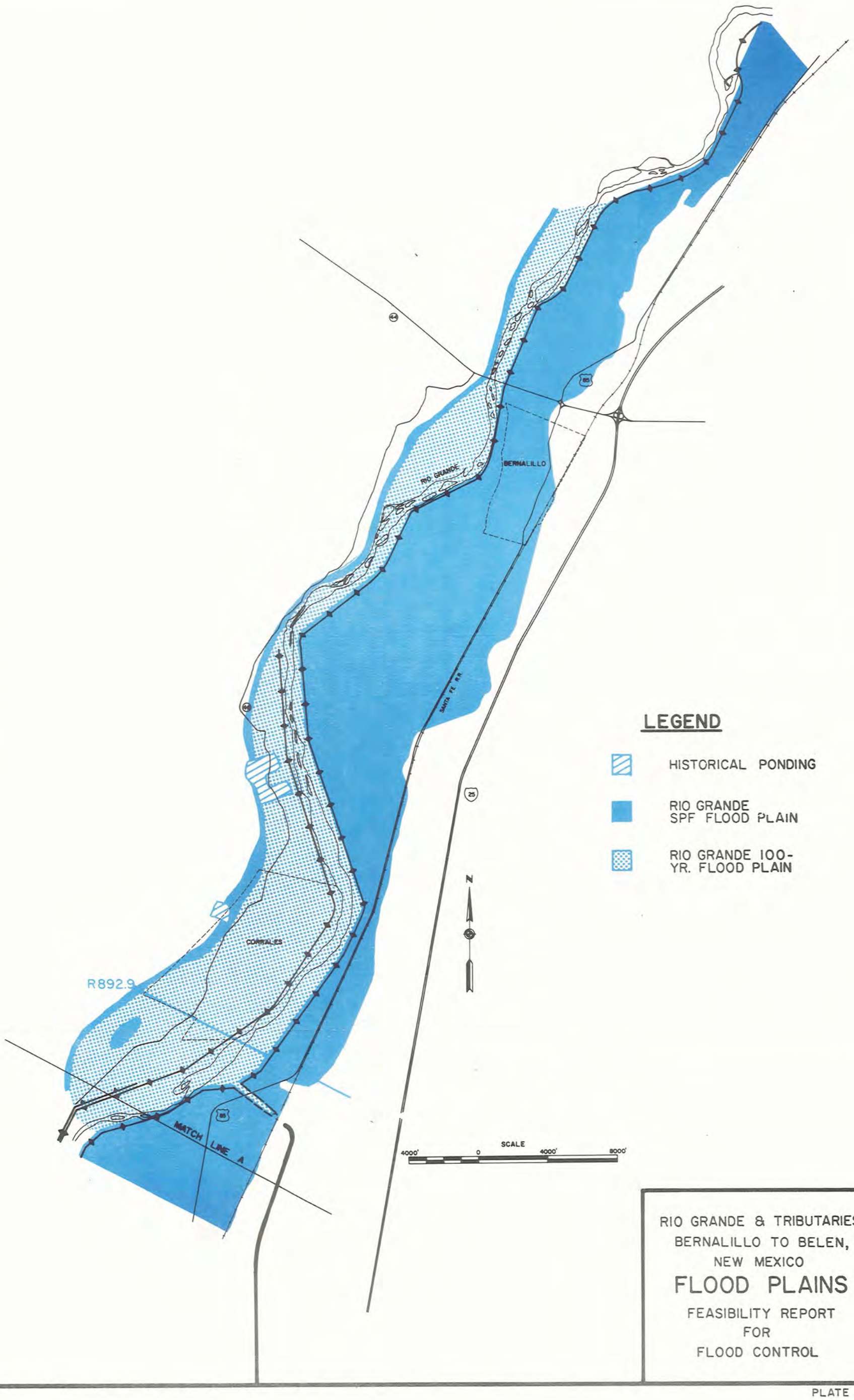
ALBUQUERQUE GREATER URBAN AREA

INDIAN LANDS

ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS

JUNE, 1975

PLATE A-4



LEGEND

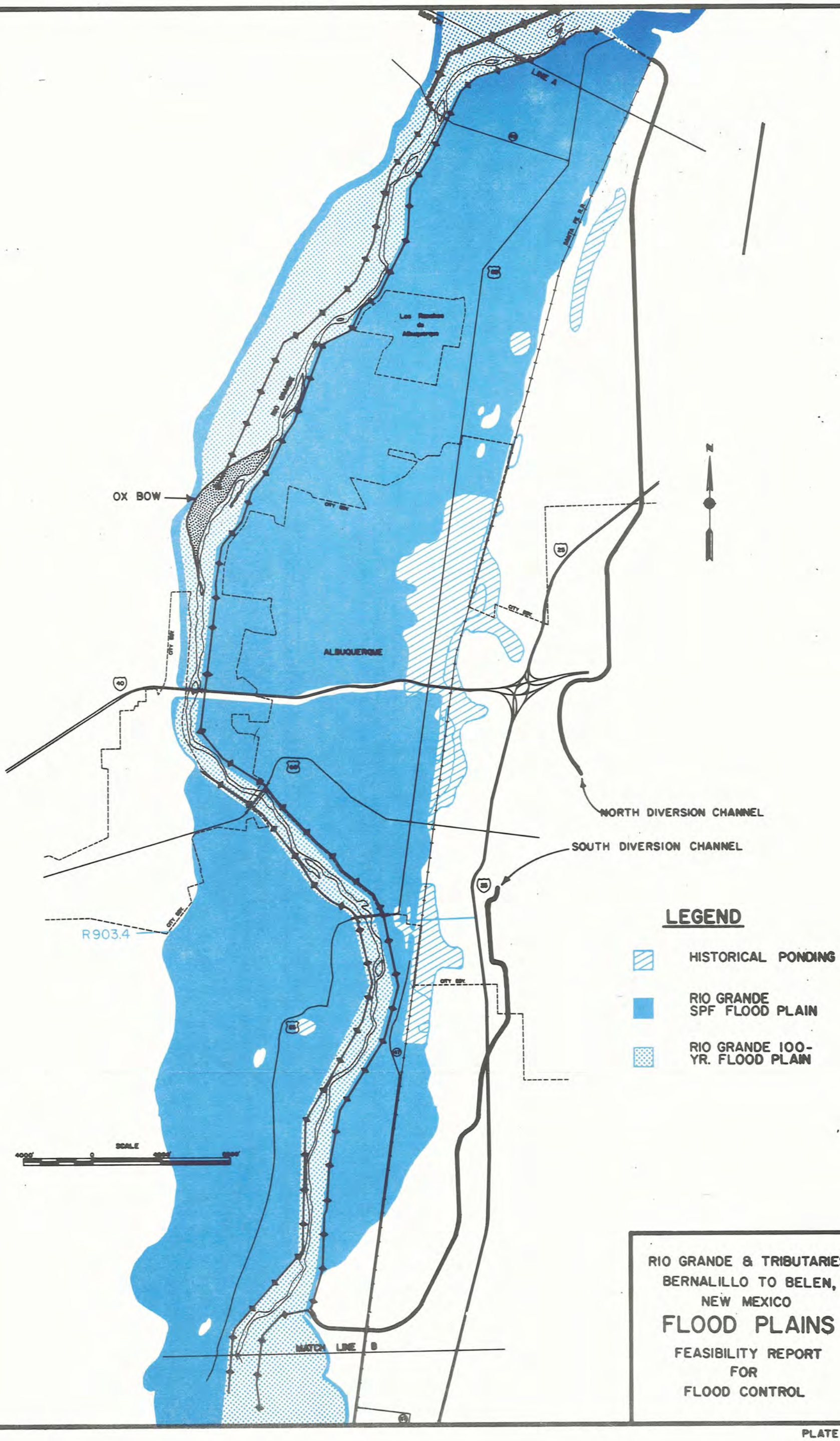
- HISTORICAL PONDING
- RIO GRANDE SPF FLOOD PLAIN
- RIO GRANDE 100-YR. FLOOD PLAIN

RIO GRANDE & TRIBUTARIES
BERNALILLO TO BELEN,
NEW MEXICO

FLOOD PLAINS

FEASIBILITY REPORT
FOR
FLOOD CONTROL

PLATE A-5

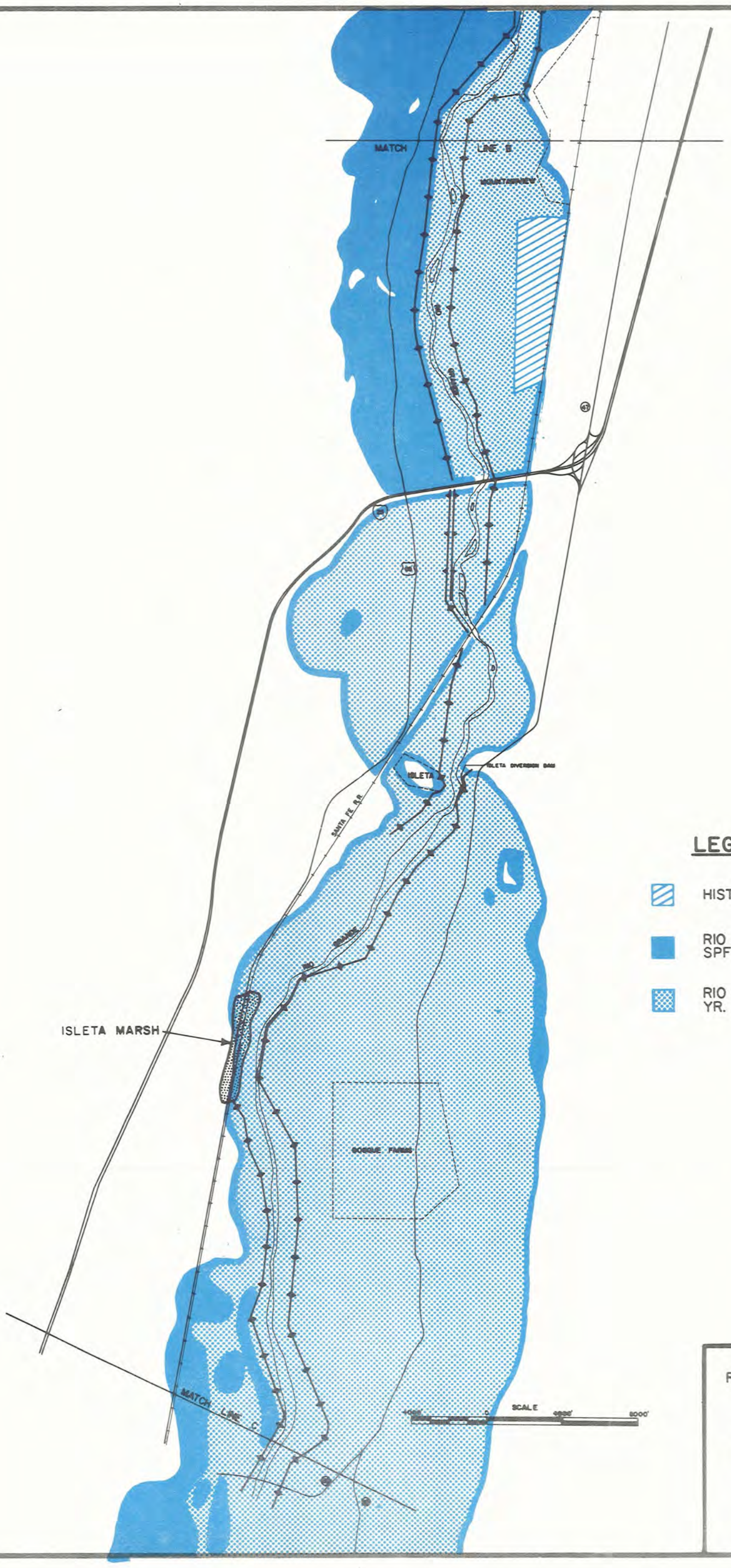


RIO GRANDE & TRIBUTARIES
BERNALILLO TO BELEN,
NEW MEXICO

FLOOD PLAINS

FEASIBILITY REPORT
FOR
FLOOD CONTROL

PLATE A-6



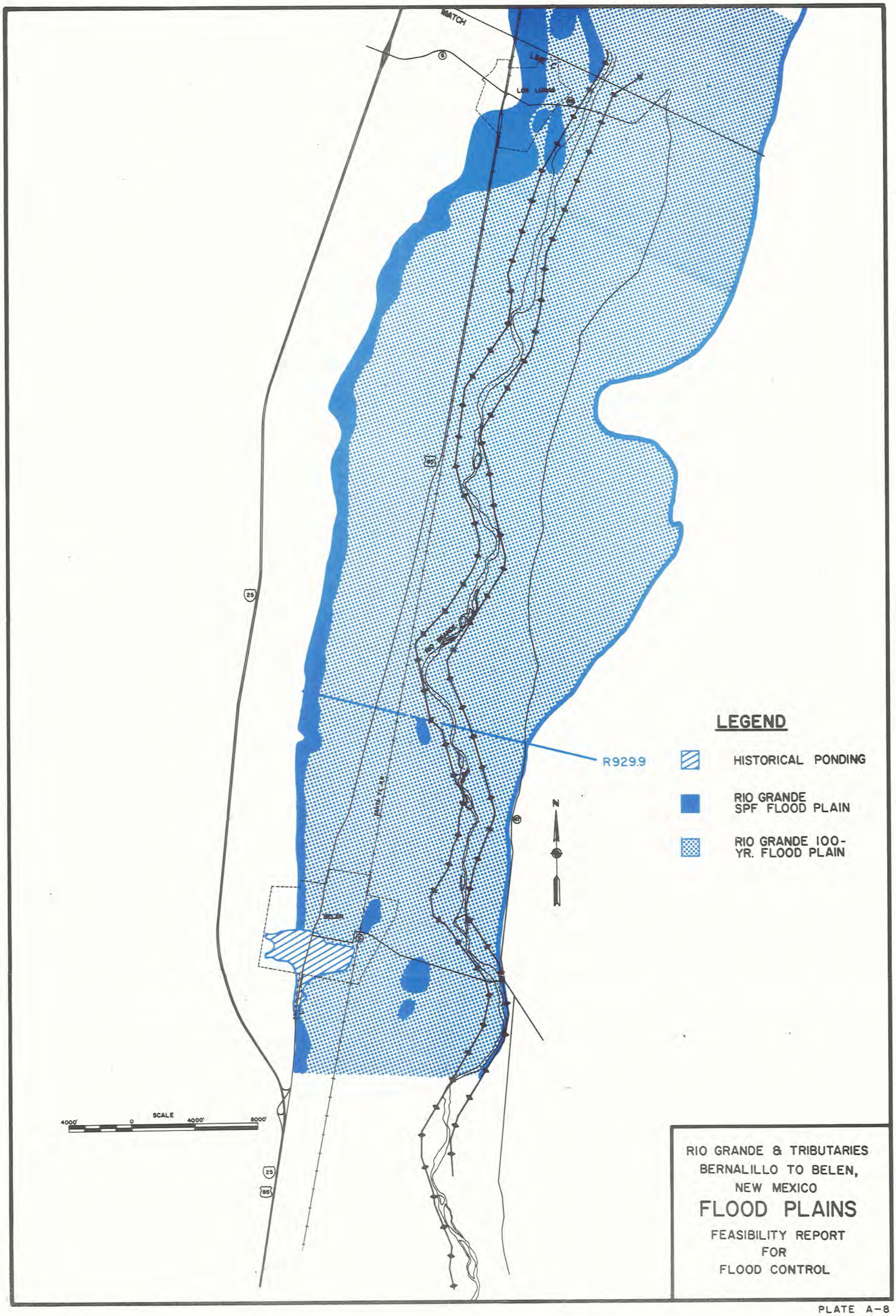
LEGEND

- HISTORICAL PONDING
- RIO GRANDE SPF FLOOD PLAIN
- RIO GRANDE 100-YR. FLOOD PLAIN

RIO GRANDE & TRIBUTARIES
BERNALILLO TO BELEN,
NEW MEXICO

FLOOD PLAINS

FEASIBILITY REPORT
FOR
FLOOD CONTROL



RIO GRANDE & TRIBUTARIES
BERNALILLO TO BELEN,
NEW MEXICO

FLOOD PLAINS

FEASIBILITY REPORT
FOR
FLOOD CONTROL

RIO GRANDE & TRIBUTARIES, BERNALILLO TO BELEN, N.M.

TYPICAL VALLEY CROSS-SECTION

FEASIBILITY REPORT FOR FLOOD CONTROL

PLATE A-9

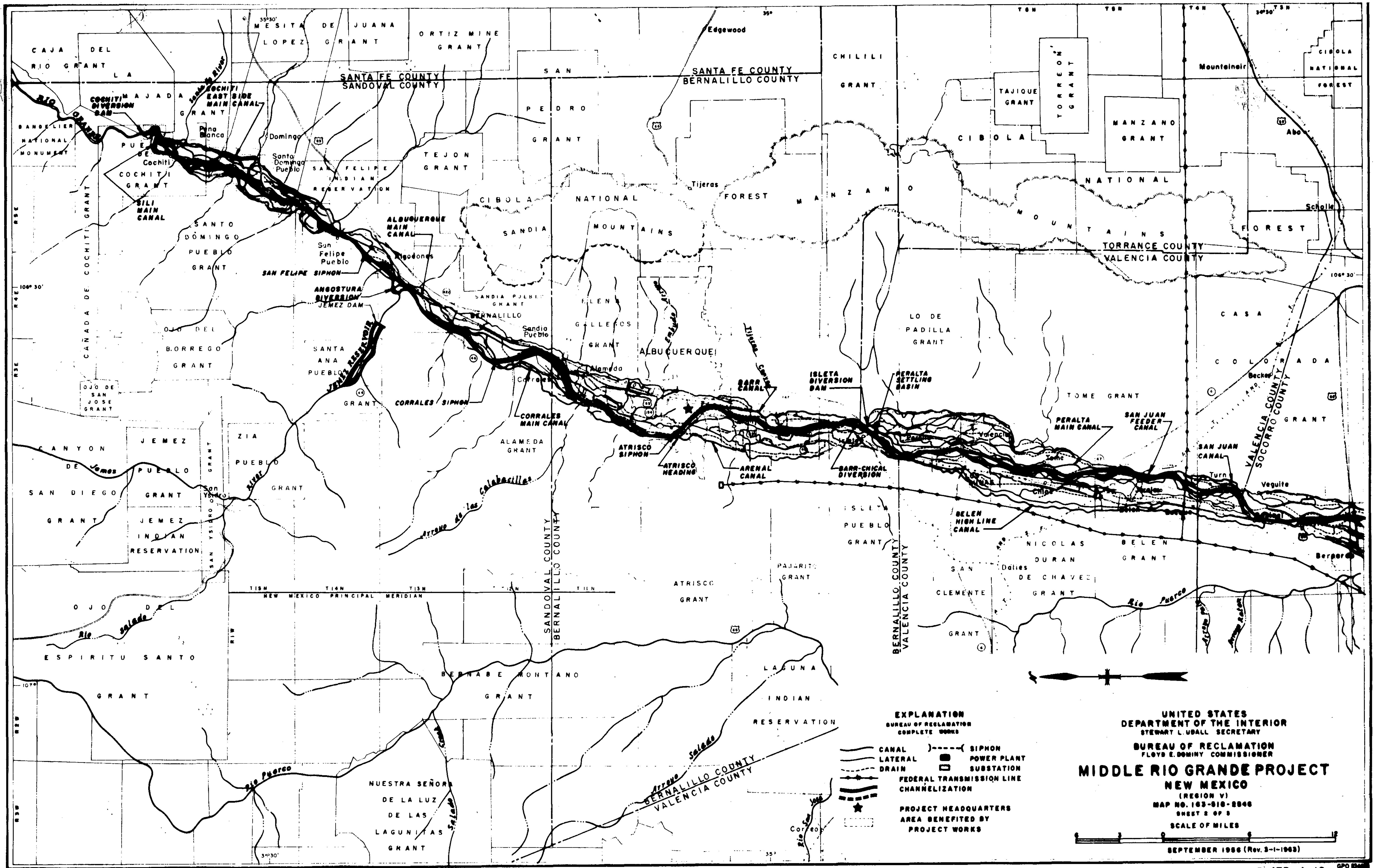


PLATE A-10

GPO 834685

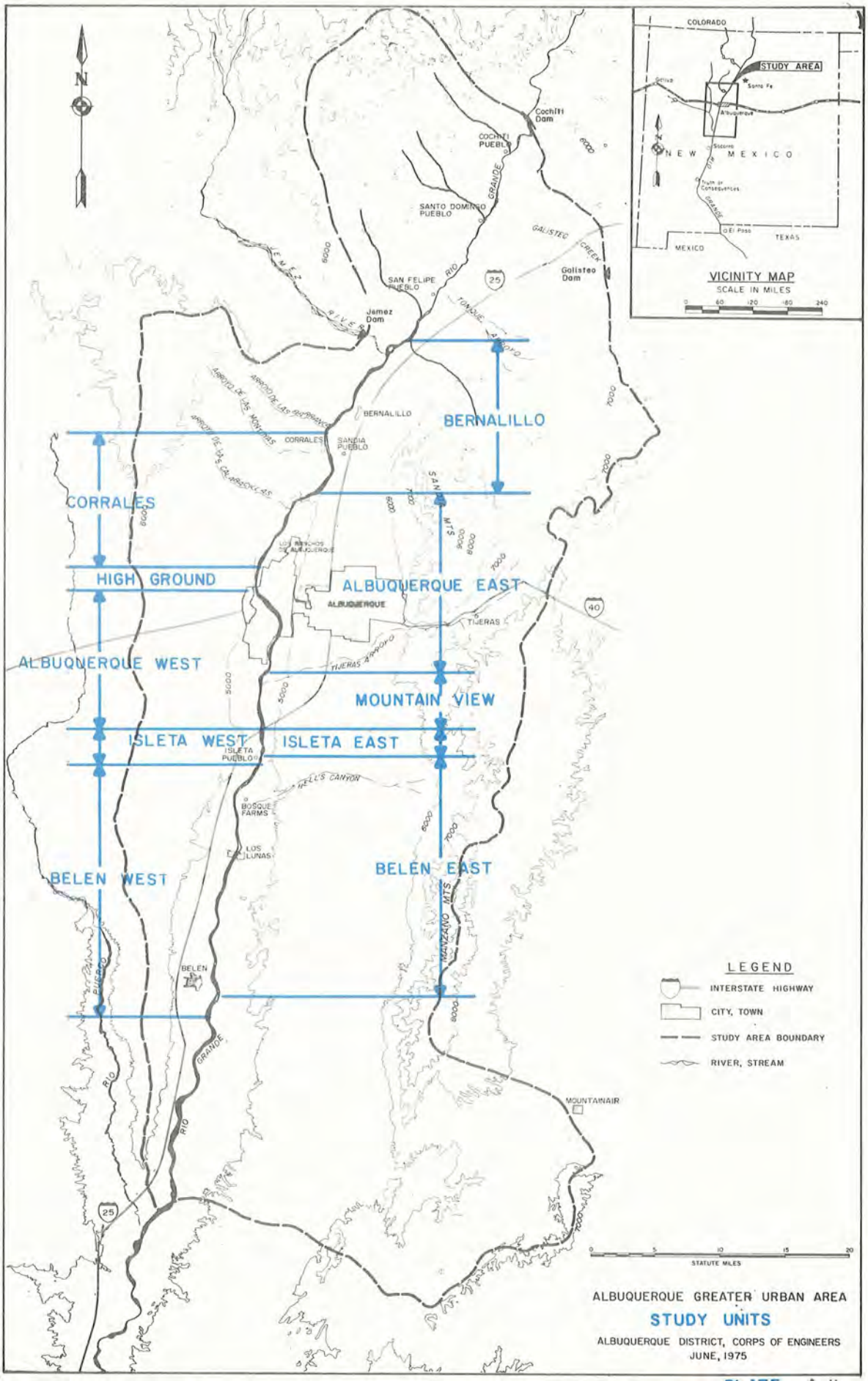
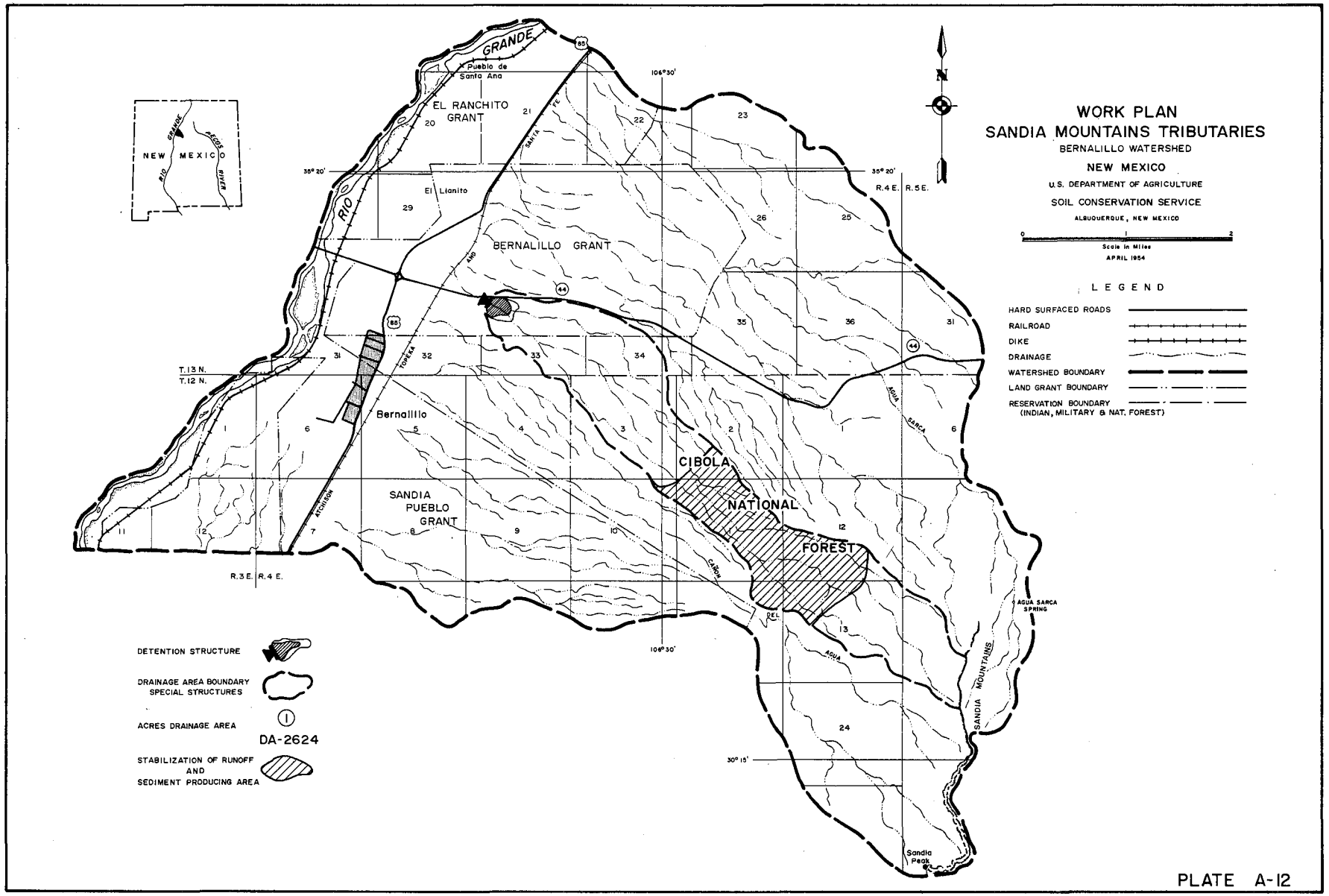
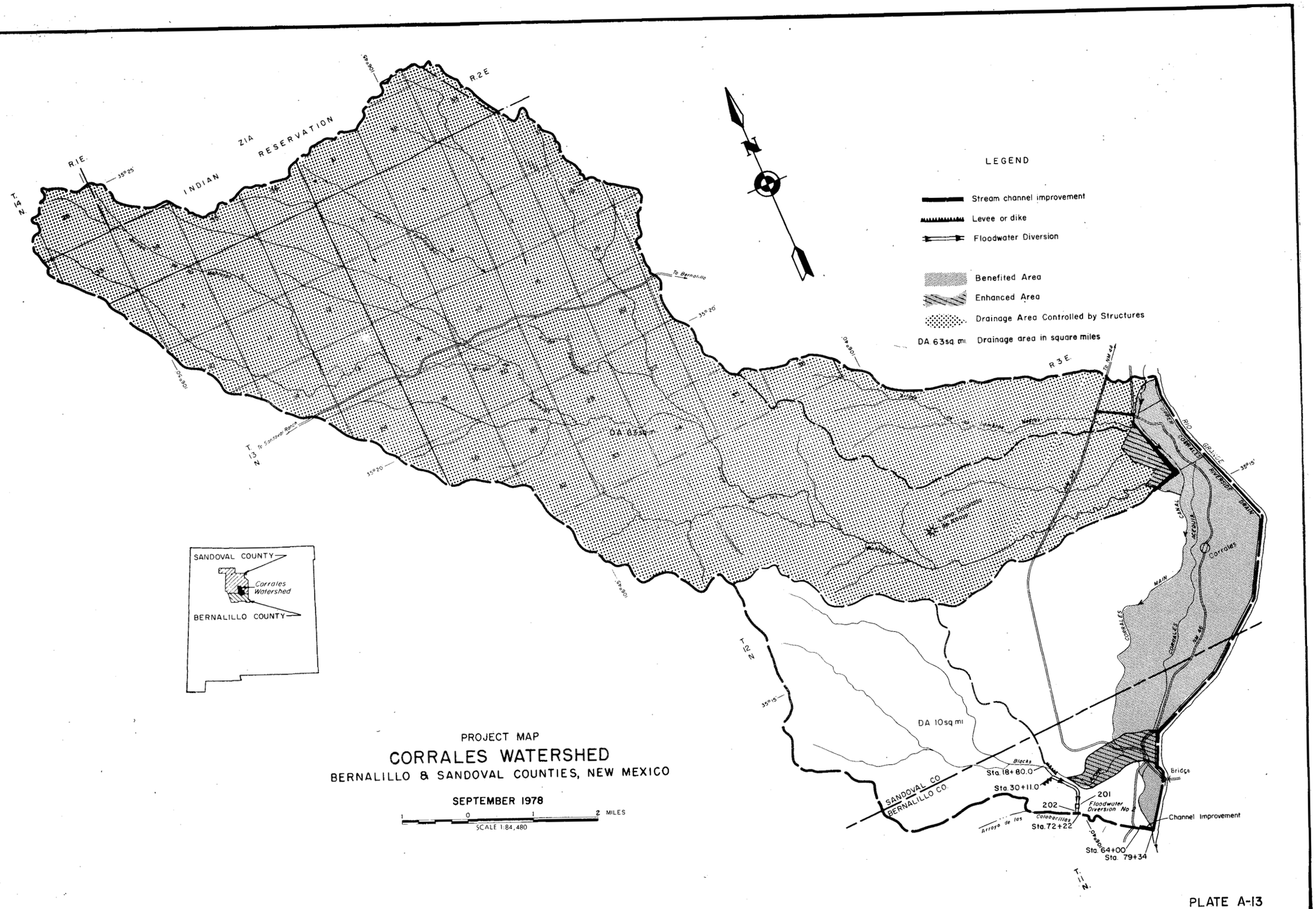

N
COLORADO
STUDY AREA
Santa Fe
Albuquerque
NEW MEXICO
Socorro
Truth or Consequences
El Paso
TEXAS
MEXICO
VICINITY MAP
SCALE IN MILES
0 60 120 180 240
Cochiti Dam
COCHITI PUEBLO
SANTO DOMINGO PUEBLO
GALISTEO CREEK
Galisteo Dam
SAN FELIPE PUEBLO
RIO GRANDE
Jemez Dam
JEMEZ RIVER
TONQUE ARROYO
ARROYO DE LAS HUERFANOS
ARROYO DE LAS MONTANAS
ARROYO DE LOS CAÑADONCITOS
BERNALILLO
CORRALES
SANDIA PUEBLO
LOS RANCHOS DE ALBUQUERQUE
ALBUQUERQUE
TIJERAS
TIJERAS ARROYO
SAN PEDRO MTS
BERNALILLO
CORRALES
HIGH GROUND
ALBUQUERQUE EAST
ALBUQUERQUE WEST
MOUNTAIN VIEW
ISLETA WEST
ISLETA EAST
ISLETA PUEBLO
HELL'S CANYON
BOSQUE FARMS
LOS LUNAS
BELEN WEST
BELEN EAST
MANZANO MTS
BELEN
RIO PUERCO
RIO GRANDE
MOUNTAINAIR
25
40
LEGEND
INTERSTATE HIGHWAY
CITY, TOWN
STUDY AREA BOUNDARY
RIVER, STREAM
0 5 10 15 20
STATUTE MILES
ALBUQUERQUE GREATER URBAN AREA
STUDY UNITS
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
JUNE, 1975

PLATE A-11


WORK PLAN
SANDIA MOUNTAINS TRIBUTARIES
BERNALILLO WATERSHED
NEW MEXICO
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ALBUQUERQUE, NEW MEXICO
Scale in Miles
APRIL 1954
LEGEND
HARD SURFACED ROADS
RAILROAD
DIKE
DRAINAGE
WATERSHED BOUNDARY
LAND GRANT BOUNDARY
RESERVATION BOUNDARY (INDIAN, MILITARY & NAT. FOREST)
NEW MEXICO
RIO GRANDE
PECOS RIVER
Pueblo de Santo Ana
EL RANCHITO GRANT
BERNALILLO GRANT
SANDIA PUEBLO GRANT
CIBOLA NATIONAL FOREST
Bernalillo
El Llanito
RIO GRANDE
SANTA FE
ANO
TOPEKA
ATCHISON
AGUA SARCA
CARBON
PEL
SANDIA MOUNTAINS
AGUA SARCA SPRING
Sandia Peak
106°30'
35°20'
30°15'
R.4E.
R.5E.
R.3E.
R.4E.
T.13N.
T.12N.
DETENTION STRUCTURE
DRAINAGE AREA BOUNDARY SPECIAL STRUCTURES
ACRES DRAINAGE AREA
DA-2624
STABILIZATION OF RUNOFF AND SEDIMENT PRODUCING AREA
PLATE A-12



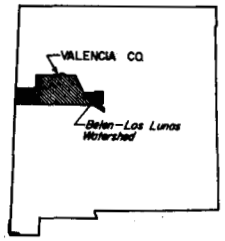
PROJECT MAP

CORRALES WATERSHED

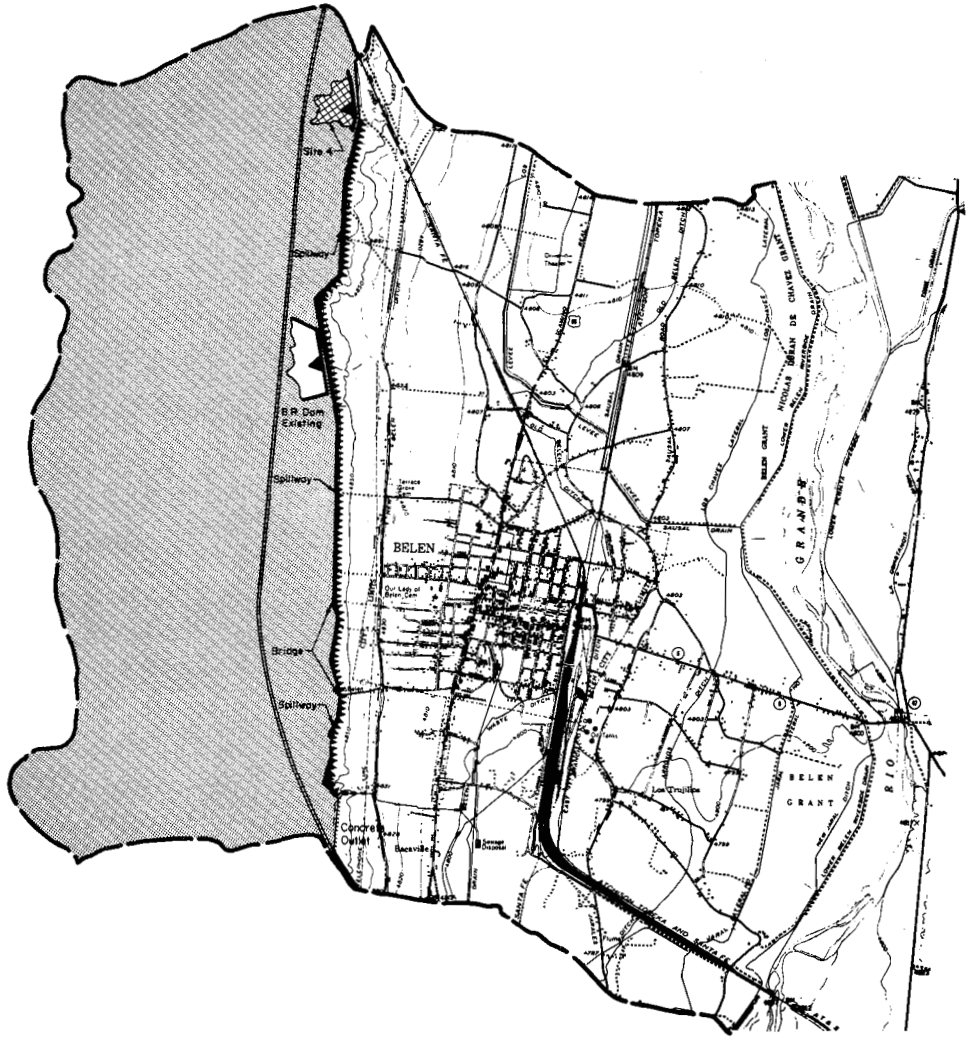
BERNALILLO & SANDOVAL COUNTIES, NEW MEXICO

SEPTEMBER 1978

PLATE A-13



LOCATION MAP



LEGEND

- Interstate highway
- Paved road
- Railroad
- Levees (existing)
- Canals and drains
- Watershed boundary
- Floodwater retarding structure (existing)
- Drainage area controlled by structures
- Floodwater retarding structure
- Canal dike (enlargement)

3/4 1/2 1/4 0 1 2 MILES

SCALE 1 : 48,000

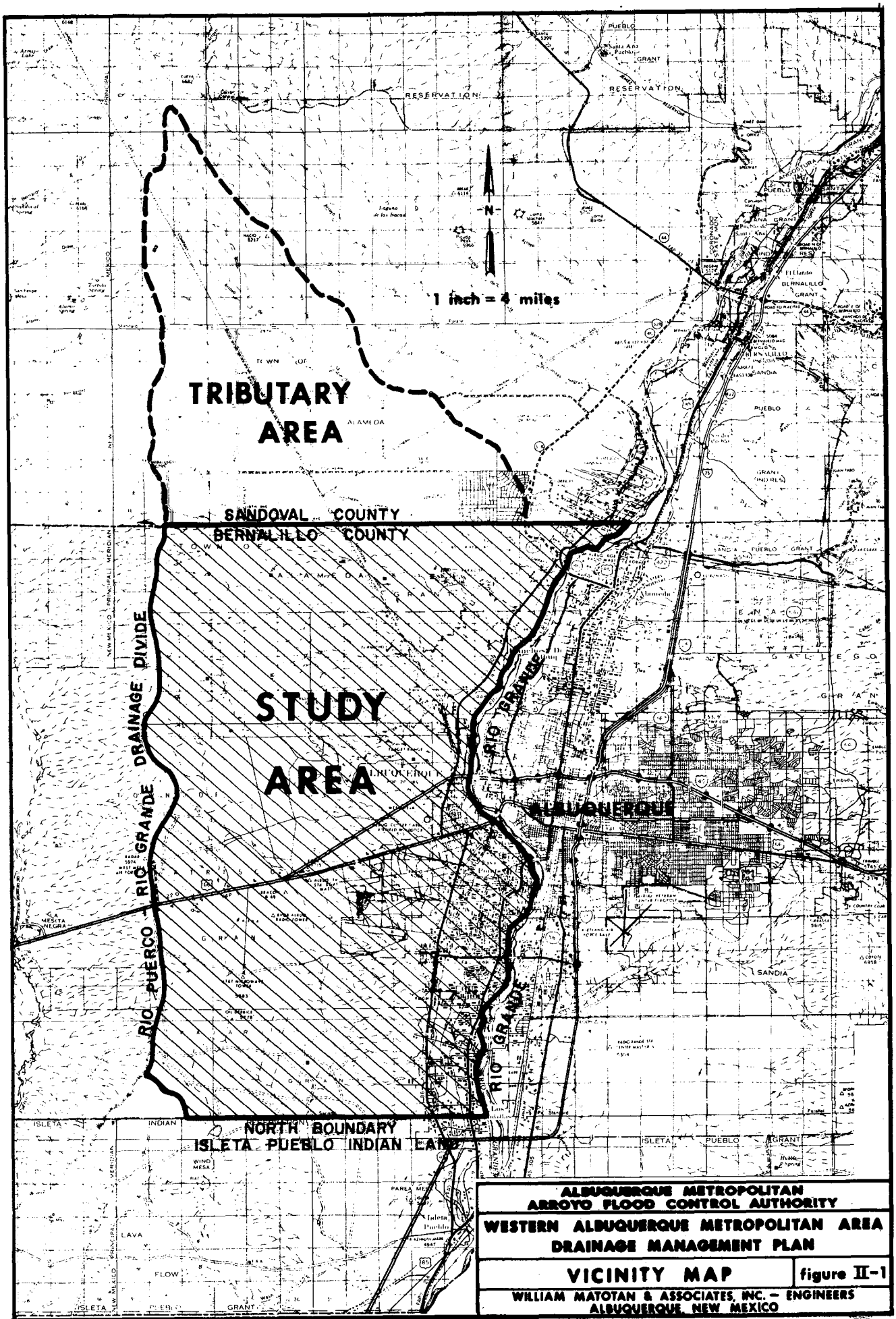
PROJECT MAP

BELEN-LOS LUNAS WATERSHED

VALENCIA COUNTY, NEW MEXICO

MARCH 1973

PLATE A-14

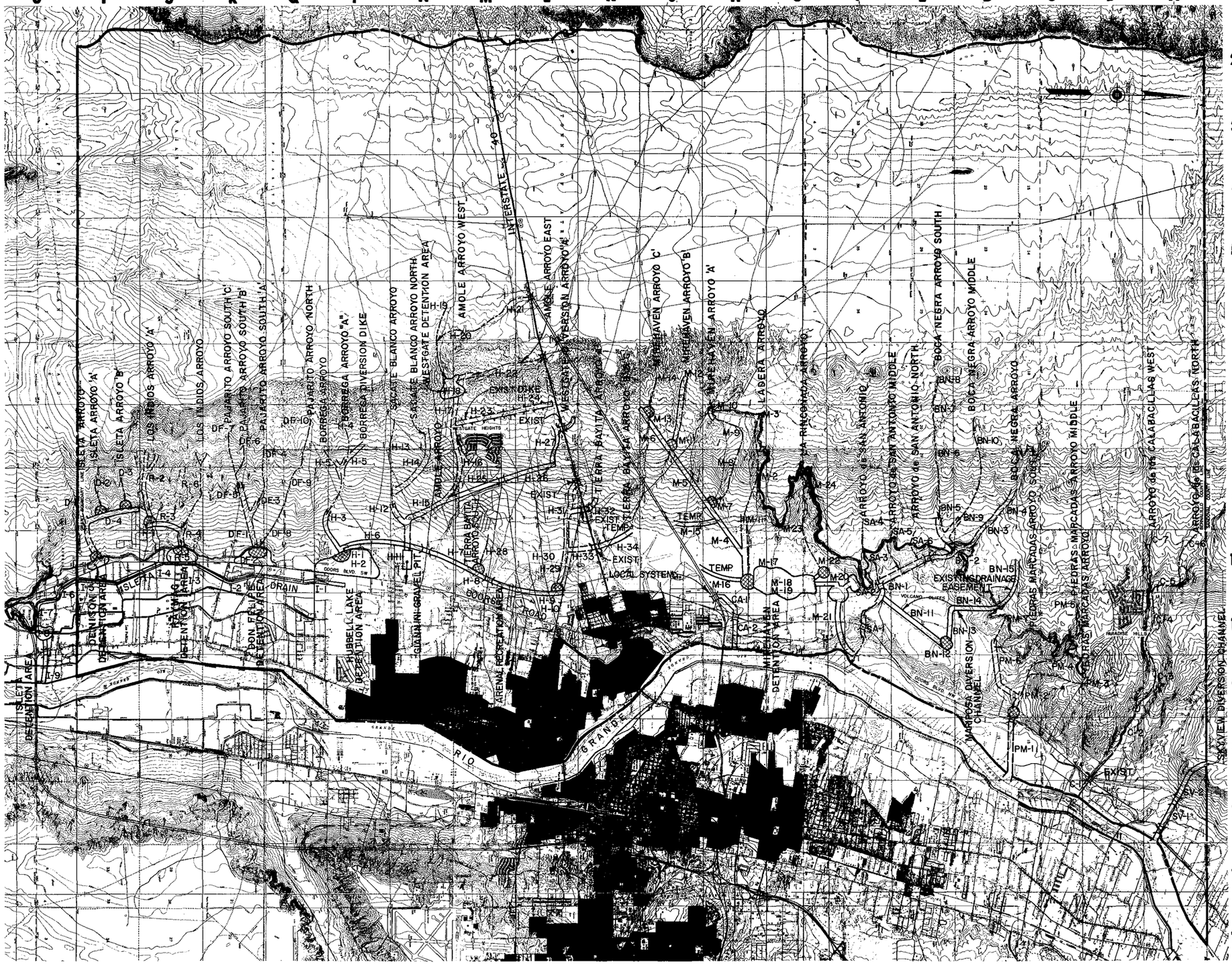


ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

WESTERN ALBUQUERQUE METROPOLITAN AREA DRAINAGE MANAGEMENT PLAN

VICINITY MAP — figure II-1

WILLIAM MATOTAN & ASSOCIATES, INC. – ENGINEERS
ALBUQUERQUE, NEW MEXICO



Original Scale: 1"=4000'

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

WESTERN ALBUQUERQUE METROPOLITAN AREA DRAINAGE MANAGEMENT PLAN

INDEX MAP

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PLATE A-16