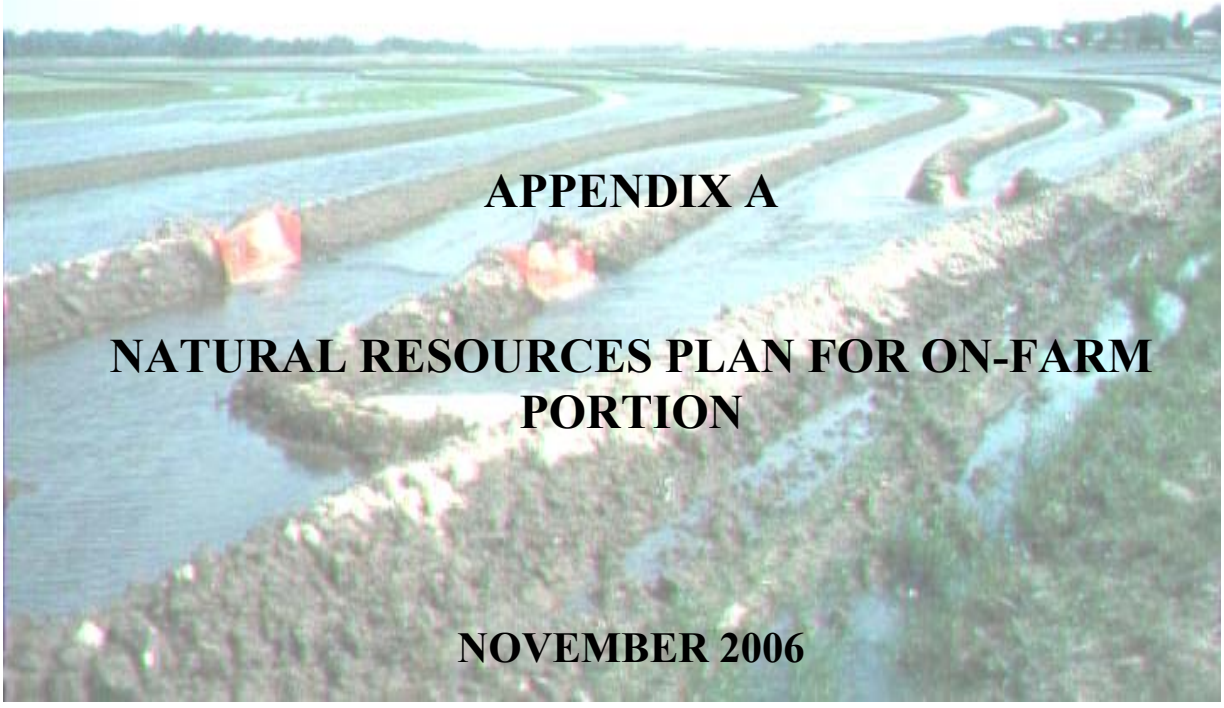
US Army Corps of Engineers
Memphis District

GRAND PRAIRIE REGION AND BAYOU METO BASIN, ARKANSAS PROJECT

BAYOU METO BASIN, ARKANSAS

GENERAL REEVALUATION REPORT

VOLUME 2



APPENDIX A

NATURAL RESOURCES PLAN FOR ON-FARM PORTION

NOVEMBER 2006

US Army Corps of Engineers
Memphis District

GRAND PRAIRIE REGION AND BAYOU METO BASIN, ARKANSAS PROJECT

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BAYOU METO BASIN, ARKANSAS PROJECT
GENERAL REEVALUATION REPORT (GRR) INDEX

NATURAL RESOURCES PLAN

FOR THE

ON-FARM PORTION
BAYOU METO IMPROVEMENT PROJECT AREA

OF THE

BAYOU METO BASIN, ARKANSAS

DRAFT
(SUBJECT TO CHANGE)

NATURAL RESOURCE PLAN

for the

ON-FARM PORTION
BAYOU METO IMPROVEMENT PROJECT AREA

of the

BAYOU METO BASIN, ARKANSAS

Arkansas, Jefferson, Lonoke, Prairie, and Pulaski Counties, Arkansas

June 2002

NATURAL RESOURCE PLAN
for the
ON-FARM PORTION
of the
BAYOU METO IRRIGATION PROJECT

Abstract

This Natural Resource Plan was developed to analyze the benefits and impacts of on-farm conservation practices, which could be utilized to address the declining groundwater, supply currently being utilized as an irrigation source for a large area of eastern Arkansas. This plan covers only the on-farm portion of the project and will be included as a part of an Environmental Impact Statement (EIS) to be completed at a later date, which will include a surface water delivery system. It also includes provisions for utilizing the project components to provide waterfowl feeding and resting areas, fish habitat, and additional habitat for shore birds during the fall and winter months.

Recommended solutions to identified problems, opportunities, and environmental impacts are included in this document.

Alternatives considered during plan formulation were a no action alternative, a conservation/storage alternative, an alternate surface source alternative, a combination conservation/storage/alternate surface source alternative, and an alternate groundwater source alternative. The recommended plan is the combination conservation/storage/alternate surface source alternative.

This document is intended to be a part of an overall project EIS which will fulfill the requirements of the National Environmental Policy Act of 1969, Public Law 91-190, as amended (42 U.S.C. et seq).

This plan was prepared by the Natural Resources Conservation Service. Others contributing to the plan include:

Arkansas Soil and Water Conservation Commission
Arkansas Game and Fish Commission
Arkansas Natural Heritage Commission
U.S. Fish and Wildlife Service

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EXECUTIVE SUMMARY

INTRODUCTION

The following plan, developed by the Natural Resources Conservation Service (NRCS), addresses the lack of a dependable water supply for cropland irrigation, fish farming, and the fish and wildlife needs of the Bayou Meto area of eastern Arkansas.

Certain areas of the Mississippi Alluvial aquifer in eastern Arkansas have been depleted to extremely low levels as a result of heavy use of groundwater as a source of irrigation water. This aquifer is the principal source of irrigation water for most of the farms within the area. Previous studies of the region have indicated that unless alternative sources of irrigation water are located the groundwater resource may be permanently damaged.

Due to the concerns of local individuals, local public officials, and state agencies, the NRCS in Arkansas was asked to assist in the planning and development of a project to protect the groundwater resource, provide a sustainable agricultural water source to maintain current production and enhance fish and wildlife habitat in the area.

The project plan will be developed in two separate but related parts:

1. On-farm conservation practices.

2. Surface water delivery system.

This document will address the on-farm portion of the natural resources plan. The on-farm components of the project include irrigation pipelines, pumping plants, tailwater recovery systems, storage reservoirs and water control structures. Many of these practices can be installed and operated independent of a surface water delivery system.

An overall project plan is being developed to include a surface water delivery system, which will utilize excess flow from the Arkansas River as an alternate surface water source. Installation of the delivery system will improve the efficiencies and capabilities of the on-farm components. The delivery system plan will be included as part of the overall project plan.

PROJECT SETTING

The Bayou Meto project area encompasses 433,166 acres in east central Arkansas approximately 20 miles east of Little Rock, lying generally south of Interstate 40, between the Arkansas and White Rivers. Rice, soybeans, cotton, wheat, and baitfish are primary crops produced within the project area. Arkansas is ranked number one in rice production in the United States and produces approximately 40 percent of the national crop. The largest baitfish production facility in the world is located within the project area. Arkansas is ranked first in mallard harvest in the U.S., and other hunting and fishing opportunities abound on and around the Bayou Meto Wildlife Management Area, which is located at the southern end of the project area. Wise water management is critical to the social, economic and environmental health of the area.

RECOMMENDED PLAN

The recommended plan describes measures to be installed (both structural and nonstructural}, permits required, costs, installation and financing, operation and maintenance, and economic and other benefits.

The purpose of the plan is to develop a strategy to protect the groundwater resources of the area whlle supplylng agricultural water for irrigation, fish farming, and the enhancement of fish and wildlife habitat. The recommended plan consists of installing on-farm conservation practices and a supplemental surface water delivery system. The delivery system will consist of a series of canals, streams and pipelines, which will deliver excess surface water from the Arkansas River to individual farms and will be described in detail in a separate document.

The on-farm water management component of the plan will consist of the installation of one or more conservation practices, which will improve irrigation efficiencies, provide any necessary storage, and/or retrofit existing irrigation system components into an overall irrigation system. This project will accelerate the installation of conservation practices commonly used in the area.

This document will address only the on-farm component of the plan and will be included as part of the overall project plan/environmental impact statement.

The problem area consists of 276,814 acres of irrigated cropland and 22,079 acres of fishponds within the project area. It is estimated that 88 percent of the agricultural water is supplied from groundwater sources. Most existing surface water sources provide supplemental water and are inadequate to supply the season long need. The entire problem area will benefit from protection of the groundwater resource.

The irrigation water for the growing season will be supplied from on-farm irrigation reservoirs, natural runoff/tailwater recovery, groundwater, and a surface water delivery system. Water for flooding fields for waterfowl in the fall and winter will be supplied from natural runoff and the surface water delivery system.

A simplified version of the operation plan is:

November - April	Fill reservoirs
May - September	Irrigate cropland
October	Perform maintenance
November - December	Flood cropland for waterfowl feeding and resting areas.

Participation in the on-farm program will be voluntary. Individuals wishing to participate will work with the Water Management/Irrigation District and NRCS to develop a "Water Management Plan". This plan will detail the practices to be installed and will include an "Operation Plan" which will improve the capability of the system. The landowner will make the final decision on practices to be installed and on the operation of the on-farm irrigation system.

Individual landowners will own, operate, and maintain the on-farm components of the project and will be responsible for management of their irrigation system.

On-Farm Measures to be Installed

Underground Pipelines - Approximately 552 miles of new permanent underground pipelines with appurtenances will be placed in existing irrigated fields to prevent loss of water quality and quantity. Such pipelines will allow the proper management of water and eliminate conveyance losses caused by evaporation and seepage.

Photograph 1

Photograph 1 - Underground irrigation pipelines provide an efficient means of distributing irrigation water and flooding fields for waterfowl.

Tailwater Recovery Systems - Approximately 234 miles of new tailwater recovery canals will be installed to collect, store, and transport runoff and tailwater for reuse on the farm. Tailwater recovery systems will improve water management and water quality.

Photograph 2

Photograph 2 - Tailwater recovery systems catch natural runoff and irrigation tailwater for reuse.

Storage Reservoirs - Approximately 8,832 acres of new storage reservoirs will be constructed to conserve water by holding it until it can be used beneficially to meet crop irrigation requirements. Reservoirs will also be utilized to ensure adequate delivery rates during peak use periods. The reservoirs will be filled from runoff, tailwater, and the delivery system. The estimated amount of additional storage needed for individual operating units was determined in the water budget analysis. Final design volumes will be determined during the development of the "Water Management Plan."

Reservoirs will generally be completely enclosed and will be filled by pumping. Most reservoirs will be constructed on cropland. Any requests to construct reservoirs on wetland areas will be evaluated individually and will require a Corps of Engineers 404 permit and clearance from NRCS. All appropriate permits and any mitigation requirements will be obtained before construction begins.

Photograph 3

Photograph 3 - Typical irrigation storage reservoirs are completely enclosed by a levee and are filled by pumping from a stream or tailwater recovery system.

Water Control Structures - Approximately 576 water control structures will be installed. These structures will improve water management and water quality by controlling runoff rate and trapping sediment. These structures will generally be included as part of the tailwater recovery system and will temporarily hold water until it can be pumped back into the reservoir.

Photograph 4

Photograph 4 - Water control structures allow the manipulation of water levels to control runoff, reduce erosion, provide storage, and flood cropland for waterfowl use.

Pumping Plants - Approximately 909 pumping plants will be installed. Pumping plants will consist of a pump and a power plant and a power unit assembly, which will be used to move water through the irrigation system, remove water from the delivery system, and fill reservoirs.

Photograph 5

Photograph 5 - Pumping plants are an important water management tool. They can be utilized to irrigate fields, recycle tailwater, and fill reservoirs.

Wildlife and Waterfowl Considerations

Wildlife and waterfall resources are abundant in the project area. The Bayou Meto Wildlife Management Area is located near the southern end of the project area and is one of the largest publicly owned and managed tracts of land in Arkansas. It is considered by many to be the heart of duck country. Wildlife and waterfowl frequently utilize cropland as feeding and resting areas. The abundance of wildlife and waterfowl provide important social and economic benefits to the area.

The project area falls within the migratory route for 21 species of ducks and three species of geese. The following measures are recommended to increase and improve wintering waterfowl habitat.

The following measures will help accomplish the goals of the North American Waterfowl Management Plan:

(1) roll stubble to allow ducks to settle into the fields and facilitate decomposition of rice straw;

{2) close water control structures and repair contour levees to hold rainfall through winter;

(3) flood 42,844 acres of cropland annually for winter waterfowl utilizing surface water sources;

{4) passively manage 23,000 acres of cropland annually for winter waterfowl;

{5) leave strips of unharvested crops {rice, beans, milo, wheat) in the field for wildlife and waterfowl;

{6) promote, cultivate, and maintain buffer strips along riparian corridors; including revegetation of riparian areas;

{7) enhance existing wetlands, farmed wetlands, wooded areas, and additional nonfarmed areas through water management;

(8) encourage hunting three days or less a week, mornings only. Heavy hunting pressure can drive ducks to other areas;

(9) control beavers and any other nuisance wildlife by bounty, trapping and/or hunting programs;

(10) utilize special design considerations to construct 8,832 acres of new reservoirs to provide additional habitat for waterfowl.

Photograph 6

Photograph 6 - Waterfowl utilize storage reservoirs as resting areas. Shore birds feed along the shallow areas of reservoirs and fishponds.

Wetlands

Existing wetlands will be preserved by installing conservation practices on cropland in most cases. Any negative impacts to wetland areas, which cannot be avoided, will be appropriately mitigated.

Landowners will be encouraged to restore and protect wetlands through the Wetland Reserve Program (WRP). The WRP is a voluntary program offering landowners the opportunity to receive payments for restoring and protecting wetlands on their property.

Mitigation Features

Very little mitigation is expected since the installation of most conservation practices will be on cropland. Any mitigation required will be coordinated with the appropriate agencies.

Permits and Compliance

All work will be subject to Section 404 of the Clean Water Act, which requires the sponsors to obtain a permit from the U.S. Army Corps of Engineers on natural resource projects. It is the responsibility of the landowner, conservation district, improvement district, city or other legal entity to obtain a permit before initiating work. The sponsors will be required to show the proposed project is in compliance with EPA's 404(b)(1) guidelines.

Costs

The total installation cost of the on-farm portion of the project is estimated to be $65,000,000.

Installation and Financing

NRCS will work closely with the District and the landowner to plan, design, and oversee the installation of conservation practices. Landowners will be reimbursed up to 65 percent of the construction costs.

Cultural Resources

Any known cultural resource sites will be avoided whenever possible and practical. Any sites which cannot be avoided or which are located during construction will be subject to the procedures of the NRCS General Manual (420 GM 401).

Operation, Maintenance, and Replacement

Operation, maintenance, and replacement of on-farm practices installed, as part of this project will be the responsibility of the individual landowners. Annual operation and maintenance costs are estimated to be, on average, approximately $24.00 per acre of cropland irrigated or approximately $12.00 per acre-foot of irrigation water applied.

NATURAL RESOURCE PLAN
for the
ON-FARM PORTION
BAYOU METO IMPROVEMENT PROJECT AREA
of the
BAYOU METO BASIN, ARKANSAS PROJECT

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Tables

Figures

SUMMARY OF THE NATURAL RESOURCE PLAN
for the
ON-FARM PORTION
BAYOU METO IMPROVEMENT PROJECT AREA
of the
BAYOU METO BASIN, ARKANSAS PROJECT

Project Name: Bayou Meto Basin, Arkansas Project

Counties: Arkansas, Jefferson, Lonoke, Pulaski, and Prairie Counties

State: Arkansas

Sponsor: Bayou Meto Water Management District

Description of recommended plan: The on-farm portion of the recommended plan consists of the installation of conservation practices throughout the project area to improve irrigation efficiencies and utilize excess surface runoff.

A supplemental surface water delivery system, which will utilize excess water from the Arkansas River, is also planned. Details of surface water delivery system plan will be presented in a separate document.

On-farm conservation practices will consist of storage reservoirs, pumping plants, pipelines, water control structures, and tailwater recovery systems. On-farm storage reservoirs will be constructed on individual farms, generally be enclosed, and will be filled by pumping. The reservoirs will be filled during late fall, winter and early spring from natural runoff captured through the tailwater recovery systems or from the delivery system when natural runoff is inadequate.

During the cropping season, water will be supplied to the plants from natural runoff captured in the tailwater recovery system, the delivery system, reservoirs, and wells. It is estimated that well pumpage will be somewhat less than sustainable yield levels, potentially allowing some recharge in the aquifer.

Water for flooding fields in the fall for waterfowl will come from natural rainfall/runoff and from the delivery system when installed.

Resource information:

Size of project area (acres}:	**433,166**
Land cover-Cropland (acres}:	**276,814**
Pasture & Hayland (acres}:	**33,717**
Forest land (acres}:	**41,350**
CRP (acres}:	**4,453**
Reservoirs (acres}:	**4,893**
Fish Ponds:	**22,079**
Lakes, Streams, Other Water:	**10,650**
Miscellaneous (acres}:	**7,614**

Land ownership-Private: 96 percent **State-Local:** 4 percent

Number of farms:	**1218**
Average farm size (acres):	**295**
Prime and important farmland (acres):	**257,000**
Number of minority farmers:	**234**
Number of limited resource farmers:	**212**
Project beneficiary profile: Socioeconomic	

	Project Area	**State**	**Nation**
Minority Population (%)	**30**	**20**	**25**
Average Per Capita Income	**$16,300**	**$16,900**	**$21,600**
Unemployment rate (%)	**6.0**	**5.1**	**4.8**

Hydric soils (acres): 153,000 (includes wooded wetlands and cropland)

Floodplain (acres by land use): N/A

Highly erodible (acres): 15,088

Endangered Species: None

Cultural Resources:

There are approximately 400 sites in the project area. All significant cultural resource sites will be avoided during implementation or otherwise preserved in place to the fullest practical extent. Any sites which cannot be avoided or which are discovered during construction will be subject to the requirements of Section 106 of the National Historic Preservation Act of 1966.

Problem identification: The Mississippi River Valley alluvial aquifer is the primary source of irrigation water for a major rice, soybean, and cotton producing area in the United States. Groundwater is being withdrawn at such a rate that the aquifer is in danger of being permanently damaged. Loss of rice, soybean, and cotton production in this area would result in severe economic and social repercussions to the local, state, and national economies.

Alternative plans considered:

Alternative No.1 -No Action Alternative (Without Project).

Install on-farm conservation practices and storage reservoirs utilizing the existing farm programs to improve efficiencies and reduce water needs.

Alternative No.2 -Conservation/Storage Alternative.

Install on-farm conservation practices and storage reservoirs at an accelerated rate utilizing project funds to improve efficiencies and reduce water needs.

Alternative No.3 - Conservation/Storage/Alternate Surface Source Alternative.

Install on-farm conservation practices to improve efficiencies and reduce water needs. Develop a delivery system to provide surface water from the Arkansas River.

Project purpose: Protect the groundwater resource and provide a sustainable agricultural water supply while enhancing fish and wildlife habitat.

Project objectives: Protect the groundwater resource, provide water for irrigation and fish farming, and enhance fish and wildlife habitat.

Project Costs: $65,000,000

Principal project measures:

On-farm Conservation Practices - The on-farm conservation practices included in the plan consist of storage reservoirs, pipelines, water control structures, pumping plants and tailwater recovery systems. This plan details the on-farm components of the project.

Delivery System -The details of the delivery system will be addressed in the project EIS to be prepared at a later date.

Project benefits: The primary benefit of the project will be continued irrigated production on 276,814 acres of cropland. Other benefits will include energy savings and increased yields due to the increased use of surface water. Labor benefits will be generated during the construction period. Approximately 34,000 acres of cropland will be flooded annually, using surface water sources, during the fall and winter for waterfowl use. An additional 23,000 acres of cropland will be managed to encourage waterfowl use.

Other impacts: Approximately 8,832 acres of prime farmland will be taken out of production and converted to reservoirs.

Environmental values changed or lost: No endangered or threatened species are known to exist in the project area. There will be no manipulation of the landscape in Smoke Hole Natural Area or the Bayou Meto Wildlife Management Area. Any construction on wetland areas will require a Corps of Engineers Section 404 permit and impacts will be minimized by constructing reservoirs on non-wetland areas in most cases. The annual flooding of 34,000 acres of cropland and the management of an additional 23,000 of cropland for waterfowl use will increase available habitat for wintering waterfowl. An additional 8,832 acres of reservoir will increase available habitat for both shore birds and wading birds.

Major conclusions: This project will improve irrigation efficiencies and balance the use of existing water resources while improving the overall environmental quality of the project area. This project will greatly enhance the region's suitability for fish and wildlife and will provide additional foraging areas for wintering waterfowl.

Areas of Controversy: There are no known areas of controversy for the on-farm portion of the project.

Issues to be resolved: The Arkansas Soil and Water Conservation Commission is currently developing an Arkansas River Water Allocation Plan, which will outline the availability and use of excess water from the Arkansas River.

INTRODUCTION

The following plan, developed by the Natural Resources Conservation Service (NRCS), addresses the lack of a dependable water supply for cropland irrigation, fish farming, and wildlife needs in the Bayou Meto area of eastern Arkansas.

As a result of heavy use of groundwater as a source of irrigation water, certain areas of the Mississippi Alluvial aquifer in eastern Arkansas have been depleted to extremely low levels. This aquifer is the principal source of irrigation water for most of the farms within the area. Previous studies of the region have indicated that unless alternative sources of irrigation water are located, the groundwater resource may be permanently damaged.

As the result of the concerns of local individuals, local public officials, and state agencies, the NRCS in Arkansas was asked to assist in the planning and development of a project to protect the groundwater resource, provide reliable agricultural water sources to maintain current production, and enhance the fish and wildlife habitat in the area.

The project plan will be developed in two parts:

1. On-farm conservation practices.

2. Surface water delivery system.

This document will address the on-farm portion of the natural resources plan and was developed to accelerate the installation of the project. The on-farm components of the project were planned to operate independently from the delivery system and installation should begin as soon as funding can be obtained. An overall project plan is being developed to include a surface water delivery system. Installation of the delivery system will improve the efficiencies and capabilities of the on-farm components. This plan will be included as part of the overall project plan to be prepared at a later date.

Included in the plan is a description of the project setting, identification of resource problems and opportunities, scope of the plan, identification and comparisons of alternatives, discussion of public participation, and a description of the recommended plan. Information, which supports the conclusions and recommendations, can be found in the Appendices.

In addition, a Documentation Report including data sources, assumptions, and methodology used by the NRCS during the study was prepared. The Documentation Report also includes a hard copy sample of the data bases utilized in the analysis of the project.

PROJECT SETTING

Location/Background

The Bayou Meto project area encompasses 433,166 acres in east central Arkansas approximately 20 miles east of Little Rock lying generally south of Interstate 40, between the Arkansas and White Rivers. Rice, soybeans, cotton, and baitfish are the primary crops produced within the project area. Arkansas is ranked number one in rice production in the United States and produces approximately 40 percent of the national crop. The largest baitfish production facility in the United States is located within the project area.

The Bayou Meto project area covers parts of Arkansas, Jefferson, Lonoke, Prairie, and Pulaski counties.

Stream Systems

Natural drainage of the project area is provided by tributaries of the Arkansas River and White River. The major tributaries include Bayou Meto, Two Prairie Bayou, Indian Bayou, Wattensaw Bayou, and Little Bayou Meto. Smaller tributary systems include Wabbeska Bayou, Baker's Bayou, Salt Bayou Ditch, Big Ditch, and Crooked Creek.

Bayou Meto is the primary tributary within the project area and provides drainage for urban, agricultural, and woodland areas. The headwaters of Bayou Meto are located north and west of the project area near Jacksonville, Arkansas. Bayou Meto flows generally south and east from Jacksonville, toward and through the Bayou Meto Wildlife Management Area, and continues to its confluence with the Arkansas River near Gillett. The Bayou Meto basin is a major wintering area for waterfowl in Arkansas.

Two Prairie Bayou begins west of Cabot, flows generally south and east toward Carlisle and then meanders south to its confluence with Bayou Meto north of U.S. Highway 165. The Smoke Hole State Natural Area is located adjacent to Two Prairie Bayou.

Indian Bayou starts at Kerr and flows generally south and east toward England. A large portion of Indian Bayou has been channelized. East of England, the flow is split. The original channel continues south and east. Indian Bayou Ditch turns due south along the range line between range 8 and 9 west. Near Tucker Prison Farm, Indian Bayou Ditch turns back southwest to its intersection with Wabbaseka Bayou. The original Indian Bayou channel continues its wide meander pattern to its junction with Wabbeseka Bayou on the Tucker Prison Farm.

The hydraulics and hydrology of the area have been significantly modified by man-made ditches and levees. Although a significant amount of channel work has been completed, flooding is still a major concern of the landowners within the area.

Topography

The Bayou Meto project area is a flat alluvial plain forming a northwest to southeast elongated lowland lying generally between Bayou Meto and the Arkansas River. The plain slopes gently southeastward from an elevation of about 260 feet northwest of Lonoke to about 190 feet at Highway 79. Relief is slight but more prominent along shallow stream valleys. The terrain consists of fluvial bottomland containing remnants of abandoned streambeds, meander scars, swamps, and oxbow lakes.

Geology/Groundwater

The Bayou Meto Project lies within the Mississippi Alluvial Plain physiographic region, which in turn is a part of the Gulf Coastal Plain physiographic province. The project is underlain by deep sedimentary deposits of the Mississippi Embayment, a geosynclinal trough plunging southward beneath the Mississippi River Valley. The western margin of the embayment is marked by the northeast-southwest trending "Fall Line" which passes through Little Rock near the northwest end of the project. The Fall Line is a common name applied to the abrupt decline of highland rock formations beneath the younger unconsolidated sediments of the alluvial plain; structurally, it represents the western flank of the embayment.

Sediments in the Bayou Meto Project area consist of Recent to Pleistocene alluvial deposits ranging in thickness from about 60 to 165 feet. The predominantly fine-grained Recent alluvium blankets the surface of the project area. The underlying Pleistocene strata consist of a basal gravel and coarse to medium sand grading upward to fine sand overlain by clay and silt. The upper, low-permeability soils form a confining layer to the underlying sands and gravel which are waterbearing. This confining layer, known locally as the "clay cap", is generally about 25 feet thick over the project area, but can range in thickness from 15 feet to more than 50 feet. The water-bearing sediments are continuous over most of eastern Arkansas, and are known as the Mississippi River Valley alluvial aquifer. The aquifer has an estimated hydraulic conductivity ranging from 120 feet to 390 feet per day, and in the Bayou Meto project area, its thickness varies from 70 feet to occasionally over 100 feet. These thickness variations in the aquifer are related to the paleotopography of the underlying Tertiary contact as well as the variable thickness of the confining layer.

Regional ground-water flow is generally southward throughout the alluvial aquifer except in areas of large withdrawals. One large withdrawal area is the Grand Prairie, just northeast of Bayou Meto, where rice and other crops require considerable irrigation pumpage. The alluvial aquifer was early recognized as a ready source of irrigation water, and the impermeable surface soils were recognized as a natural seepage retardant. Irrigation water demands have created a cone of depression beneath the Grand Prairie, and lowered the groundwater in the project area. As a result, the groundwater flow in the Bayou Meto project is largely northeast into this cone of depression, rather than the typical southward regional flow.

The Mississippi River Valley alluvial aquifer is unconformably underlain by generally less permeable Tertiary strata. Successively downward, the Tertiary deposits consist of interbedded clay, silt, and sand of the Jackson, Claiborne, Wilcox, and Midway Groups. Although some water is produced from sands in the upper three groups, the overlying Quaternary alluvium remains the principal aquifer.

Soils

The soils within the project area range from the heavy clays to the loams, to the river sands. Most of the soils can be classified as prime farmland provided adequate drainage has been accomplished. These soils are very well suited for crop production and provide excellent yields with proper moisture levels.

Major soils within the Bayou Meto Irrigation Project area include the Perry, Hebert, Crowley, Calhoun, Calloway, and Portland series.

The Perry series consists of deep, poorly drained, very slowly permeable soils that formed in clayey alluvium on bottomlands of the Arkansas River. These soils are on broad flats and in depressions that were backswamps of the Arkansas River. They have a high water table in late winter and early spring. The native vegetation under which these soils formed was mixed hardwood forest. The slopes range from 0 to 1 percent.

The Hebert series consists of deep, somewhat poorly drained, moderately slowly permeable, level soils that formed in loamy alluvium on bottomlands of the Arkansas River. These soils are on the lower parts of the natural levees bordering abandoned stream channels of the Arkansas River. The native vegetation under which these soils formed was mixed hardwood forest. The slopes range from 0 to 1 percent.

The Crowley series consists of deep, level, somewhat poorly drained, very slowly permeable, loamy soils on terraces. These soils typically have layers with high clay content within about 12 to 30 inches of the surface. Depth to these layers should be determined before land leveling is attempted. This soil is well suited to cultivated crops such as rice, soybeans, and grain sorghum. Wetness is a moderate limitation and surface drainage may be needed in some areas. Nearly all the acreage of this soil is cultivated.

The Calhoun series consists of deep, level, poorly drained, slowly permeable, loamy soils on broad flats. These soils are well suited for rice production and moderately suited for most other crops. Wetness is the main restriction on these soils and surface drainage is needed in most areas. Most areas of this soil have been cleared and are used for production of rice, soybeans, and grain sorghum.

The Calloway series consists of deep, level to nearly level, somewhat poorly drained, slowly permeable, loamy soils on terraces. These soils typically have a compact, brittle fragipan at a depth of about 24 to 36 inches. These soils are well suited for crop production. Wetness is a moderate limitation on level areas and surface drains may be needed. Erosion is a moderate hazard on nearly level areas. Practices such as minimum tillage, contour farming, and the use of cover crops help

reduce runoff and control erosion. Most areas of this soil have been cleared and are used for production of soybeans, rice, grain sorghum, and wheat.

The Portland series consists of deep, somewhat poorly drained, very slowly permeable soils that formed in clayey slackwater deposits in bottomlands of the Arkansas River. They have a high water table in late winter and early spring. The native vegetation under which these soils formed was mixed hardwood forest. The slopes range from O to 1 percent. Minor soils within the project area include moderately steep, moderately well drained, silty loam Loring soils on terraces and uplands in the Loess Hills and Loess Plains; well drained, silty loam Rilla soils on higher parts of older natural levees; moderately well drained, silty loam Stuttgart soils on broad flats and terraces in the Loess Plains; and poorly drained, silty loam Tichnor soils on floodplains of streams in the Loess Hills and Loess Plains.

The majority of the soils in the project area have restrictive layers (i.e., traffic pans) that limit rooting and water holding capacity, as well as restrict vertical groundwater recharge. This is due to movement over the landscape by agricultural equipment. As a result, crops cannot endure long periods without moisture replenishment during summer months.

Climate

The climate is broadly classified as ranging from humid to subhumid. Monthly average temperatures range from approximately 43 degrees F in January to approximately 83 degrees F in July. Summers are normally long and warm with relatively mild and short winters. However, occasional periods of excessive summer heat and winter cold are characteristic of the area. The first and last killing frosts normally occur in early November and early April. The mean freeze-free period is about 200 days.

Precipitation is predominantly of the shower type except for occasional periods of general rainfall during the late fall, winter, and early spring. The average annual number of days with measurable precipitation is about 73. Rainfall quantities are the least in the summer and fall when monthly precipitation totals average 3 to 4 inches. The average annual rainfall for the project area is approximately 47 inches based upon the gage station at the University of Arkansas Experiment Station east of Stuttgart.

Rainfall varies from a maximum monthly average of about 5 inches in May to 2.7 inches in October. Table 1 lists the average rainfall by months, in inches.

TABLE 1

Month	Rainfall (In)	Month	Rainfall (In)
January	3.63	July	2.88
February	3.49	August	3.21
March	4.92	September	3.91
April	4.46	October	2.68
May	4.99	November	4.05
June	3.53	December	5.61

Socioeconomic Conditions

The study area encompasses parts of Arkansas, Jefferson, Lonoke, Prairie, and Pulaski counties in east central Arkansas. All of the cities of Lonoke and England and half of Carlisle are in the area. Other smaller communities partially or completely in the project area are Coy, Humnoke, Allport, Keo, Sherrill, Humphrey, Altheimer, and Wabbaseka. The population within the study area was estimated to be 13,109 in 2000. About 30 percent of the population was minority. The 2000 population for the state of Arkansas and for the United States was 2,673,000, and 281,422,000 persons respectively. The 2000 study area population was 347 persons or two percent more than the 1990 population. This compares to a national growth rate of 13.2 percent and a 13.7 percent growth for the state.

The labor force in the area totaled 6,900 in 2001 with an unemployment rate of about 6.0 percent. Employment for the state and the United States for the same period was 1,226,000 and 144, 815,000, respectively. This employment was concentrated in manufacturing and retail trade for the study area, state, and nation. The average unemployment was 5.1 percent for the state of Arkansas and 4.8 percent for the United States as of 2001. Per capita income for the study area was estimated to be $16,300 for 2000 and was lower than the $16,900 and $21,600 for the state and nation, respectively.

In 2000, there were 1,240 farms in the study area with an average area per farm of about 330 acres and an average value per acre of land and buildings of $1,100. About 28 percent of the farmers have their principal occupation off the farm.

It is NRCS policy to perform a Civil Rights Impact Analysis for watershed projects and environmental assessments. The purpose of the analysis is to examine the civil rights implications of NRCS actions related to employment, management, program development, program implementation, or decision making and to prevent any adverse impact on employees as well as on program beneficiaries, such as socially and economically disadvantaged groups, minorities, women, and persons with disabilities. There are 212 women and 234 minority farmers in the area. Seven farmers are handicapped and approximately 22 percent of the producers in the project area are limited resource farmers.

The NRCS provides technical assistance to individuals, groups, and units of government. NRCS assists landowners within conservation districts to develop and apply resource conservation systems to solve a host of natural resource problems on lands with a variety of uses.

Cost share programs are provided by NRCS and the Farm Service Agency for natural resource conservation practices of long-term benefit.

NRCS provides technical assistance in determining where conservation practices are practical and necessary, preparing conservation plans, and in the design and layout of the practices. NRCS also supervises and certifies proper installation of the practices. The Federal Government typically pays 50 percent of the installation cost of eligible conservation practices up to the limit established in each county.

Conservation Level

Average field irrigation efficiencies are estimated to be approximately 60 percent, which coincides with estimated efficiencies in the Eastern Arkansas Region Comprehensive Study. This value was determined utilizing data from the Eastern Arkansas Water Conservation Project (EAWCP) and from the Irrigation Water Needs Analysis Worksheet prepared for a typical farm within the project area. During the EAWCP, 20 season long studies were conducted on continuous flood rice irrigation and 25 evaluations were conducted on other crops using intermittent flood irrigation. The results of these studies are published in the 1987 EAWCP report.

The installation of structural conservation practices and the implementation of improved water management practices are expected to bring average irrigation efficiencies to the 70 percent level throughout the project area.

Land Use and Cover

The total acreage of the project area is about 433,166 acres. Cropland amounts to 276,814 acres. Major crops are rice (81,675 acres), soybeans (154,580 acres) and cotton (38,418 acres) with small acreages of corn (2,369) and grain sorghum (1,384). About 49,513 acres of late soybeans are double cropped with wheat. Grass and CRP amount to 38,170 acres. Water area totals approximately 40,000 acres with 4,893 acres of that in irrigation reservoirs and 22,079 acres of commercial fishponds. Total other uses cover an area of 113,000 acres that includes urban, transportation, etc.

Agricultural production accounts for most of the economic activity in the project area and is expected to continue to be the dominant economic activity in the foreseeable future.

Forestland is 15 percent of the project area and is made up primarily of bottomland hardwood communities and isolated upland communities.

Other land use consists primarily of urban areas, roads, utilities, and domestic and agricultural buildings. Primary land use is shown in Table 2.

TABLE 2
Bayou Meto IPA Primary Land Use

Land Use	Acres	Percent
Cropland	276,814	64
CRP	4,453	1
Pasture & Hayland	33,717	8
Woodland	41,350	10
Reservoirs	4,893	1
Fish Ponds	22,079	5
Lakes, Streams, Other Water	10,650	2
Other 1/	39,210	9
Total	433,166	100

1/ This category includes transportation services, commercial/industrial, community services and "other" land uses.

Future cropping patterns and land use are expected to shift to dryland cropping as the water available for irrigation decreases under the without project conditions. With project, the cropping pattern would remain basically the same as present. The quantity of prime farmland and farmland of statewide importance are also expected to be reduced by the amount of land required for storage reservoirs, tailwater recovery systems, and the delivery system of the project.

Cultural Resources

Human inhabitation in southeast Arkansas has spanned a period of at least 12,000 years. The prehistoric occupation by Native American populations has been subdivided into several culture periods based upon various technological, social, and subsistence adaptations over time. In generalized terms, these are the Paleoindian period {ca. 12,500-9,500 B.P.), Archaic period {9,500-1,500 B.P.), and Post Contact period {1540-present). For a detailed summary of the entire sequence, the reader is advised to consult the Arkansas State Plan {Davis, Ed. 1982).

The prehistoric culture periods of particular interest in the project area range from the Middle Archaic through Woodland periods inclusive. In the Arkansas River Lowland region, Archaic site components are relatively common but the nature of daily life activities has yet to be clearly understood. The hunting and gathering subsistence strategies that predominate the Archaic period are generally thought to be adaptations to changing Holocene environments {Griffin 1967). Settlement systems appear to be based on organized bands of people coalescing and dispersing during seasonal rounds.

Through time, as the number and population of Late Archaic components increase, a certain degree of economic specialization occurs. Altschul {1981) attributes this to the increased resource exploitation of "ecological seams" as a result of Poverty Point cultural influences toward a more structured and sedentary settlement pattern.

The transition to and developmental characteristics of Early Woodland sites are extremely difficult to postulate because so few sites are known in this vicinity. These sites are thought to represent small hamlet-sized loci of limited activity and are distributed on natural levees of relict meander belts. As settlement and community patterns became increasingly structured, site distribution shows a marked increase.

During the Baytown period (A.D. 300-700), sites become larger and more varied, suggesting a stable, increasing population and the development of more complex socio-political organizations. Mounds were used not only for burial but also as the base for building structures.

The succeeding period is Coles Creek {A.D. 700-1000). These sites range in size from multiple mound complexes to small midden areas that are interpreted to be a hierarchical organization of villages, hamlets, small farmsteads, or camp sites (Rolingson 1982: SEU 6).

Research at the Toltec site {3LN42) has defined a new Plum Bayou Culture {Rolingson 1982) that spans the later Baytown and Coles Creek periods. Based upon the material culture assemblage, the Plum Bayou culture is distinctive from Coles Creek sites farther to the south in the Felsenthal subregion {c.f. Rolingson and Schambach 1981). The Plum Bayou sphere of influence ranges from the White River lowland to the Bartholomew-Macon subregion and is centered primarily within the Arkansas River lowland.

The succeeding Mississippi cultures in the project area are not well understood due to a lack of known sites. Middle to Late Mississippian phases have been documented to the south and east. Some Late Mississippian and Quapaw affiliated sites are distributed throughout the vicinity of the Arkansas River lowland.

The historic exploration and settlement of the southeast Arkansas area began indirectly with the DeSoto Expedition that was later followed by fur trappers and tradesmen primarily of French origin. During the Pioneer period {ca. 1780-1850), the state's rural population expanded and a strong agricultural base developed. Plantation holdings similar to the structure of antebellum society farther south were established {mostly post 1800) in the alluvial bottomlands of the eastern delta. Limited fractional holdings secured under the homestead acts beginning in 1819 provided immigrants with the subsistence base for creating small local communities. The post Civil War era witnessed a fragmentation of the plantation structure in which large land holdings were reduced in size, and the number of individually owned plots increased. This eventually led to a neoplantation development {Prunty 1955) with small, sharecropper farms tied to a decentralized plantation complex. The Tenant Farm period {ca. 1870-1950) is the most dynamic phase of economic and social growth which was dominated by commercial agriculture. Changing agricultural markets, partially brought about by increased post-WW II farm mechanization, eventually brought about a reduction in the number of support and residential units to what the modern agricultural land use patterns closely resemble today.

This section gives the general cultural history, which suggests the potential cultural resources of the project area. If elements of the proposed plan are implemented, the lead federal agency must carry out the requirements of Section 106 of the National Historic Preservation Act of 1966, as amended, prior to implementation. There are 591 known cultural resource sites within the project area. All significant cultural resources will be avoided during implementation or otherwise preserved in place to the fullest practical extent.

PROBLEMS AND OPPORTUNITIES

The major resource problem in the project area is the lack of a dependable long-term agricultural water supply to continue to irrigate cropland.

(Note: The following groundwater data is somewhat dated and currently being researched for possible updating. However, significant improvement in the groundwater situation is not anticipated. The supporting maps referred to below, as Figure 1, Figure 2, etc, are available in printed copies of this report.)

The spring 1996, potentiometric surface map show the effects of large withdrawals east of the project area. The cone of depression in the Grand Prairie Region has elongated northwestward toward Lonoke. The potentiometric surface varies from 219 ft. msl near Scott to 106 ft msl halfway between Lonoke and Carlisle. The average water surface elevation by land section is 164 ft. msl.

Depth to water shows a similar pattern to the potentiometric surface except that the reference point is land surface. Values ranged from as little as 16 feet to water southwest of Sherril to 123 feet to water east of the town of Lonoke.

The declining water levels are a source of major concern by water users and water managers. Over time significant declines have occurred in the area. The map of water level change from 1991 to 1996 (spring) shows large declines of 10 to 15 feet between Lonoke and Carlisle. The northern half of the area was mostly in a zone of 5 to 10 feet decline, as in the southern tip of the area and the east central portion of the area. Other intervening areas have declines of zero to 5 feet. The entire area has experienced a decline in the water table over the period of 1991 to 1996.

Figure 1 indicates that in 1990 approximately 1/2 of the project area had a saturated aquifer thickness of 40 to 60 feet with a small area near Lonoke with less than 40 feet remaining. The aquifer varies in thickness from 70 to 100 feet. These figures become particularly significant when analyzing the rate the saturated thickness is declining. Figure 2 shows the rate of decline for the period of 1984 through 1989. Most of the project area had rates of decline greater than 5 feet with a large area greater than 10 feet. Average declines ranged from 1 to 2 feet per year.

Figure 3 indicates a slowing of the rate of decline from 5 to 9 feet for most of the project area from 1987 through 1992. The typical drawdown during pumping is 1 foot per 100 gallons per minute. A well producing 1000 gallons per minute could be expected to have localized drawdown of 10 feet. In areas with 40 feet of remaining saturated thickness, the problem is becoming critical. Figure 4 shows the area where more than 50% of the saturated thickness of the aquifer has been

depleted. As shown in Figure 5, pumping depths range from more than 120 feet near Lonoke to less than 20 feet near the Arkansas River.

The groundwater supply is insufficient to continue to irrigate the cropland indefinitely at the current rate. Agricultural production is expected to decline and pumping costs are expected to increase with declining groundwater levels. In addition to agricultural production loss, degradation of fish and wildlife habitat is expected due to over use of surface water.

Many opportunities exist for enhancing environmental values and improving the quality of life for residents in the project area.

SCOPE OF THE PLAN

The U.S. Water Resource Council's document, Principles and Guidelines for Water and Related Land Resources Implementation Studies requires a scoping process to identify the range of actions, alternatives, and impacts to be considered. The issues significant in defining the problems and formulating and evaluating alternative solutions are summarized in Table 5. Concerns displayed with a high or moderate degree of significance are discussed in more detail in the document. For a discussion of the scoping process used, refer to the section entitled "CONSULTATION AND PUBLIC PARTICIPATION."

TABLE 5

IDENTIFIED CONCERNS
BAYOU METO PROJECT

Economics, Social, Environmental, and Cultural Concerns	Degree 1/ of Concern	Degree 2/ of Significance	Remarks
Flood Protection	Medium	Low	Project is expected to have minimal impact on flooding.
Cultural Resources	High	Medium	Sites will be avoided during construction.
Natural Areas	High	Low	No impact.
T&E Species	High	Low	None present.
Fish Habitat	Medium	Medium	TWR ditches and reservoirs will provide additional fisheries.
Health & Safety	Low	Low	No impact.
Important Ag Land	Medium	Medium	Continued irrigation will maintain production and agricultural inputs.
Highly Erodible Cropland	Low	Low	Very few acres of HEL land in project area.
Water Quality Quality.	Low	Low	Improve water
Groundwater	High	High	Continued withdrawal will deplete aquifer.
Air	Low	Low	More available water will mean less dust pollution.

Transportation/ Navigation	Low	Low	Conservation practices to be installed on-farm
Recreation	High	High	Additional flooded acreage will be available for consumptive and non-consumptive recreation.
Waterfowl	High	High	Additional flooded rice acreage will be available for resting and feeding waterfowl.
Wetlands	High	Low	Wetlands will be avoided to extent possible when construction is being carried out.
Visual Resources	Low	Low	No impact
Social and Economics	High	High	Reduced economic activity from shift to dryland farming
Limited Resource Farmers	High	Low	Communities have minority populations, which depend on the farm economy for employment.
Wildlife Habitat	Medium	Medium	Additional rice flooded for fall/ winter resting, feeding, and hunting.
Minorities	High	Low	Dependent on successful farming operations for employment.

1/ Degree of Concern (High, Medium, or Low), in general
2/ Degree of Significance (High, Medium, or Low), potential formulation
3/ Explanation of Significance

FORMULATION
AND
COMPARISON OF ALTERNATIVES

Formulation Process

The process used to formulate alternatives was based on the primary objectives of the sponsors. The objectives are to protect the groundwater resource, to provide an adequate supply of water for irrigation and fish farming, and to enhance fish and wildlife habitat.

The sponsors hope to develop a plan to achieve their primary objectives while minimizing adverse environmental impacts without inducing flood damages.

The sponsors recognize an opportunity to supply an economical source of water for flooding cropland for wildlife feeding and resting areas during the fall and winter.

Several options were considered in the development of the final alternatives. These options included:

No action.
Installation of conservation practices and storage reservoirs.
Development of alternate surface water sources.
Combination of conservation/storage/alternate surface source.
Development of alternate underground sources.

Two of the options were determined not to be practical in the early stages of the planning process and were not developed as alternatives. The options eliminated were: development of alternate surface sources and development of alternate underground sources.

Preliminary analysis indicated the Arkansas River and the other natural streams in the area could provide adequate flow but it was considered impractical to design a delivery system for peak use capacity when wide ranges of flow would occur. Further consideration of the option to develop a sole surface water supply was terminated.

The Sparta Sand is a deep aquifer and was considered to be the most reasonable source for an alternate groundwater source. This high quality water is utilized by many municipal and industrial users. The area near El Dorado, which relies heavily on this aquifer as a water source, has recently been declared a critical groundwater area by the Arkansas Soil and Water Conservation Commission due to a declining water table. For these reasons, consideration of the Sparta Sand as an alternate groundwater source was eliminated.

One alternative, which meets the objectives of the sponsors, was formulated. This alternative was the combination Conservation/Storage/Alternate Surface Source and is recommended for installation.

The Conservation/Storage alternative required that several thousand acres of irrigated cropland revert to dryland farming. Severe negative economic and social impacts could be expected due to reduced yields. This alternative does not meet the objectives of the sponsor.
Another alternative displayed for comparison purposes is the No-Project Action Alternative. The No-Project Action does not meet the sponsor's objectives nor does it meet the four tests in "Principles and Guidelines."

The Arkansas River was chosen as the alternative surface water source because of its proximity to the area and preliminary analysis indicates an adequate supply of excess water of suitable quality. Most of the irrigators are currently using groundwater wells as their primary irrigation source.

The basis of the recommended plan is to improve field irrigation efficiencies by 10%, utilize groundwater at somewhat less quantity than sustainable yield levels (thereby allowing for some potential recharge of the aquifer), install additional irrigation storage reservoirs, and use some existing streams and canals as a delivery system to convey the water. Where no streams or canals presently exist, an open channel canal or underground pipeline is planned. Construction of irrigation reservoirs in wetland areas will not be allowed without 404 permits and Food Security Act (FSA) clearances.

The enhancement of wetlands within the project area will be on a voluntary basis. Water for this purpose may be delivered utilizing the on-farm irrigation system. Incentives for wetland enhancement may be available through water pricing structures or cost-share payments such as the Wetland Reserve Program.

The capacity of the irrigation delivery system was designed to provide sufficient irrigation water with on-farm water conservation measures in place. The sponsors will encourage the development of individual water conservation plans for each irrigator. Technical and financial assistance will be provided through NRCS and/or the District.

In formulating the Plan, consideration was given to dividing the project area into evaluation units based on types of on-farm practices recommended. This effort proved to be futile because all of the project measures are necessary in order to achieve the objectives of the sponsors. Net benefits were lost and the plan failed the four tests of completeness, acceptability, effectiveness, and efficiency. The measures planned are an interdependent system. All of the planned features work together and are needed to meet the project objectives. However, because of a significant difference in the severity of the groundwater decline between the prairie portion of the project in the northeast part of the project area and the rest of the project area, the on-farm storage requirement, as a percent of the total irrigation need, was considered separately for these two areas.

Description of Alternative Plans

Alternative No.1 No Action (Future Without Project)

This alternative would require no project action. The desired land use and demand for irrigation water will remain. However, groundwater levels are projected to decline such that available water sources can only support irrigation on approximately 97,716 acres of cropland and fishponds. The remainder of the area would have to convert to dryland farming practices which would mean essentially soybean production. This alternative does not meet the objectives of the sponsors.

Alternative No.2 - Conservation/Storage Alternative

This alternative would include installation of conservation practices and storage reservoirs in the project area without any supplemental water. Reservoir construction is limited by the available runoff of the drainage area and tailwater capture. The aquifer would continue to be depleted and irrigated cropland would revert to dryland farming. This alternative does not meet the objectives of the sponsor.

Alternative No.3 - Conservation/storage/alternate source alternative. (Recommended Plan)

This alternative would include the installation of conservation practices and storage reservoirs in the project area along with an import system to provide supplemental water to sustain agriculture as it is currently practiced. This alternative would meet the objectives of the sponsor.

Effects of Alternative Plans

The following section describes the economic, environmental, and social effects of each alternative. Concerns listed in Table 5 with a high or moderate degree are described. A brief description of some concerns not significant to formulation is also included due to federal laws, regulations, or special interests. The effects of the Without Project Action were discussed previously in the "Setting" and "Problems" sections.

Wildlife Habitat - Existing Conditions

General Wildlife distribution and populations depends largely on the quantity and quality of available habitat. Habitat conditions are in turn influenced by land use, land management, distribution of water, climate, human influences, and other limiting factors. Therefore, wildlife populations are in general directly proportional to the availability and suitability of their habitat requirements. Wildlife species are opportunistic in obtaining necessary life requisites. The most favorable habitat condition for terrestrial wildlife is a mixture of vegetative cover types that are all within the home range of the various species. Diversity, then, is an important element of productivity.

Terrestrial Wildlife Habitat and Species The land use of the project area has been placed into five categories. Table --- illustrates these land uses and the respective acreages and percentages of each. Wildlife habitat can best be described in terms of vegetative cover types. From the five land

use categories, three general vegetative cover types can be delineated to describe the terrestrial wildlife habitat of the project area.

Timbered habitat is the second largest cover type in the project area and accounts for 41,350 acres. Both Timbered Wetlands and Upland Communities are taken into consideration. Species composition varies according to soil type, moisture conditions, slope aspect, and other external factors.

Dominant upland forested community types that occur within the project area are as follows:

(1) Southern Red Oak-White Oak-Hickory sp.
(2) Oak spp.-Mixed hardwoods
(3) White Oak-Post Oak
(4) White Oak-Sweetgum-Mockernut Hickory
(5) Loblolly Pine
(6) Post Oak

Timbered habitat provides all or some life requisites for many wildlife species. Wildlife species or groups that rely on timbered habitats include white-tailed deer, fox squirrels, gray squirrels, southern flying squirrel, woodchuck, eastern cottontail rabbits, swamp rabbits, eastern spotted skunks, striped skunks, river otters, bobcat, mink, raccoon, coyote, ninebanded armadillo, foxes, mice, rats, wild turkeys, woodpeckers, owls, hawks, and song birds including nuthatches, warblers, and chickadees. Several species of reptiles and amphibians are also included.

Pasture and hayland occupy 33,717 acres and are the third most abundant cover type. Native and improved pasture are included with species composition varying according to soil type, moisture condition, and management practice.

Well-managed native range or pasture is a mixture of tall grasses composed principally of big bluestem, little bluestem, switchgrass, and Indian grass. These areas may also include numerous forbs. If not managed properly, broomsedge, common weeds, and alien species may become dominant. Introduced pasture in the basin consists mainly of bermudagrass.

Wildlife species or groups commonly associated with pasture land include white-tailed deer, rabbits, skunks, coyotes, fox, mice, rats, bob-white quail, birds of prey, songbirds, reptiles, and amphibians.

Cropland is the dominant cover type and consists of 276,814 acres of monocultures of seasonal crops requiring frequent or seasonal tillage, intensive management practices, or both. Vegetative composition varies according to soil types, moisture conditions, and production goals or purposes. Crops within the basin include wheat, soybeans, rice, grain sorghum, corn and cotton. Wildlife species rely heavily on croplands as a food source due to the abundance of insect species and the actual crops grown. Some species or groups that are commonly encountered in the cropland cover type and the adjacent edge communities include white-tailed deer, rabbits, raccoons, fox, mice, rats, wild turkey, bob-white quail, mourning doves, flycatchers, sparrows, birds of prey, waterfowl, and a number of shorebirds.

Alternative No.1 No Action - No land is expected to be cleared for agricultural purposes. Some land may be cleared for urban activities, road construction, and utility right of ways. Wildlife habitat loss will need to be considered in stream and riverine systems due to the demand for water. Without the project, surface water intake will increase due to loss of available groundwater; therefore it will impact existing conditions.

Without the project, availability of water will reduce habitat for shorebirds, waterfowl, and other dependent species.

Alternative No.2 Conservation/Storage - The construction of reservoirs will delay the uptake of surface water in certain areas of the project area. The aquifer will continue to be depleted and habitat loss is eminent.

Alternative No.3 Conservation/Storage/Alternate Surface Source - The construction of reservoirs in the area and readily available surface water to existing croplands will provide additional wildlife habitat for waterfowl, shorebirds, and other cropland dependent species. Demands for groundwater will be decreased tremendously.

Wetlands - Present Conditions - To evaluate wetland habitats that could be disturbed by construction, wetlands were grouped into five categories:

(1) Forested Swamps (Dominated by woody vegetation greater than 6 meters tall).

A. Cypress, Water Tupelo or Cypress and Water Tupelo

B. Bottomland Hardwoods (Oak-Hickory spp.)

(2) Scrub/Shrub Swamp (Dominated by woody vegetation less than 6 meters tall).

(3) Emergent Wetland (Dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens).

(4) Riverine (Deep water systems bound by banks on each side)

(5) Impoundments (Reservoirs, Lakes, Fish Ponds)

There are various communities that fall in each of the above categories. Forested Swamp bottomland hardwoods (Oak-Hickory) was the most heavily studied community type in the project area, mainly because the larger tracts of land are in this category.

An interagency group composed of biologists from the U.S. Fish & Wildlife Service, Arkansas Game & Fish Commission, Arkansas Natural Heritage Commission, U.S. Army Corps of Engineers, and NRCS agreed upon the groups and conducted the habitat evaluations.

These aquatic communities are extremely high in species diversity and provide essential habitat for many water-oriented species. Included among these species are groups of ducks, geese, shore birds including herons and egrets, songbirds, birds of prey, white-tailed deer, turkey, raccoons, rabbits, beavers, muskrats, reptiles, and amphibians.

Alternative 1 - No Action - Wetland communities in the project area will be degraded due to the increasing rates of surface water uptake. The natural water regime that wetland communities are dependent upon will be manipulated, causing major impact on all wetland communities. Without the amounts of water needed for the natural systems to function, the composition of the wetland communities would be altered.

Alternative No.2 Conservation/Storage - The construction of reservoirs in the project area would mean a delay in the surface water uptake from waterways.

Alternative No.3 Conservation/Storage/Alternate Surface Source - The construction of on-farm reservoirs will provide irrigation water for 276,814 acres of irrigated cropland. Groundwater use will decline to somewhat less than sustainable yield levels (thereby potentially allowing for some recharge of the aquifer) and surface water taken from existing streams will be replenished from the Arkansas River. With these functional components of the project in place, existing wetlands will be preserved. High quality natural communities like Smoke Hole Natural Area are not expected to be negatively impacted by irrigation practices.

Fishery - Existing Conditions - Fishery habitat consists of manmade ditches, streams, reservoirs, and lakes.

Approximately 4,893 acres of irrigation reservoirs provide fair to good quality fish habitat. During extremely dry periods fishery resources may be eliminated in these reservoirs. Many local fishermen have quit fishing traditional fishing spots and now go to irrigation reservoirs because of the fishing success.

Recommendation for newly designed surface water reservoirs will enhance fish habitat and increase productivity. These reservoirs may include tire reef structures for cover, 1% or greater slope along the bottom, and vegetated earthen wind breaks.

Alternative No.1 No Action - Waterways in the project area will continue to be degraded by over-pumping of the water for irrigation purposes. Degrading the water quality will mean a decrease in productivity levels.

Alternative No.2 Conservation/Storage - The addition acres of reservoir would provide additional fishery habitat.

Alternative No.3 Conservation/Storage/Alternate Surface Source - The reservoirs in the project area and cooperation from farmers could mean more acres of productive fisheries. The project will improve the availability of water in existing waterways and would be expected to increase productivity. Withdrawals from the Arkansas River are expected to have little or no effect on the river fishery due to the timing of withdrawals and the large storage capacity of the navigation pools.

Endangered and Threatened Species - Existing Conditions -The Arkansas Natural Heritage Commission (ANHC), Arkansas Game and Fish Commission, and the U.S. Fish and Wildlife Service records revealed that no federally listed endangered and/or threatened species occurred in the project area.

Alternative No.1 No Action - No change in the status of endangered and threatened species is likely to occur.

Alternative No.2 Conservation/Storage - No change in the status of endangered and threatened species is likely to occur.

Alternative No.3 Conservation/Storage/Alternate Surface Source - No change in the status of endangered and threatened species is likely to occur.

Waterfowl/Shore birds - Existing Conditions

Waterfowl - Arkansas has long been considered to be one of the "Meccas" for waterfowlers throughout the continent. This circumstance has resulted from a number of factors including its location at the heart of the wintering range for the Mississippi Flyway, its historically abundant wetland resources, and its national ranking as the most important wintering state for mallards. (Yaich) Mallards, pintails, and black ducks typically comprise 2/3 to 3/4 of the harvest in the state. To illustrate the importance of Arkansas from a waterfowl harvest and hunter activity perspective, some national rankings for Arkansas' 1988-89 waterfowl season are as follows (for comparison, Arkansas ranked 33rd in total human population in the 1980 census):

Mallard harvest	1st
Total duck harvest	5th
Wood duck harvest	5th
Days hunted/adult hunter	3rd
Ducks /adult hunter day	4th
Ducks harvested/adult hunter (season)	1st

These statistics not only provide support for the statement that Arkansas is one of the most important harvest areas for ducks in the country, but also exhibit evidence of the biological importance of Arkansas in providing for the needs of wintering waterfowl. Midwinter survey records indicate that during the 1970s an average of 5.23% (1.06 million) of all ducks counted in the nation were observed in Arkansas. The average count of mallards during this period was 919,000, approximately one-third of the Mississippi Flyway's total. Arkansas plays as a dominant role in the provision of mallard wintering habitat as it does in harvest. (Yaich)

The principal habitats utilized by waterfowl -- bottomland hardwoods, scrub-shrub swamps, irrigation reservoirs, moist-soil areas, etc. -- fall into three general habitat management categories. These basic categories are: (1) unmanaged, naturally ponded or flooded habitat; (2) public managed habitat; and, (3) private managed habitat. While acreage included in the managed categories already contributes consistently to the annual habitat needs of wintering waterfowl, land in the unmanaged category provides habitat only when flooded by natural overflow. One basic habitat problem is that wintering waterfowl are currently dependent upon this unmanaged habitat for the provision of a very significant portion of their needs, particularly for foraging. Although flooding is common, it cannot be relied upon to occur annually, and its duration and extent are highly variable. (Yaich)

Shore birds - Thirty-one species of shore birds migrate through the state of Arkansas each year. In addition, two local species reside in the area and seven other species are infrequent visitors in the state. This magnificent group of birds is heavily sought after each spring and fall by hundreds of birders. The majority of the birds migrate through eastern Arkansas utilizing drying reservoirs and mudflats for food and cover. Surface water reservoirs with a moderate slope along the bottom provide excellent habitat. These reservoirs exhibit sizable areas of shallow water with high levels of invertebrates. Invertebrates are critical forage for shore birds due to their high protein levels. Reservoirs in this region provide shore bird habitat that is essential during migration.

Alternative No.1 No Action – Most irrigated cropland would be converted to dryland farming. Levees will be closed after harvest on the remaining acres of rice to capture rainfall. This water will be pumped back to surface reservoirs. If sufficient rainfall occurs, temporary storage on the rice fields will provide some waterfowl habitat. Rainfall typically comes late in November and may be sporadic. Other cropland will not typically be leveed and flooded for waterfowl.

Alternative No.2 Conservation/Storage – Significant acres of cropland would be converted to dryland farming. Levees will be closed after harvest on the remaining acres of rice to capture rainfall. This water will be pumped back to surface reservoirs. If sufficient rainfall occurs, temporary storage on the rice fields will provide some waterfowl habitat. Rainfall typically comes late in November and may be sporadic. Other cropland will not typically be leveed and flooded for waterfowl. New reservoirs will capture surface runoff for irrigation purposes. The new reservoirs will provide habitat for migrating shore birds.

Alternative No.3 Conservation/Storage/Alternate Surface Source – Over 90 percent of the area's irrigated cropland will remain in production. An additional 8,832 acres of reservoirs will be installed. Approximately 34,000 acres of cropland will be flooded and actively managed for waterfowl use from November 1 to March 1. An additional 23,000 acres of cropland have the potential of being flooded from water collected from rainfall. Additional forage means healthier waterfowl during the late winter months, which is critical for the migration to breeding grounds. New reservoirs will provide additional habitat for shore birds.

Natural Areas - Existing Conditions - The only natural area that is within the boundaries of the project area is Smoke Hole Natural Area. The Arkansas Natural Heritage Commission (ANHC)

either holds fee title or a conservation easement on the natural area. The area is managed by ANHC to protect its' natural features and high species diversity (ANHC report).

Smoke Hole Natural Area is a 437-acre tract of land straddling the Lonoke-Prairie county line. The name "Smoke Hole" actually refers to a small opening in an otherwise densely associated stand of an area, which supports a near exclusive stand of water tupelo. The tupelo is surrounded by a mature bottomland hardwood forest. The remainder of the tupelo trees are densely associated, and they form a maze of confusion because of their uniform size and growth habit. An unusual feature of this tupelo brake is the complete absence of bald cypress (ANHC site description).

Alternative 1 - No Action - Further depletion of the aquifer will increase the uptake of surface water from existing waterways. Withdrawal of large quantities of water from Two Prairie Bayou for irrigation of crops during extremely dry summers could have a drastic effect on Smoke Hole Natural Area. This water tupelo community is highly dependent on standing water and a shift in species composition may occur with long term dry out.

Alternative 2 - Conservation/Storage - Further depletion of the aquifer will increase the uptake of surface water from existing waterways. Withdrawal of large quantities of water from Two Prairie Bayou for irrigation of crops during extremely dry summers could have a drastic effect on Smoke Hole Natural Area. This water tupelo community is highly dependent on standing water and a shift in species composition may occur with long term dry out.

Alternative 3 - Conservation/Storage/Alternate Surface Source - With the project installed, natural flows will remain constant throughout the project area. Therefore, long term dry out will not occur and a change in the vegetative composition of the Smoke Hole NA and the Bayou Meto WMA will be avoided.

Recreation - Existing Conditions - The large number of waterfowl that winter in the state has produced a great waterfowling tradition on the part of both resident and non-resident hunters over the years. Additionally, enthusiasm for waterfowl hunting has resulted in the production of an economic benefit for the state proportionally larger than for other types of hunting. For example, in 1985, Arkansas residents spent an estimated $30 million for expenditures related to migratory bird hunting. In addition, the tradition of Arkansas as the most important wintering area for mallards in the country, coupled with the mallards' reputation as the duck of choice for most waterfowlers, has led to a significant flow of non-resident hunters (with their attendant economic benefits) into the state. Non-residents brought a conservatively estimated $7.3 million into the state for trip-related expenses (gas, food, lodging) alone in 1985. Additionally, a larger proportion of the total migratory bird hunting in the state was conducted by non-residents (22 percent) than for any other type of hunting (Yaich).

When compared to hunting, there are a greater number of individuals that participate in non-consumptive wildlife recreation. In 1991, the Arkansas Game and Fish Commission estimated that 45% of the Arkansans over the age of 16 (812,000) participated in this type of recreation. Both residents and non-residents visit this area of the state each year to observe the large numbers of

wintering waterfowl and shore birds. An estimated $189 million dollars is spent on non-consumptive recreation each year.

Alternative No.1 No Action - Crop yield and the associated wildlife food source would be significantly reduced, as wasted grain is a percentage of yield.

Alternative No.2 Conservation/Storage - New reservoirs would be constructed to the extent practical with existing water sources. Economic incentives would allow specialized construction to enhance wildlife use. Intense competition to capture runoff to fill these reservoirs would reduce naturally flooded areas. The use of field levees to slow runoff would provide positive benefit. Crop yield and the associated wildlife food source would be significantly reduced, as wasted grain is a percentage of yield.

Alternative No.3 Conservation/Storage/Alternate Surface Source - Approximately 8,832 acres of new reservoirs would be installed. Economic incentives would allow specialized construction of these reservoirs to enhance wildlife use. The use of field levees to improve seasonal flooding would provide positive benefit. Conservation plans would include a fish and wildlife component. Crop yields, and thus the waste grain for wildlife food source, would be maintained.

Water Quality - Existing Conditions - Water in the Arkansas River and Bayou Meto are suitable for irrigation of crops and use by fish and wildlife. Arkansas River water is generally of lower quality than Bayou Meto water, except that phosphorous concentrations are significantly higher in Bayou Meto, especially below Jacksonville.

Alternative No.1 No Action - Water quality in natural streams can be expected to decline as more of the natural runoff is utilized for irrigation. During extended hot, dry weather, Bayou Meto and other streams in the area will consist of a series of shallow stagnant pools separated by stretches of exposed streambed. Most fish will not survive the poor water quality and high water temperatures.

Alternative No.2 Conservation/Storage - This alternative could be expected to yield virtually the same impacts to natural streams as Alternative No.1, except the effects would be delayed and dampened by the construction of new reservoirs. Water quality in these reservoirs would be similar to that of natural streams during the winter and early spring. Water quality will decline as water is utilized for irrigation. Due to the inadequate water supply, most reservoirs will be pumped down to levels, which would not sustain fish survival.

Alternative No.3 Conservation/Storage/Alternate Surface Source - The overall water quality of existing streams could be enhanced by the introduction of Arkansas River water especially during summer months when streams are pumped until dry or nearly dry. The introduction of any water into the natural drainage system during hot, dry periods would be expected to improve water quality and sustain fish life.

Ground Water - Existing Conditions - Current groundwater withdrawals cannot continue with total depletion of the groundwater resources. The state of Arkansas has recognized groundwater depletion as the state's No. 1 water resources problem and is working both legislatively and developmentally to implement measures to protect and conserve this life sustaining resource.

Alternative No.1 No Action - Further declines will continue until regulation is implemented or total depletion of the aquifers occur.

Alternative No.2 Conservation/Storage - Overdraft of the aquifer will continue but at a slower rate.

Alternative No. 3 Conservation/Storage/Alternate Surface Source -Withdrawal of groundwater will be at the somewhat less than sustainable yield level, thus potentially allowing for some recharge of the aquifer. Aquifer storage will continue to decline during the construction period but stabilize when construction is completed.

Cultural Resources

Cultural impacts will vary depending on the size and location of irrigation field ditches, regulating pits, storage reservoirs, and underground pipelines. None of the known historic and architectural properties will be affected.

The cultural resources surveys of areas to be disturbed will provide information, which can be used to evaluate the effects of the plan on the resources. Given the long use of the project area by man, additional sites will likely be discovered. Many of these agricultural activities may no longer contain significant information. All will be evaluated with reference to the National Register of Historic Places criteria and to their ability to contribute to the goals of the Arkansas State Plan.

Alternative No. 1 No Action - This alternative will require no project action, but cultural resources will be considered for any continuing conservation practices.

Alternative No. 2 Conservation/Storage - Installation of conservation practices will require consideration and evaluations. These cultural resource considerations, with resulting evaluations, will be according to procedures set forth in the "State Level Agreement Between the NRCS and the Arkansas State Historic Preservation Officer".

Alternative No. 3 Conservation/Storage/Alternate Surface Source - The installation of conservation practices will require cultural resource considerations according to the State Level Agreement. Significant cultural resources will be avoided or preserved in place to the fullest practical extent.

Disadvantaged Groups, Minorities, Women, and Persons with Disabilities - Existing Conditions - Disadvantaged groups consist of an estimated 212 women, 234 minority and 273 limited resource farm owners and operators in the project area. Women and/or minorities may also be counted under the limited resource category.

Alternative No.1 - No Action - As cropland is converted to dryland operations; disadvantaged groups will be impacted similarly to other groups. Persons with limited resources would be less able to adjust and probably would not be able to construct reservoirs.

Alternative No.2 - Conservation/Storage - These groups would be affected as under Alternative 1, taking into account the difference in time frame for the construction of the reservoirs.

Alternative No.3 - Conservation/Storage/Alternate Surface Source - Conservation Plans will be developed with minority landowners. Sixty-five percent cost-share rates will allow a large number of minority farmers to participate in the project.

Important Agricultural Land - Existing Conditions - Approximately 276,814 acres of cropland in the project area are currently being used to produce rice, soybeans, wheat, cotton, milo, and corn. Most of this cropland is currently irrigated with groundwater.

Any farmland considered to be prime, unique, or of statewide importance will be subject to the conditions of the Farmland Protection Policy Act and will be considered in the location of conservation practices.

Alternative No. 1 No Action – Irrigated cropland would revert to dryland farming or other land uses.

Alternative No. 2 Conservation/Storage - Cropland would be converted to storage reservoirs. Acreage would also revert to dryland farming or other land uses.

Alternative No. 3 Conservation/Storage/Alternate Surface Source - Approximately 8,832 acres of cropland would be converted to storage reservoirs. All other current irrigated cropland would remain in irrigated production.

Social and Economic Effects - Existing Conditions - Currently about 276,814 acres of cropland are irrigated and serve as the base for the economy of the area. Production of rice, soybeans, corn, and grain sorghum generate approximately $53 million in annual purchases of supplies and equipment for use in production and marketing of the crops. In addition, the strong economic contribution of the recreation industry based primarily on hunting, fishing, and non-consumptive wildlife expenditures contribute approximately $760 million annually (1991 National Survey of Fishing, Hunting and Associated Recreation).

Alternative No. 1 - No Action – Agriculture as currently practice in the region would cease to exist. Crops production expenses would be reduced by approximately $15,000,000, which would adversely affect the agricultural economy of the area.

Alternative No. 2 - Conservation/Storage – Conversion of irrigated cropland to dryland farming would significantly impact the area's economy. This would mean a reduction in annual ownership and operating expenditures of approximately $15 million.

Alternative No. 3 - Conservation/Storage/Alternate Surface Source - This alternative would maintain production on 276,814 acres of irrigated cropland. A total of 8,832 acres would be converted to reservoirs. This would generate a benefit of reduced annual on-farm energy costs of $4,000,000 and increased yields due to use of surface water of about $2,000,000. A labor benefit during construction of the project would amount to $675,000 annually. In addition, this alternative

would continue the high level of production that would keep the economy of the area on a high level.

Increased economic activity accruing to the agricultural community from operation and ownership cost would amount to nearly $15,000,000 annually.

The enhancement of the waterfowl and fishery habit will result in more sustained hunting and fishing as well as the non-consumptive recreation activities.

Limited resource and/or minority farmers - Existing Conditions - Currently there are 273 limited resource and 234 minority farmers in the project area.

Alternative No. 1 - No Action - Without project action, the economic survival of these farmers will be questionable as the availability of irrigation water declines and they are forced into dryland farming operations.

Alternative No. 2 - Conservation/Storage - The impact of this alternative will be the same as alternative 1.

Alternative No. 3 - Conservation/Storage/Alternate Surface Source - Limited resource and minority farmers would be encouraged to participate in the project through the cost share programs of this project.

Relationship of the Alternatives to Local and Regional Comprehensive Plans and Land and Water Use Plans, and Controls.

The Arkansas Soil and Water Conservation Commission was authorized by Act 217 of 1969 to write a state water plan. The acts gave the Commission responsibility for water resources planning at the state level and for the creation of a master plan to serve as the primary water policy document for the state of Arkansas. The water plan provided criteria for the delineation of critical groundwater areas and outlined a strategy to correct the widespread groundwater overdraft problems in the state.

The critical decline rate for unconfined aquifers such as the Alluvial Aquifer in the project area was established at one foot per year for a period of 5 years.

The problems of groundwater overdraft were addressed in the 1985 General Legislative Session with passage of Act 417, entitled "Water Resource Conservation and Development Incentives Acts of 1985." This act stated that existing water use patterns were depleting underground water supplies at an unacceptable rate because alternative surface water supplies were not available in sufficient quantities and quality at the time of demand. The act provided groundwater conservation incentives in the form of state income tax credits to encourage the construction and restoration of surface water impoundments and conversion from groundwater based irrigation systems to surface water withdrawal and delivery systems.

RECOMMENDED PLAN

The recommended plan describes measures to be installed, (both structural and nonstructural), permits required, costs, installation and financing, operation and maintenance, and economic benefits.

The purpose of the plan is to develop a strategy to protect the groundwater resources of the area while supplying agricultural water for irrigation, fish farming, and the enhancement of fish and wildlife habitat. The recommended plan consists of installing on- farm conservation practices immediately and developing a supplemental surface water delivery system at a later date, which will be described in a separate document.
The on-farm water management component of the plan will consist of the installation of one or more conservation practices, which will improve irrigation efficiencies, provide any necessary storage, and/or retrofit existing irrigation systems to utilize the delivery system. This project will accelerate the installation of conservation practices commonly used in the area. The conservation practices will be installed on cropland and will be designed to operate independently of a supplemental surface water delivery system.

This document will address only the on-farm component of the plan and will be included as part of the overall Environmental Impact Statement to be prepared at a later date.

The problem area consists of 276,814 acres of irrigated cropland and 22,079 acres of fishponds within the project area. It is estimated that 88 percent of the agricultural water supply comes from groundwater. Surface water accounts for the remaining 12 percent, which is utilized as a supplemental source. The entire problem area is at least partially dependent on groundwater during drought years and will benefit from protection of the groundwater resource.

The irrigation water will be supplied from on-farm irrigation reservoirs (12 percent), natural runoff/tailwater recovery (8 percent), groundwater (22 percent), and the delivery system (40 percent).

A simplified version of the operation plan is:

November - April	Fill reservoirs from natural runoff and from delivery system when needed.
May- September	Irrigate cropland. Priority for use: 1. Runoff/tailwater 2. Import water 3. Reservoir water 4. Groundwater
October - December	Flood cropland for waterfowl feeding and resting areas.

Beneficial or Adverse Effects on Identified Wetlands and How These Effects Relate to the Wetland Conversion Provisions of the Food Security Act.

Approximately 8,832 acres of new storage reservoirs will be constructed. Most of the reservoirs will be constructed on existing cropland. Any reservoirs constructed on wetlands as defined by the Food Security Act, (i.e., Farmed Wetlands) will be subject to the conditions of the Act and may require mitigation. Construction of reservoirs subject to the Act will be delayed until any required Corps of Engineers permits and/or NRCS clearances are obtained. Negative impacts on wetlands will be minimized.

The Wetland Reserve Program will encourage the return of farmed wetlands and other converted wetlands to a natural condition with long-term lease agreements.

Approximately 8,832 acres of surface water will be created and used by waterfowl for winter resting. These reservoirs will provide shorelines suitable for use by wading shore birds and other animals will also benefit from the additional surface water and shoreline habitat.

Relationship Between Short Term Uses of Man's Environment and the Maintenance and Enhancement of Long Term Productivity.

Conversion of 8,832 acres of cropland will result from the construction of tailwater recovery systems and storage reservoirs. This conversion will provide an adequate supply of irrigation water to sustain agricultural production without depleting the groundwater resource base.

Executive Order 11990 - Protection of Wetlands.

Storage reservoirs will typically be constructed on existing cropland. Any reservoirs constructed on wetlands will require Corps of Engineers 404 permits and/or NRCS approval. These permits may require mitigation such that no net loss of wetlands occurs.

Irreversible or Irretrievable Commitments of Resources.

Under Alternative 3, 8,832 acres of cropland will be permanently converted to tailwater recovery systems and reservoirs. Agricultural production will be lost on this acreage. The commitments of labor, fuel, machinery, and materials to the project will be irretrievable.

Comparison of Alternative Plans

Three alternatives are compared in this section:

1) Alternative No. 1 - No Action

2) Alternative No. 2 - Conservation/Storage Alternative

3) Alternative No. 3 -Conservation/Storage/Alternate Surface Source Alternative

Table 7 is presented to display the four accounts addressed in "Principles and Guidelines." A summary of all major items used in the decision making process is shown. The measures used in each alternative and a comparison of effects are included. Alternatives that could be recommended are called candidate plans. Alternatives 2 and 3 are candidate plans.

TABLE 7
Summary and Comparison of Candidate Plan
Bayou Meto Improvement Project Area

ENVIRONMENTAL QUALITY ACCOUNT

Measures	Alternative No. 1 No Action	Alternative No. 2 Conservation/ Storage	Alternative No. 3 Conservation/ Storage/ Alternate Surface Source
Air Quality			
Wildlife Ditches	Uptake of surface water will decrease aquatic habitat.	Additional habitat for aquatic species.	Same as Alternative No. 2.
Pasture Land	No Change	Same as Alternative No. 1	Same as Alternatives No. 1 and No. 2
Woodland	No Change	No Change	No Change
Agricultural Land			
Fish Habitat	Uptake of surface water will decrease available habitat.	Additional Habitat.	Same as Alternative No. 2.
Cultural			
Threatened & Endangered	No Change	No Change	No Change
Water Quality			
Wetland Adjacent to Ditches	Change in Species Composition due to Surface Water Uptake.	Decrease Surface Water Uptake.	Same as Alternative No. 2.
Visual			

Risk and Uncertainty

As with most natural resource projects, the need for the project and the operation of the components of the project are directly related to the weather. The inherent risk and uncertainty, when trying to make decisions based on weather, are compounded by utilizing natural streams as both a source of irrigation water and a means of removing excess runoff from the project area. Proper planning and sound engineering design can minimize these risks but they cannot be totally eliminated.

The presence of dioxin in the sediment of some sections of Bayou Meto bring specialized uncertainties to the project. Although no extensive channel excavation is planned, some disturbance of bottom sediments will occur with the installation of low-water weirs, pumping plants, water control structures, and canal or pipeline junctions. Numerous reports and studies have documented the presence of dioxin in the sediment and biota of Bayou Meto but none have addressed the effects of construction within the channel. The development of specialized construction techniques by a multidisciplinary/multi-agency team will minimize the impact of construction on the stream. Monitoring during the construction period will be utilized to evaluate the effectiveness of these techniques and to refine the processes.

Rationale for Plan Selection

Alternative 3 was selected as the recommended plan because it was the only alternative, which met the long-term objectives of the sponsors. This alternative will protect the resources of the project area while providing a long-term source of agricultural water. Fish and wildlife habitat are expected to be improved with the installation of the project and the integrity of many existing wetland areas is expected to be maintained.

Many of the recommended on-farm conservation practices can be installed before the construction of the surface water delivery system. Immediate benefits would be realized and some the existing overdraft of the aquifer would be reduced.

CONSULTATION AND PUBLIC PARTICIPATION

A scoping notice was sent to federal and state agencies on April 2, 1996. The agencies notified were the State Clearinghouse, Arkansas Highway and Transportation Department, Arkansas Natural Heritage Commission, Arkansas Department of Pollution Control and Ecology, Arkansas Game and Fish Commission, U.S. Fish and Wildlife Service, and Little Rock District Corps of Engineers.

Participation in the on-farm program will be voluntary. Individuals wishing to participate will work with the District and the NRCS to develop a "Water Management Plan". This plan will detail the practices to be installed and will include an "Operation Plan" which will improve the reliability of having an adequate water source. The landowner will make the final decision on practices to be installed and on the operation of his on-farm irrigation system.

Individual landowners will own, operate, and maintain the on-farm components of the project and will be responsible for management of their irrigation system.

On-farm Measures to be Installed

Underground Pipelines - Approximately 552 miles of new permanent underground pipelines with appurtenances will be placed in existing irrigated fields to prevent loss of water quality and quantity. Such pipelines will allow the proper management of water and eliminate conveyance losses caused by evaporation and seepage.
Tailwater Recovery Systems - Approximately 234 miles of new tailwater recovery canals will be installed to collect, store, and transport runoff and tailwater for reuse on the farm. Tailwater recovery systems will improve water management and water quality.

Storage Reservoirs - Approximately 8,832 acres of new storage reservoirs will be constructed to conserve water by holding it until it can be used beneficially to meet crop irrigation requirements. Reservoirs will also be utilized to ensure adequate delivery rates during peak-use periods. The reservoirs will be filled from runoff, tailwater, and the delivery system. The estimated amount of additional storage needed for individual operating units was determined in the water budget analysis. Final design volumes will be determined during the development of the "Water Management Plan".

Reservoirs will generally be completely enclosed and will be filled by pumping.

Water Control Structures - Approximately 576 water control structures will be installed. These structures will improve water management and water quality by controlling runoff rate and trapping sediment. These structures will generally be included as part of the tailwater recovery system and will temporarily hold water until it can be pumped back into the reservoir.

Pumping Plants - Approximately 909 pumping plants will be installed. Pumping plants will consist of a pump and a power unit assembly, which will be used to move water through the irrigation system, remove water from the delivery system, and fill reservoirs.

Wildlife and Waterfowl Considerations

The project area falls within the migratory route for twenty-one species of ducks and three species of geese. The following measures are recommended to increase and improve wintering waterfowl habitat and thereby accomplishes the goals of the North American Waterfowl Management Plan.

Recommended measures on private lands:

(1) roll stubble to allow ducks to settle into the fields and facilitate decomposition of rice straw;

(2) close water control structures and repair contour levees to hold rainfall through winter;

(3) flood 23,000 acres of field crops annually for winter waterfowl use;

(4) passively manage 34,000 acres of field crops annually for winter waterfowl use;

(5) leave strips of unharvested crops (rice, beans, milo, wheat) in the field for wildlife and waterfowl use;

(6) promote, cultivate, and maintain buffer strips along riparian corridors; including revegetation of riparian areas;

(7) enhance existing wetlands, farmed wetlands, wooded areas, and additional non-farmed areas through water management;

(8) encourage hunting three days or less a week, mornings only;

(9) control beavers and other pest wildlife by hunting, trapping or bounties;

(10) construct 8,832 acres of new reservoirs.

Wetlands

Existing wetlands will be preserved by installing conservation practices on cropland in most cases. Any negative impacts to wetland areas, which cannot be avoided, will be appropriately mitigated.

Landowners will be encouraged to restore and protect wetlands through the Wetland Reserve Program (WRP). The WRP is a voluntary program offering landowners the opportunity to receive payments for restoring and protecting wetlands on their property.

Mitigation Features

Very little mitigation is expected since the installation of most conservation practices will be on cropland. Any mitigation required will be coordinated with the appropriate agencies.

Permits and Compliance

All work will be subject to Section 404 of the Clean Water Act, which requires the sponsors to obtain a permit from the U.S. Army Corps of Engineers on natural resource projects. It is the responsibility of the landowner, conservation district, improvement district, city or other legal entity to obtain a permit before initiating work. The sponsors will be required to show the proposed project is in compliance with EPA's 404(b) (1) guidelines.

Costs

The total installation cost of the on-farm portion of the project is estimated to be $65,000,000.

Installation and Financing

NRCS will work closely with the District and the landowner to plan, design, and oversee the installation of conservation practices. Landowners will be reimbursed up to 65 percent of the construction costs.

Cultural Resources

Any known cultural resource sites will be avoided whenever possible and practical. Any sites which cannot be avoided or which are located during construction will be subject to the procedures of the NRCS General Manual (420 GM 401).

Operation, Maintenance, and Replacement

Operation, maintenance, and replacement of on-farm practices installed, as part of this project will be the responsibility of the individual landowner. Annual operation and maintenance costs are estimated to be, on average, approximately $24.00 per acre of cropland irrigated or approximately $12.00 per acre-foot of irrigation water applied.

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BAYOU METO BASIN

GENERAL REEVALUATION

ON-FARM PORTION

BAYOU METO BASIN
GENERAL REEVALUATION
ON-FARM PORTION

DOCUMENTATION REPORT

Prepared by:

UNITED STATES DEPARTMENT OF AGRICULTURAL

NATURAL RESOURCES CONSERVATION SERVICE

SEPTEMBER, 2002

SECTION A
INTRODUCTION

This report was prepared as a part of Bayou Meto Basin General Reevaluation which is being conducted by the United States Army Corps of Engineers (Memphis District). The study details a plan to protect the groundwater resource of the area while supplying water for irrigation, fish farming, and the enhancement of fish and wildlife habitat. The Corps of Engineers has entered into a cooperative agreement with the United States Department of Agriculture, Natural Resources Conservation Service to assist in the planning and development of the project.

SECTION B
PURPOSE

The purpose of this report is to document the work conducted by the Natural Resources Conservation Service during fiscal years 1998 through 2002 on the Bayou Meto Basin General Reevaluation. This report is intended to be an appendix to the NATURAL RESOURCE PLAN for the ON-FARM PORTION of the BAYOU METO BASIN GENERAL REEVALUATION, prepared by the Natural Resources Conservation Service, June, 2002.

SECTION C
WORK AUTHORIZATION

The work performed by the Natural Resources Conservation Service was performed through an agreement with the District Engineer, Memphis District Corps of Engineers.

SECTION D
GENERAL DESCRIPTION OF THE PROJECT

The proposed project area includes portions of Arkansas, Lonoke, Jefferson, Prairie and Pulaski counties in eastern Arkansas. This project covers approximately 433,166 acres which includes approximately 276,814 acres of cropland. This area is a major rice and soybean producing area which relies heavily on groundwater as an irrigation source. The extensive use of the groundwater resource has depleted groundwater reserves to extremely low levels and continued use at current rates threatens to severely damage the resource. The Eastern Arkansas Water

Conservation Project (EAWCP), the Arkansas State Water Plan, and several United States Geological Survey (USGS) studies have reported consistent annual water level declines for many years. The aquifer is generally less than 100 feet in saturated thickness with some critical areas at less than 50% of original saturated thickness.

The proposed project would preserve the groundwater resource while providing a sustained agricultural water supply to the project area such that the region's farm based economy can continue to function.

The Eastern Arkansas Water Conservation Project (EAWCP) has indicated that the objectives of the project can be accomplished by implementing a combination of measures such as: improved irrigation efficiencies, additional on-farm water storage reservoirs, the diversion of excess surface runoff from the Arkansas River and utilizing the groundwater resource at safe yield levels.

Irrigation efficiencies can be improved by installing water conservation practices such as reservoirs, tailwater recovery systems and underground irrigation pipelines, and implementing irrigation water management practices such as soil moisture monitoring and irrigation scheduling.

On-farm storage now supplies approximately 5% of the irrigation water and can be increased by constructing additional storage reservoirs on individual properties. Reservoirs store excess runoff and improve management of the on-farm irrigation system.

The diversion of excess surface runoff from the Arkansas River can be accomplished by the installation of a large diversion pumping plant on the Arkansas River immediately north of David D. Terry Lock and Dam No. 6. This pumping plant would discharge into a system of canals, streams, and pipelines in order to deliver water throughout the project area.

Groundwater resources are planned to be utilized at the sustained safe yield level.

SECTION E
SCOPE OF WORK

This section of the documentation report describes the items of work scheduled for completion by the Natural Resources Conservation Service.

SECTION F
PROJECT ASSUMPTIONS

In order to provide reasonable and consistent estimates of water requirements within the project area, it was necessary to make several initial assumptions. These assumptions are intended to indicate the farming operation of individual tracts or the operation of individual irrigation systems. The farming operations and the operation of individual irrigation systems will be left strictly to the farmers. Certain restrictions will be placed on the removal of water from the project delivery system network.

Based on the EAWCP and field reconnaissance of the project area, the NRCS project planning team has assumed that:

1. All cultivated cropland is irrigated.

2. All pumping plants, including individual wells and relifts, will be operated a maximum of 20 hours during a 24 hour day. This allows for system interruptions due to water availability, breakdown and for routine maintenance.

3. All on-farm storage reservoirs will be filled beginning January 1 and filling will be completed by April 30.

4. Land use data as reported to FSA is the most reliable source of information and will be utilized when available.

5. Peak import flow rates (Q's) for the delivery system will occur during the irrigation season.

6. Runoff captured by tailwater recovery systems will be used to supply crop demand and fill reservoirs.

7. All landowners and operators with cultivated land in the project area will use imported surface water from the delivery system.

8. The irrigation efficiency will be constant throughout the project area.

9. Commercial fish farming operations will utilize imported surface water.

10. Evaporation in excess of rainfall in all lakes and reservoirs, including fish ponds, is considered a demand.

11. Twenty five percent of the fish pond volume will be drained annually and refilling will occur during April.

12. Flooding land for winter waterfowl will occur during November and December.

13. Groundwater data is used to indicate the safe yield from the ground water resource.

14. Groundwater availability is distributed equally across all irrigated cropland.

15. Planting and harvesting dates of crops are constant throughout the project area.

16. Soil irrigation characteristics are constant throughout the project area.

17. Wheat and oats are not irrigated.

18. All wheat and oats are double cropped with late soybeans which are irrigated.

19. Existing reservoir volumes will be computed by measuring surface areas and estimating depths.

20. All existing reservoirs will be utilized throughout the life of the project.

21. Water will be made available to all tracts with cultivated cropland.

22. Farm base acreages will be allocated proportionally to the tract cropland acres.

23. FSA reported cropland acreages for 1994 will be used as the project cropland acres.

24. Cropland in excess of FSA base acres CRP or grass is considered to be planted with early soybeans.

25. New reservoirs will be constructed on soybean acreage when available. Additional area required will be taken from rice acreage.

26. All other land use will remain constant throughout the life of the project.

27. Peak flow rates computed in this phase of the project are for tract requirements only. Minimum stream flow requirements for seepage and evaporation losses, fish and wildlife needs, water quality, and storm capacities will be added to the computed flow rates during the hydraulic analysis.

28. The project boundaries are the Bayou Meto Improvement Project Area. The initial proposed boundaries will be determined by water needs and tract location.

29. Any tract adjacent to a segment of the delivery system is considered to be provided with a water source.

30. All tracts will be capable of capturing tailwater and runoff from the irrigated acres.

31. Water will be used according to the following priorities:
    1) runoff capture
    2) import water
    3) storage
    4) groundwater

32. Approximately 25% of the irrigation water requirements will be supplied from new or existing storage reservoirs in the north part of the project area; 10% in the south part.

SECTION G

DATA COLLECTION

LAND USE DATA

Land use data was obtained from FSA records, aerial photographs, USGS quadrangle maps, and field inspection. Farmers participating in the USDA Farm Programs report annual cropping history to the FSA. The cropping history is used to calculate crop "base" acreages on which farm subsidy payments are made.

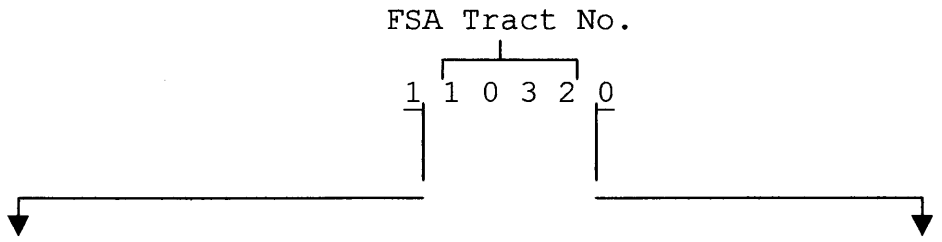
FSA has developed a tracking system for reporting cropping history which consists of a farm number and a tract number. The tract is the smallest designation on which FSA records are maintained and is a contiguous piece of property with single or group ownership. A farm may consist of a single tract or a group of tracts. Base acreage were computed on a farm basis.

Tract boundaries are outlined on FSA aerial photographs with the assistance of landowners and farmers. Each tract in a county is assigned a unique number by FSA personnel. This parcel of ground retains this tract designation permanently unless the tract is split due to the transfer of ownership. If a tract is split, the parts are assigned new unique numbers and the boundaries are outlined on the aerial photographs. Old tract numbers are not reused. Parcels of land not in the FSA farm programs were assigned tract numbers beginning at 5000 by NRCS personnel.

NRCS personnel worked closely with FSA personnel to obtain the necessary records for tracts located within the proposed project boundary. Land use information was not available from FSA on property not enrolled in the USDA farm programs. Land use for these parcels was obtained from aerial photographs, USGS quadrangle maps, field observation, and NRCS records.

The NRCS study team developed a six digit tract numbering system which is consistent with the FSA tract numbering system with a few modifications. The FSA tract number consists of a maximum of four digits. An example tract number is 1032 in Arkansas county. Since the project area covers parts of four counties it was necessary to add a one digit county identifier to the front of the tract number. The county identifier numbers are: Arkansas County - 1, Lonoke County - 2, Prairie County - 3, Jefferson County - 4 and Pulaski County 5. In addition, because some tracts are very large land areas and require division in order to adequately deliver water to the tract, a one digit division identifier was

added to the end of the FSA tract number. A zero division identifier indicates the tract was not split. Any other digit indicates the tract was split and each part was assigned a division identifier from one through nine. Thus, if tract number 1032 in Arkansas county was not split the project tract number would become 110320. If the tract was split into two sections the project tract numbers would be 110321 and 110322. Figure 4 shows a graphic explanation of the project tract number.



County Code No. Identifier No.
1 - Arkansas
2 - Lonoke
3 - Prairie
4 - Jefferson
5 - Pulaski

Assignment No.
0-4 -FSA No.
5- NRCS No.

Division
O-Tract is not split
1-9 -Tract is split

FIGURE 4

The tract boundaries and the four digit FSA tract numbers were manually transferred from the FSA aerial photos to the Corps of Engineers aerial photos. The Corps of Engineers utilized these photos to digitize the tract boundaries into a Geographic Information System (GIS) which was utilized in the planning of the project. The tract boundaries and numbers were also transferred to USGS quadrangle maps which were utilized in the planning and layout of the delivery system network. Land use data is included in the data base file with categories listed and defined in Appendix E.

EXISTING STORAGE DATA

Existing water bodies were identified from a visual survey of the Corps of Engineers aerial photographs and surface areas were computed by the use of a planimeter. The average depth and current use of each water body was determined by NRCS personnel using NRCS records, personal knowledge, and landowner or farmer interviews. Existing storage data is included in the data base file with categories listed and defined in Appendix E.

CLIMATIC DATA

Climatic data was obtained from the National Oceanic and Atmospheric Administration (NOAA) and the Corps of Engineers for the Stuttgart reporting station for the period of record 1965 through 1998. A copy of the raw data is included in Appendix B.

SOIL DATA

A review of the General Soil Map indicated that the primary soil type for the "25%" part of project area is the Crowley-Stuttgart-Grenada Association which consists of poorly drained to moderately well drained, level to gently sloping, loamy soils that formed in windblown silts overlying old alluvium on upland flats and low ridges. The primary soil types for the "10%" part of project area are the Perry-Portland and Hebert-Rilla associations. The Perry-Portland Association consists of poorly drained and somewhat poorly drained, level, clayey soils on bottom lands of the Arkansas River. The Hebert-Rilla Association consists of somewhat poorly drained to well drained, level and nearly level , loamy soils on bottom lands of the Arkansas River. While these soils vary to some degree, they are similar enough in farming and irrigation characteristics (texture, available water capacity, and the existence of a compact subsoil) that no distinctions of soil type were made for planning purposes.

PLANTING AND HARVEST DATES

Typical planting and harvest dates for the primary crops grown in the project area were provided by the Natural Resources Conservation Service state agronomist. This data was utilized in the water budget and consumptive use computations. A copy of his report is included in Appendix D.

SECTION H

DELIVERY SYSTEM NETWORK

The delivery system for the project will consist of canals, streams and pipelines. Water from the Arkansas River will be pumped into a canal which begins near David D. Terry Lock and Dam No. 6 and extends east to near Carlisle and south to near Altheimer. Water will be released or pumped into other canals, streams, and pipelines along the entire length of the primary canal. Gravity flow will be used whenever possible to deliver water. Water will be controlled by a system of weirs and gates throughout the delivery system network.

The NRCS planning team used preliminary studies, aerial photography, USGS quadrangle maps, and field observations to plan the layout of the delivery network. The delivery system was planned to supply water to all tracts with irrigated land within the project area. It would be anticipated that additional analysis would result in some alignment changes, but would not result in significant impacts to the project.

The planning team developed a seven digit delivery system numbering system which aids in the location of individual components and allows automated analysis of the system. The numbering system consists of four digits to the left of the decimal point and three digits to the right of the decimal point. Trailing zeros to the right of the decimal point are dropped to save time and space. Four digit numbers indicate that this segment of the delivery system is a canal or stream while six or seven digit numbers indicate that this segment is a pipeline.

The primary canal is divided into six sections designated by even 1000 series numbers beginning with 1000 at the pumping plant and continuing through 4000 north of Lonoke. (See Figure 5)

The first lateral channel downstream from the pumping plant along canal 1000 is numbered 1100. The second lateral channel along canal 1000 is numbered 1200. The sequence continues until approximately five lateral channels have been designated. At this point the primary delivery canal is assigned number 2000. The same sequence continues as the first lateral channel downstream along canal 2000 is numbered 2100.

In similar fashion, the first lateral channel downstream along canal 2100 is numbered 2110 and the first channel along canal 2110

is numbered 2111. Each subdivision is limited to nine laterals due to the limitations of the numbering system.

All pipelines are designated by a six or seven digit number. The four digits to the left of the decimal point indicate the source channel and the digits to the right of the decimal point indicate the location along the channel. In order to account for many pipelines along a channel, the first two digits to the right of the decimal point are utilized to indicate its location along the channel. Thus, the first pipeline downstream along channel 2111 is numbered 2111.01. The third digit to the right of the decimal point is reserved for lateral pipelines along the main pipeline. Pipeline 2111.011 is the first lateral pipeline along pipeline 2111.01. Figure 7 shows a example schematic of the numbering system.

Each delivery system component is divided into segments. A segment is that part of the canal, stream or pipeline from one delivery system discharge point to the next delivery system discharge point. That is from a lateral top the next lateral. The lateral may be a canal, stream, or pipeline.

All canals, streams and pipelines have a segment numbering system in which segments are numbered consecutively beginning at the source canal, stream, or pipeline with segment one and continuing downstream. See Figure 8 for a schematic showing an example of the segment numbering system.

BAYOU METO DELIVERY SYSTEM
MAIN CHANNELS

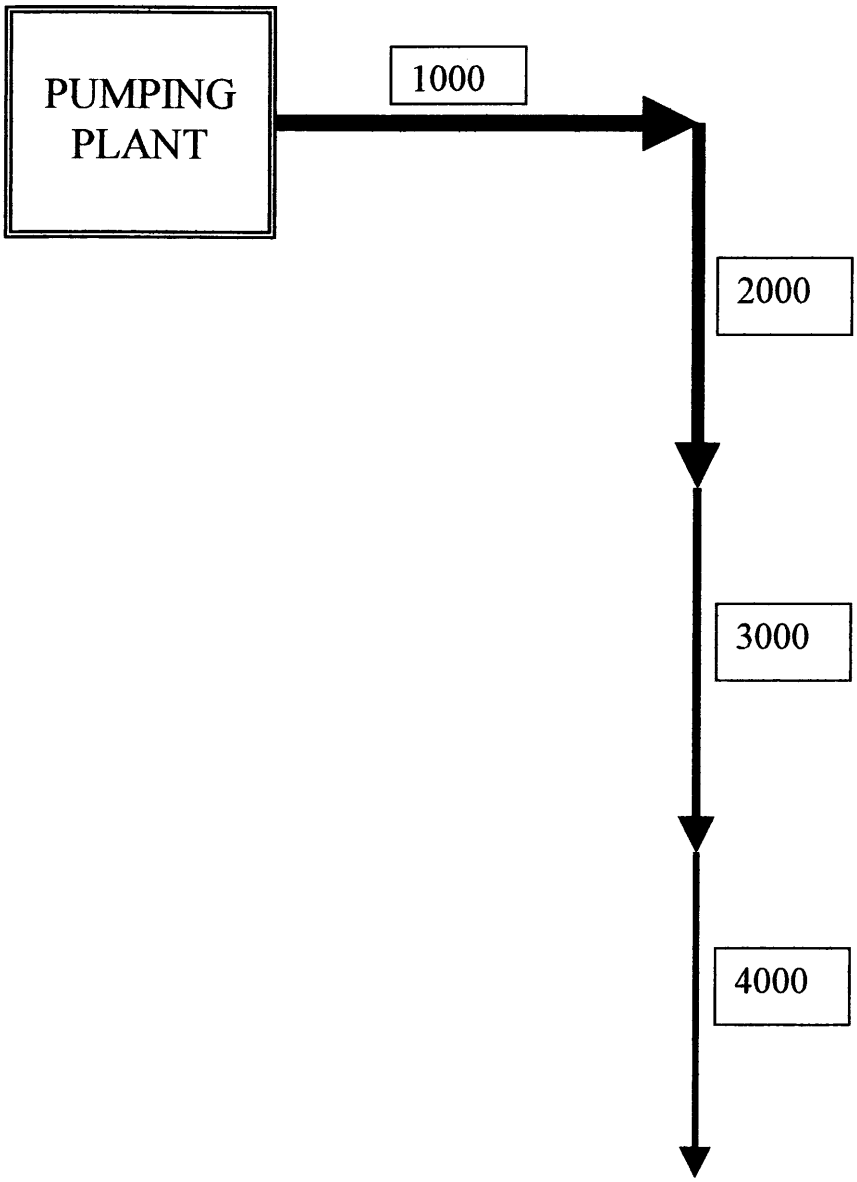


Figure 5

BAYOU METO DELIVERY SYSTEM
MAINS AND LATERALS

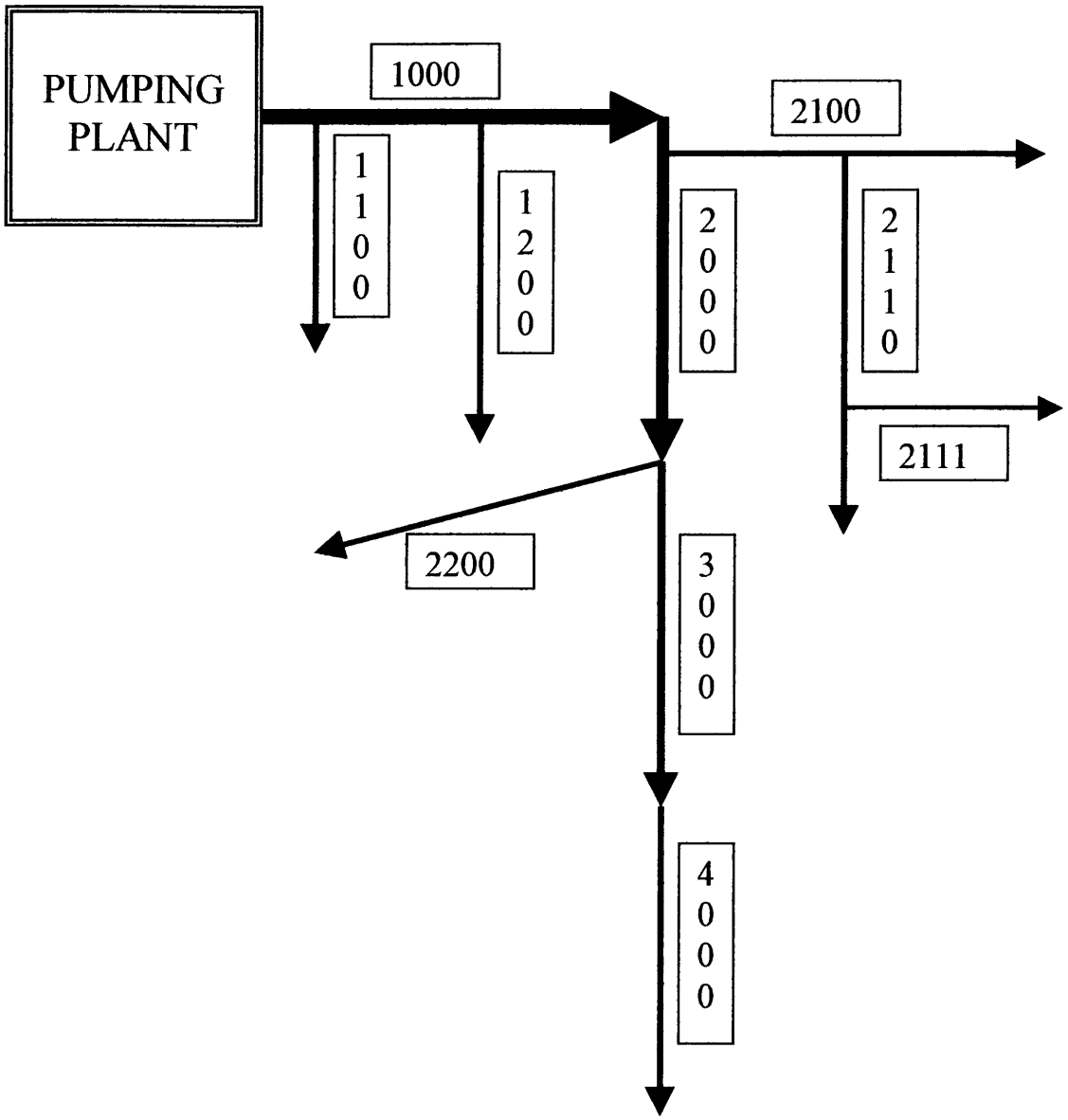


Figure 6

BAYOU METO DELIVERY SYSTEM
MAINS, LATERALS, AND PIPELINES

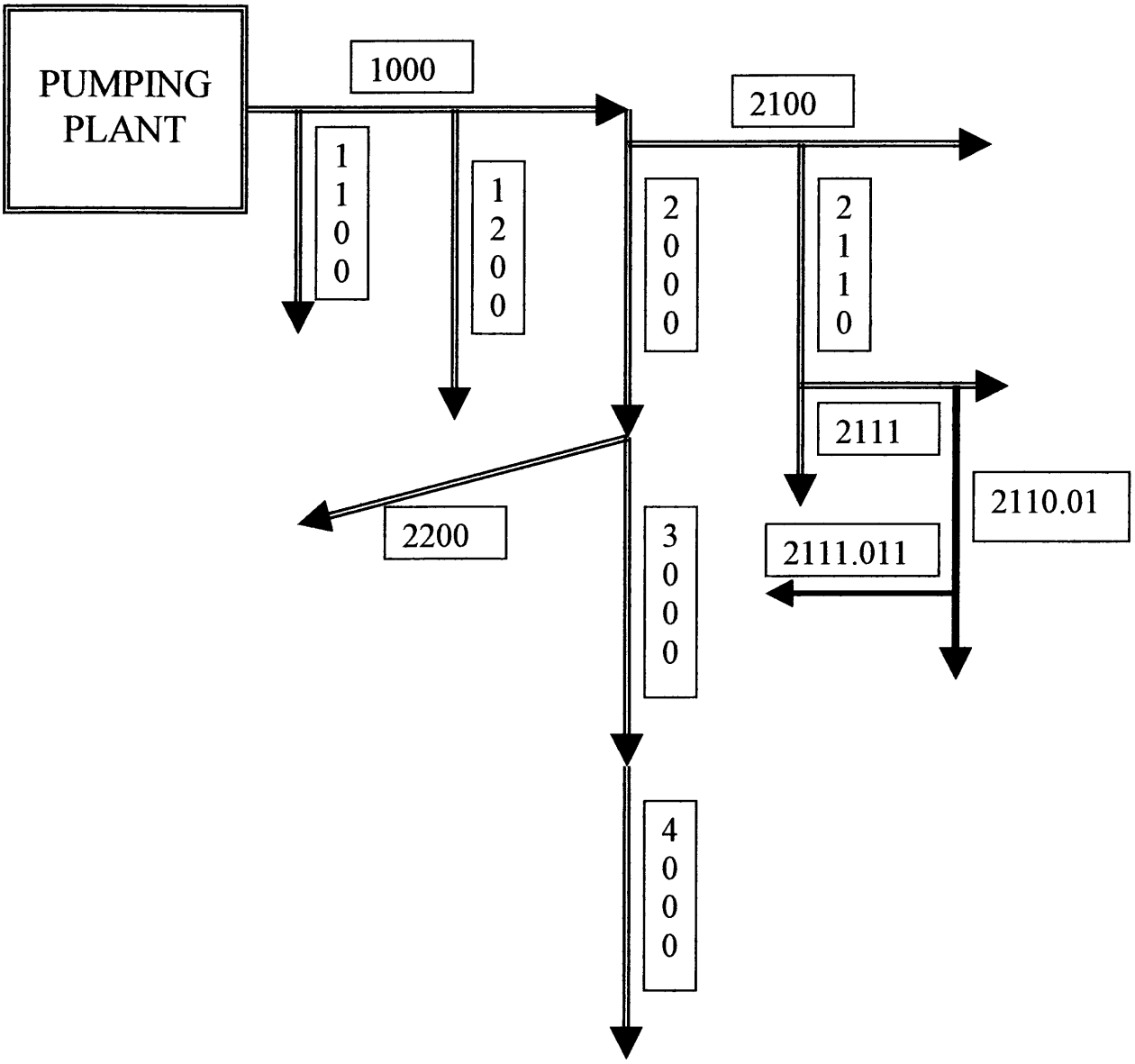


Figure 7

BAYOU METO DELIVERY SYSTEM
SEGMENTS

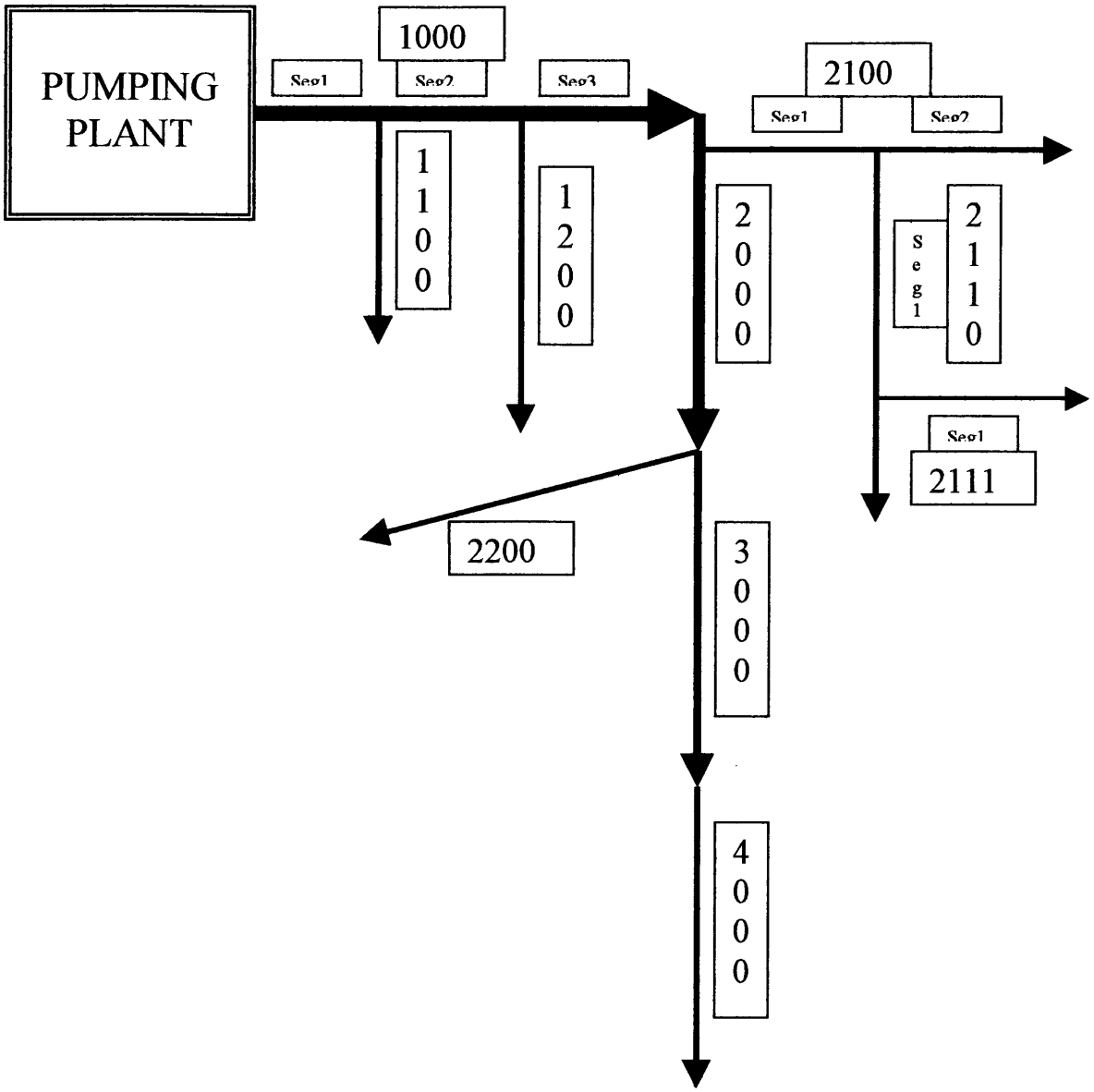


Figure 8

SECTION I

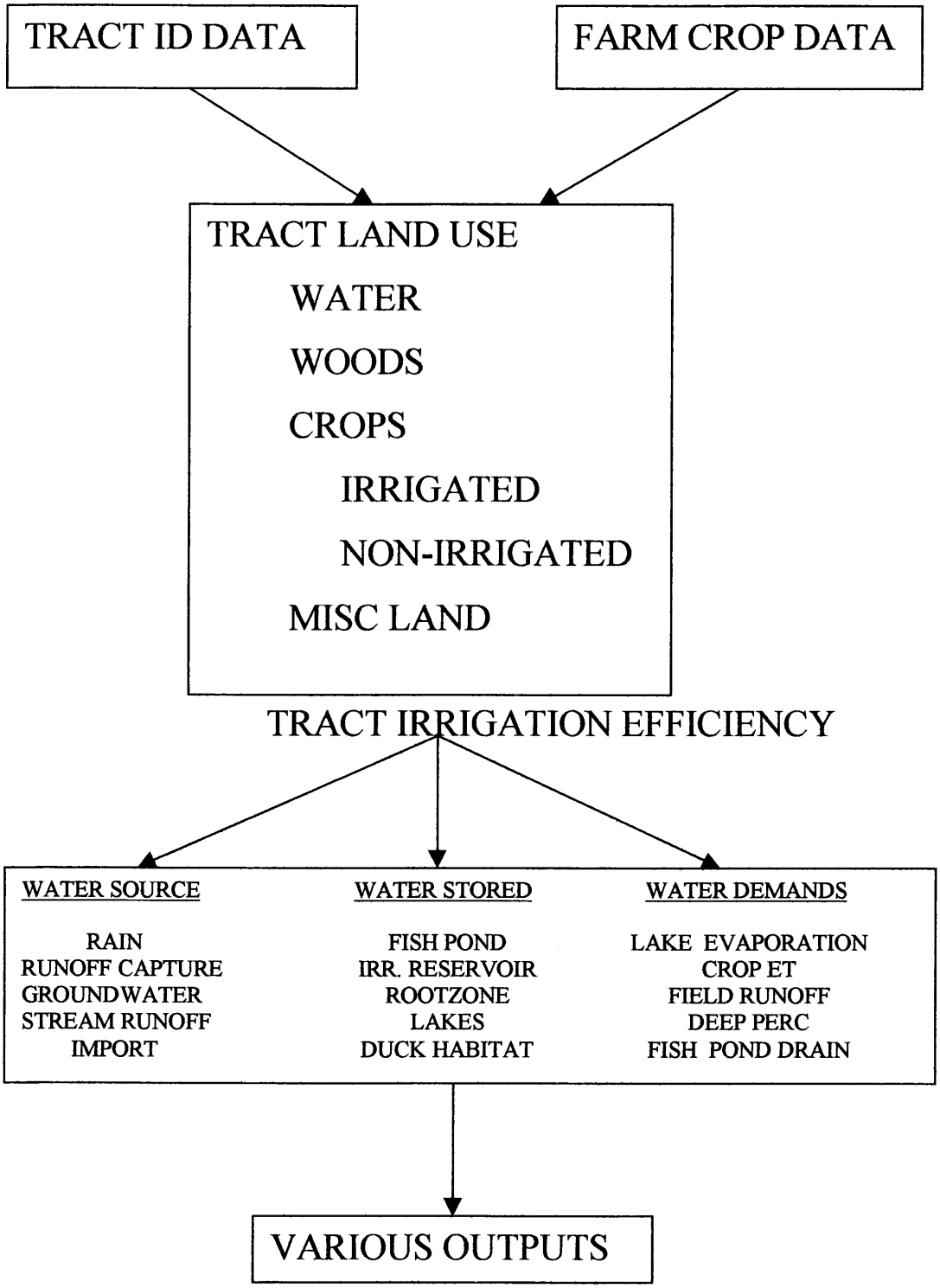
COMPUTER MODELS

In order to determine water needs for each tract with in the project, several existing computer models were used in conjunction with several newly developed models.

Crop irrigation water requirements were determined using a NRCS program called CONUSE. This is a computational program based on the modified Blaney-Criddle method for determining consumptive use for various crops under varying climatic conditions. The specific method is contained in SCS Technical Release No.21, "Irrigation Water Requirements" (SCS 1970). This procedure is a widely accepted method for determining plant water use in the humid southern United States.

CONUSE was run for each of the major crops grown in the project area using the following parameters:

NRCS WATER BUDGET FLOW CHART



The primary crops produced in the project area are: rice, soybeans, grain sorghum, corn, wheat, and oats.

1. Soybean acreages were divided into two categories. Early soybeans which are typically planted early in the growing season and require the entire growing season to produce acceptable yields. Late soybeans are typically planted following the harvest of wheat or oats in a double crop rotation.

2. Rainfall and temperature data was based on monthly totals for a 69 year period of record from 1930 through 1998 at the Stuttgart, AR reporting station. (See Appendix B)

3. Soil moisture holding capacities and irrigation characteristics were considered uniform throughout the project area. Typical soils in the Bayou Meto basin are silt loams near the surface with a hardpan located 12 to 24 inches below the surface.

4. Crop planting and harvest dates were considered the same throughout the project area and were obtained from the NRCS State Agronomist as per East Arkansas Planting Guides.

The CONUSE computer program and normal year climatic data were used to compute the monthly consumptive use and net irrigation requirement for the major crops produced in the project area. The results were used in the NRCS water budget program to compute individual tract water needs. These computations were later revised to 10 day values at the request of the Corps of Engineers due to low river flows during the peak irrigation period.

In order to predict future (with project) groundwater availability, groundwater model output data was used. In order to duplicate, as nearly as possible, current trends in irrigated agriculture in the Bayou Meto Basin, the model runs were selected which were limited by a minimum aquifer saturated thickness of 50% of the original saturated thickness. The resulting groundwater availability values were used as an input table for use in the NRCS water budget model.

A comprehensive monthly water budget program developed by NRCS was used to integrate land use, water demands, existing on-farm storage, planned storage, potential tailwater (runoff) capture, groundwater availability, and import needs for each tract of cultivated land in the project area.

A simple explanation of this model is that water demand, existing water supplies, and potential water supplies are compared on a 10 day basis in order to determine (1) total import needs (acre-feet) and (2) peak delivery capacity (cubic feet per second) that is required for each tract under project conditions. The input data of the water budget program is a database of information which includes land use and existing water storage for all tracts in the project.

Land Use

In order to determine specific land use on a tract, a computational procedure was followed that assumes crops will be grown on each tract according to the same ratio as FSA crop base acres for the entire farm. For example, a farm may consist of several tracts as explained in the data assembly section of this report. However, FSA base acres are established on a total farm basis. Rice acreage, for example, is determined on the tract as being the farm rice base divided by the farm cropland times the tract cropland. The same procedure is followed for each of the other base crops. Soybeans is not a base crop, therefore, it is computed as the remaining cropland after all other summer crops are subtracted out. The wheat and oat base acreage was used to establish late season (double crop) soybeans. Fish pond acreage was determined by map measurements and is considered a crop with water requirements.

Other water bodies in the data base were identified by map measurement and include fish and wildlife lakes, treatment lagoons and irrigation reservoirs. The average depth of each reservoir was estimated in order to compute existing storage available for irrigation. If a reservoir serves more than one tract, an estimated portion of the stored water was assigned to each tract served.

Irrigation Efficiencies

An important aspect of determining water needed per tract is the efficiency of delivering and applying water to the crops being irrigated. Irrigation application efficiency is defined as the amount of applied water that benefits the crop divided by the total amount of water applied. It is an indicator of the water loss due to levee seepage, evaporation, deep percolation and tailwater runoff. Based on irrigation studies conducted in eastern Arkansas since 1984 as part of the EAWCP, the average existing efficiency of water application was estimated to be uniform throughout the project area at 60 percent.

Potential improvements in water application efficiencies will be made possible as part of the overall project by installing water conservation practices and utilizing water management techniques. Conservation analysis on typical cells and comparison of benefits and costs have shown that an improvement of about 10 percent can realistically be achieved. Therefore, the potential (with project) demands were based on a project wide 70 percent efficiency in water applications.

Water Demands

Existing monthly crop water needs is computed using the results of the CONUSE (crop irrigation requirements) program along with the specific crop acres as previously determined for each tract. Tract water needs, other than crop requirements, are also computed as part of the total tract water demands per 10 day period. This includes evaporation losses from irrigation reservoirs, fish ponds and other water bodies. The off-season (non-cropping season) water demands for such items as reservoirs filling and flooding for waterfowl habitat is also computed as part of the total yearly water demands.

Both existing and future (with project) water demands are computed from the same base land use data. The assumptions used to adjust existing to future water demands are as follows:

1) All planned irrigation reservoirs, set as a target requirement for with-project conditions, will be constructed on predominately on cropland, thus reducing irrigated acreage.

2) The priority of cropland reduction for reservoir construction will be full season soybeans, late soybeans, and rice.

3) Only very minor changes in woodland acreage will occur.

4) There will be no increase in cropland acres or crop distribution changes in the project area.

5) Under project conditions, there will be an estimated increase in winter waterfowl habitat due to flooding 10 percent of the cropland not previously flooded. The volume of water required to flood for waterfowl is estimated at an average depth of 6 inches over the area flooded. The months

of November and December are assumed to be the months when habitat flooding occurs.

Existing and future (with project) total water demands per tract were calculated on a 10 day basis and summed in two separate demand tables, the results of which are used in the tract water budget calculations.

The net changes in water demands due to the project are:

1. In-season demand decreases due to new reservoir construction on previously irrigated land.

2. Off-season demand increases due to winter waterfowl flooding.

Water Supply

The next step employed in the water budget model is to calculate potential water demands.

Groundwater

In order to reduce groundwater withdrawal to sustainable levels, a limit or fixed value of available groundwater was used in the with project (potential) water supply computations. The value used for each tract is derived from the location of each tract with the available groundwater being that predicted in groundwater modeling studies.

Runoff Capture

The potential runoff capture is based on the irrigated acres and was computed as a percentage of the monthly runoff. (See Appendix C) .Runoff capture is considered available for meeting both in-season and off-season demands.

Storage

Storage available for irrigation is based on the target parameters established as 25 percent of the demand for the north part of the project area and 10% for the south part. This includes existing storage, storage available from reservoirs on other tracts (off-tract) and planned reservoirs on the tract being considered. Adjustments are made when existing storage and/or off-tract water

exceeds 25 percent or 10% of the demand, depending on which part of the project area the tract is in. This water is considered available throughout the cropping season on an as-needed and as-available basis, after other surface water sources fail to meet the monthly demands.

Import Water

Import water (stream diversion) will be used to fulfill monthly demands after considering all other supply sources according to the target parameters established for the project. The total volume of import water is computed as the reduced demand after conservation improvements, less tailwater capture, less available storage, less target level groundwater. In order to determine the monthly volumes of import while minimizing the flow capacities, a three step water budget process is used.

Approximate 10 day import rates are estimated in the **first step** using the hypothesis that the import curve during the cropping season will follow a trapezoidal shape.

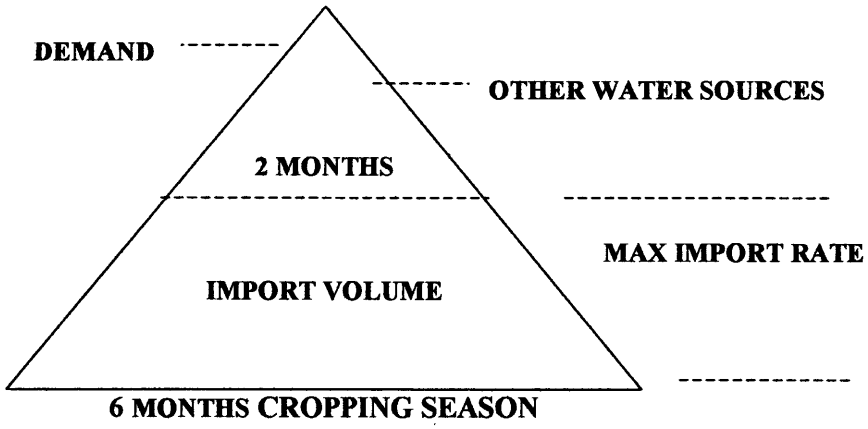


FIGURE 11

The **second step** is to use the approximate 10 day import rates along with runoff capture, storage, and groundwater to compute a monthly water budget distribution. For these calculations storage is considered available from May through December (January to April are refill months). Groundwater is not considered available until June which is the month when other water sources normally run short. The bottom line of these calculations is an adjusted import need per 10 day period computed as the approximate values used above, plus any unmet demands for each period after all sources are exhausted.

The **third step** in minimizing import capacities is a final 10 day water budget computation setting the priority of water use as that which will normally be used by most water users in the project. Tailwater capture will be the first water used to meet demands.

Import water will be utilized next until it no longer fulfills the need. Storage will then be used until exhausted and finally groundwater will be pumped to complete the requirements for meeting water demands. Import values used during the cropping season in this step is limited to a value computed as the average of the 10 day import values for June, July, and August computed in the second step iteration.

Results

The NRCS water budget model results are compiled in output data files. An example printout of this file is included in Appendix F.

SECTION J

CONCLUSIONS

The analysis of the project in this phase of the work indicates a peak import water requirement of approximately 963 cubic feet per second (without losses) which would be withdrawn from the Arkansas River near David D. Terry Lock and Dam No. 6. This would protect the groundwater resource, provide for fish and wildlife habitat enhancement and allow the continued irrigation of approximately 267,982 acres of cultivated cropland.

Water demand would be reduced by increased efficiencies due to improved management practices and the installation of conservation practices. Water would be supplied by a combination of on-farm surface runoff, on-farm storage reservoirs, imported surface water from the Arkansas River and groundwater.

These withdrawal rates were analyzed by the Corps of Engineers to determine the availability and reliability of Arkansas River as a source of water.

The project appears to be a viable project and warrants moving into the design and implementation phase of the project.

APPENDIX A

CROP CONSUMPTIVE USE TABLES

USDA

SOIL CONSERVATION SERVICE

MODIFIED BLANEY-CRIDDLE CONSUMPTIVE USE
using a- 1 -HUMID AREA ADJUSTMENT FACTOR

STATION USED- STUTTGART, AR LATITUDE- 34 DEGREES 30 MINUTES
BEGINING OR PLANTING DATE-MAR 15 ENDING OR HARVEST DATE-AUG 25 NET IRRIG APPLIC.= 2 IN.
CROP-CORN-grain--------GSC # 19

MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
MEAN TEMP	42.9	47.0	54.5	64.8	72.1	79.1	82.7	81.6	75.3	64.6	53.4	45.9	
MEAN PRECIP	3.63	3.49	4.92	6.46	4.99	3.53	2.88	3.21	3.91	2.68	4.05	5.61	47.36
INCHES/MO	0.00	0.00	0.77	2.85	6.16	8.71	9.17	4.97	0.00	0.00	0.00	0.00	
CUM INCHES	0.00	0.00	0.77	3.62	9.78	18.49	27.66	32.63	0.00	0.00	0.00	0.00	32.63
INCHES/DAY	0.00	0.00	0.05	0.10	0.20	0.29	0.30	0.20	0.00	0.00	0.00	0.00	

PEAK USE 0.36 (INCHES/DAY)

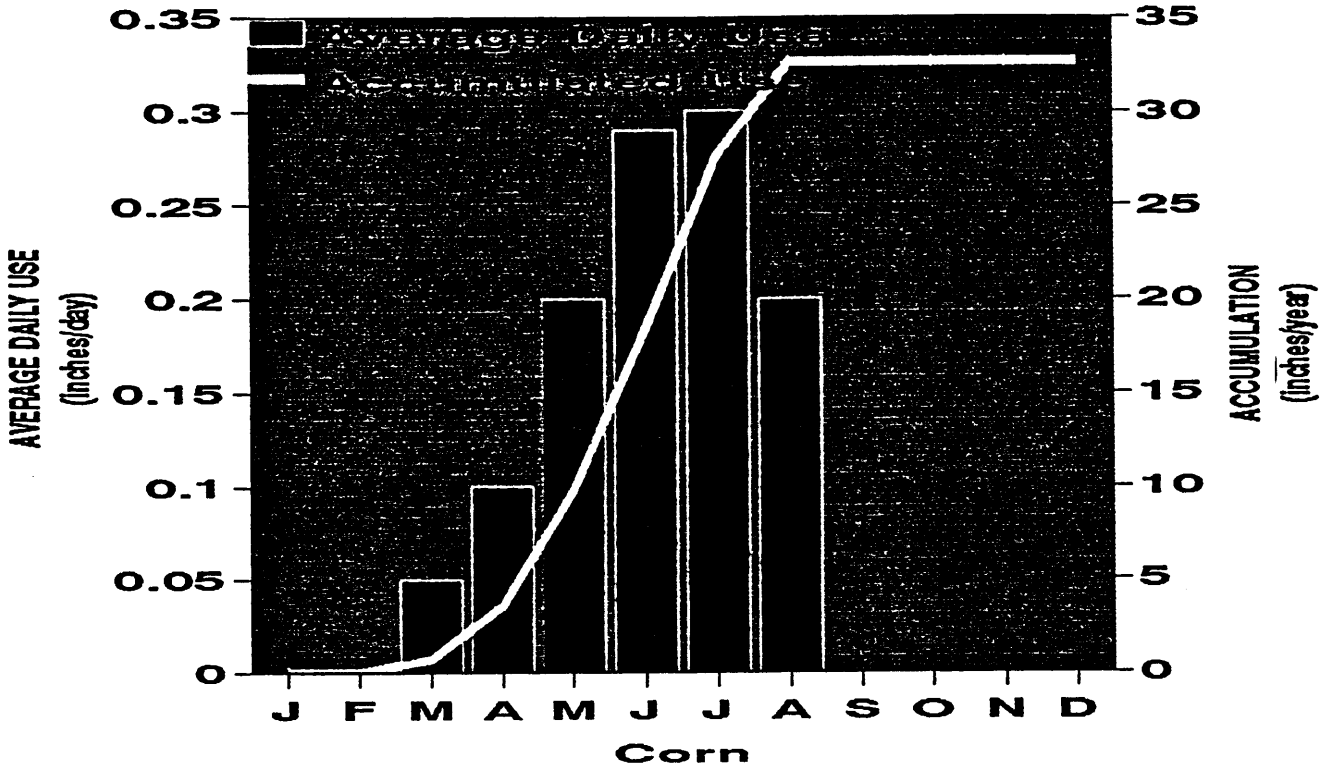
##########

(THE NET IRRIGATION REQUIREMENT IS COMPUTED LEAVING THE END OF SEASON SOIL MOISTURE AT 50% OF AVAILABLE WATERHOLDING CAPACITY-THE INITIAL SOIL MOISTURE OF 3.00 INCHES WAS 75% OF AVAILABLE CAPACITY OF 4.00 INCHES)

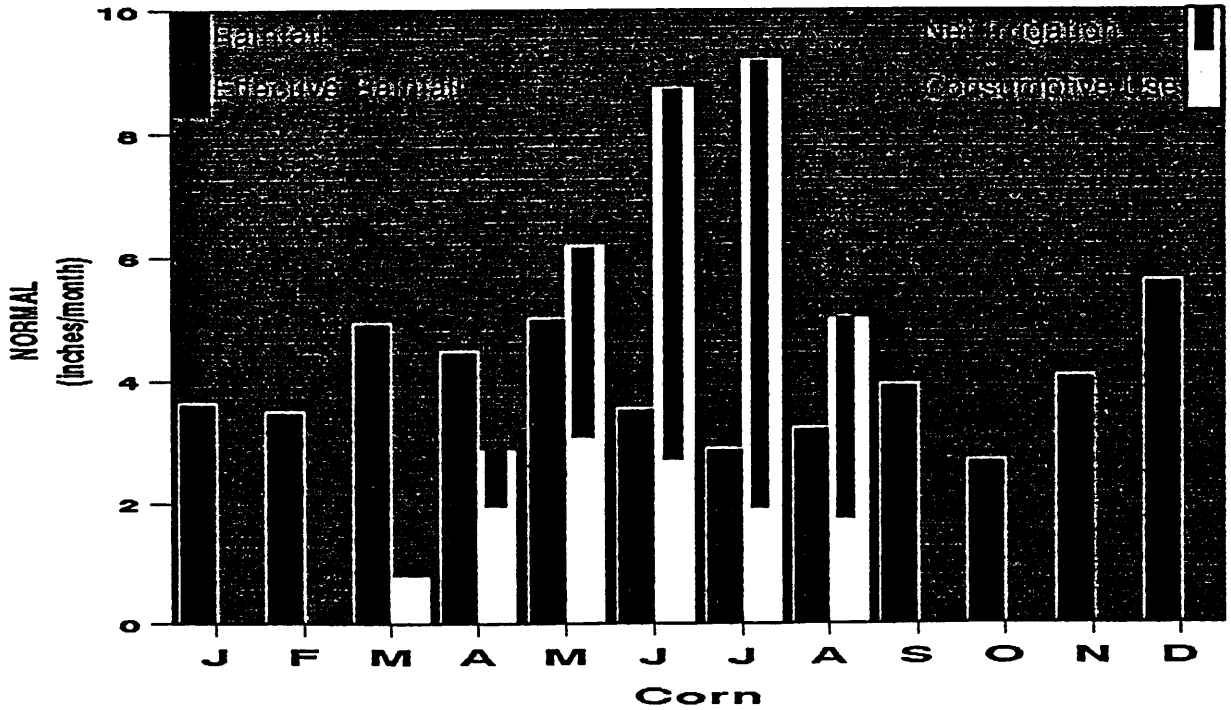
EFFECT RAIN	0.00	0.00	0.77	2.50	3.32	2.83	2.43	2.26	0.00	0.00	0.00	0.00	14.11
NET IRR REQ	0.00	0.00	0.00	0.35	2.84	5.88	6.74	1.71	0.00	0.00	0.00	0.00	17.52

##########

CONSUMPTIVE USE
Stuttgart, Arkansas



RAINFALL - NET IRRIGATION
Stuttgart, Arkansas



USDA

SOIL CONSERVATION SERVICE

MODIFIED BLANEY-CRIDDLE CONSUMPTIVE USE
using a- 1 -HUMID AREA ADJUSTMENT FACTOR

STATION USED- STUTTGART, AR LATITUDE- 34 DEGREES 30 MINUTES
BEGINING OR PLANTING DATE-MAR 20 ENDING OR HARVEST DATE-AUG 20 NET IRRIG APPLIC.= 2 IN.
CROP-SORGHUM ----------GSC # 45

MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
MEAN TEMP	42.9	47.0	54.5	64.8	72.1	79.1	82.7	81.6	75.3	64.6	53.4	45.9	
MEAN PRECIP	3.63	3.49	4.92	4.46	4.99	3.53	2.88	3.21	3.91	2.68	4.05	5.61	47.36
INCHES/MO	0.00	0.00	0.54	2.95	6.37	8.32	7.39	3.09	0.00	0.00	0.00	0.00	
CUM INCHES	0.00	0.00	0.54	3.49	9.87	18.19	25.58	28.67	0.00	0.00	0.00	0.00	28.67
INCHES/DAY	0.00	0.00	0.05	0.10	0.21	0.28	0.24	0.15	0.00	0.00	0.00	0.00	

PEAK USE 0.32 (INCHES/DAY)

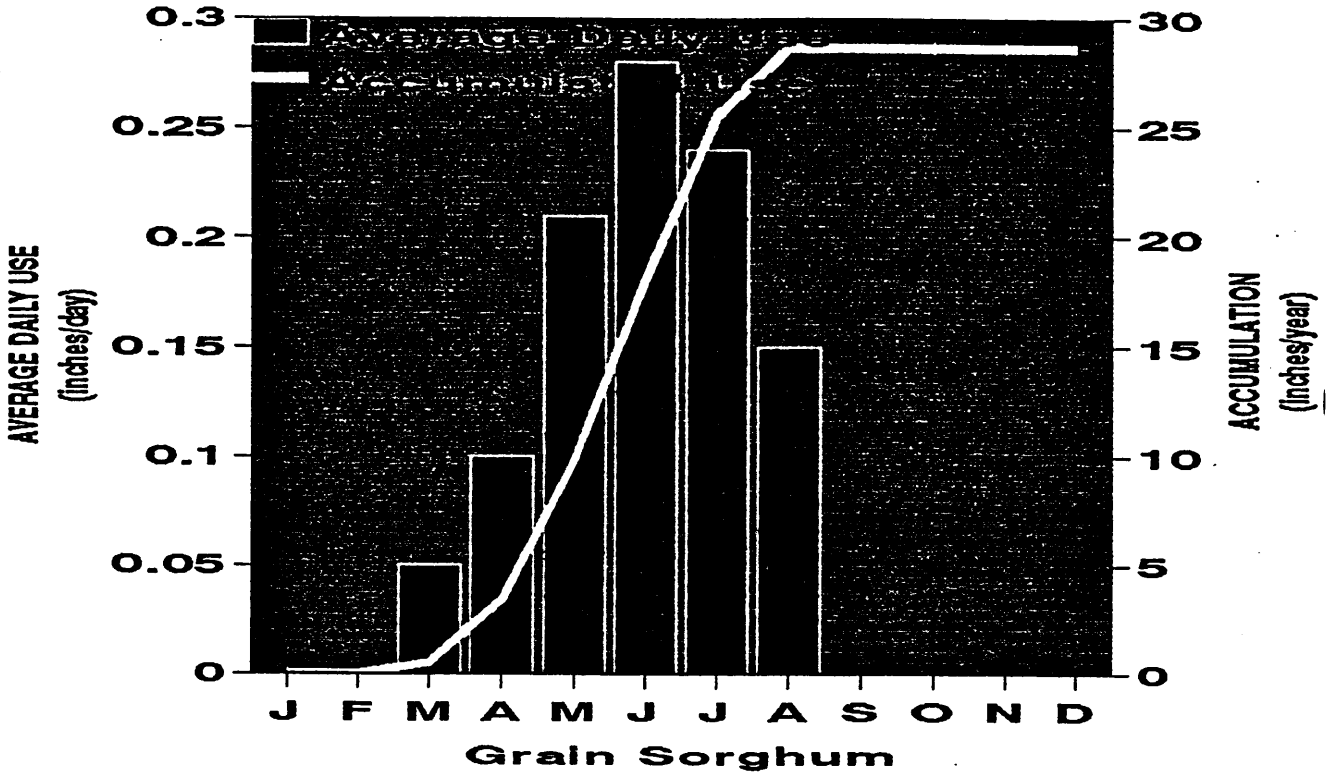
##########

(THE NET IRRIGATION REQUIREMENT IS COMPUTED LEAVING THE END OF SEASON SOIL MOISTURE AT 50% OF AVAILABLE WATERHOLDING CAPACITY-THE INITIAL SOIL MOISTURE OF 3.00 INCHES WAS 75% OF AVAILABLE CAPACITY OF 4.00 INCHES)

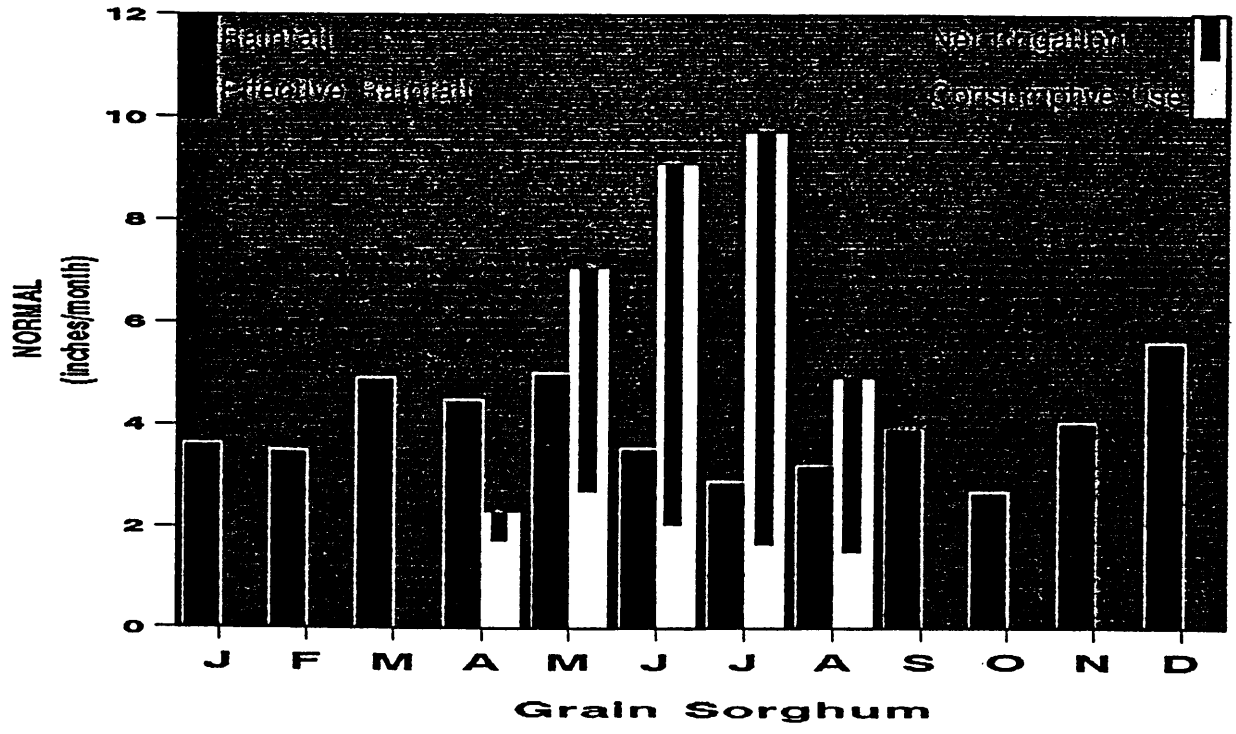
EFFECT RAIN	0.00	0.00	0.54	2.52	3.36	2.77	2.20	1.99	0.00	0.00	0.00	0.00	13.38
NET IRR REQ	0.00	0.00	0.00	0.43	3.02	5.55	5.19	0.10	0.00	0.00	0.00	0.00	14.28

##########

CONSUMPTIVE USE
Stuttgart, Arkansas



RAINFALL - NET IRRIGATION
Stuttgart, Arkansas



USDA

SOIL CONSERVATION SERVICE

MODIFIED BLANEY-CRIDDLE CONSUMPTIVE USE
using a- 1 -HUMID AREA ADJUSTMENT FACTOR

STATION USED- STUTTGART, AR LATITUDE- 34 DEGREES 30 MINUTES
BEGINING OR PLANTING DATE-MAY 15 ENDING OR HARVEST DATE-OCT 15 NET IRRIG APPLIC.= 2 IN.
CROP-SOYBEANS ---------GSC # 46

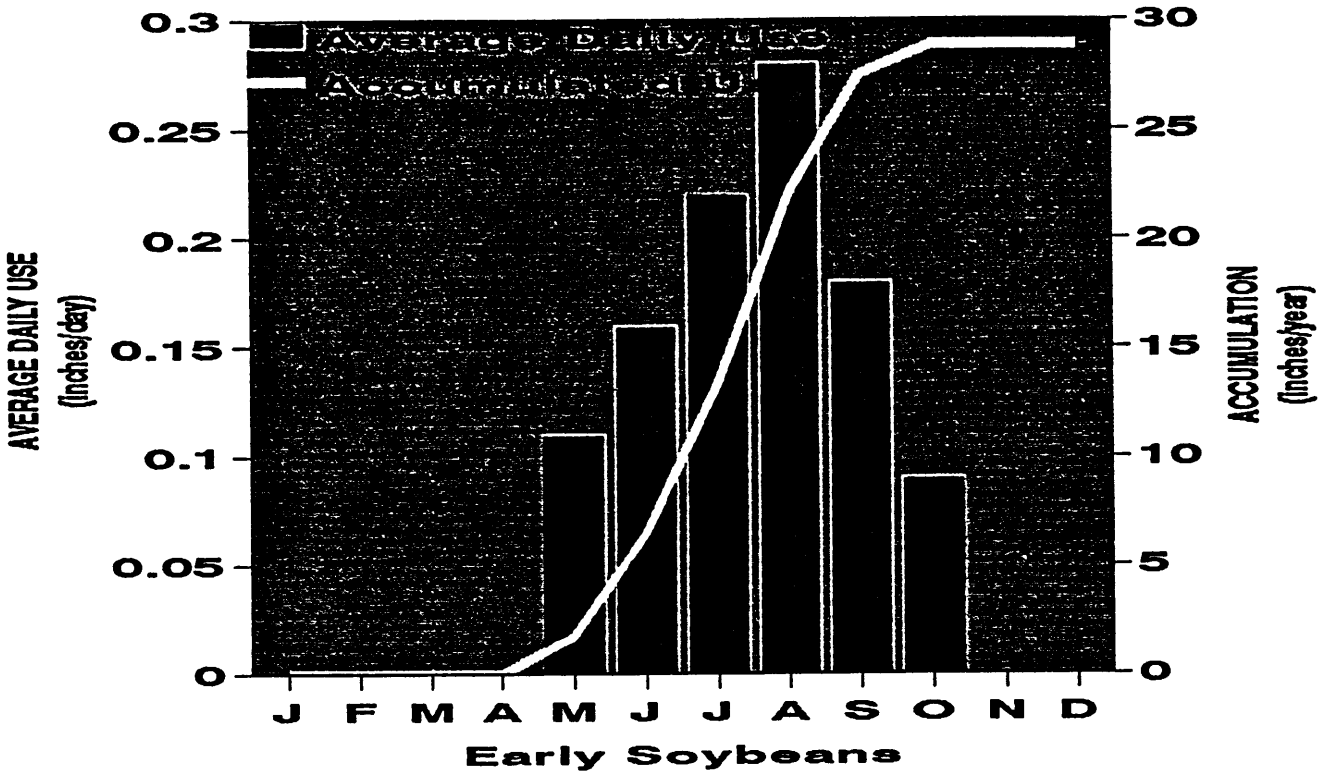
MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
MEAN TEMP	42.9	47.0	54.5	64.8	72.1	79.1	82.7	81.6	75.3	64.6	53.4	45.9	
MEAN PRECIP	3.63	3.49	4.92	4.46	4.99	3.53	2.88	3.21	3.91	2.68	4.05	5.61	47.36
INCHES/MO	0.00	0.00	0.00	0.00	1.74	4.73	6.93	8.70	5.38	1.37	0.00	0.00	
CUM INCHES	0.00	0.00	0.00	0.00	1.74	6.47	13.40	22.10	27.48	28.85	0.00	0.00	28.85
INCHES/DAY	0.00	0.00	0.00	0.00	0.11	0.16	0.22	0.28	0.18	0.09	0.00	0.00	

PEAK USE 0.34 (INCHES/DAY)

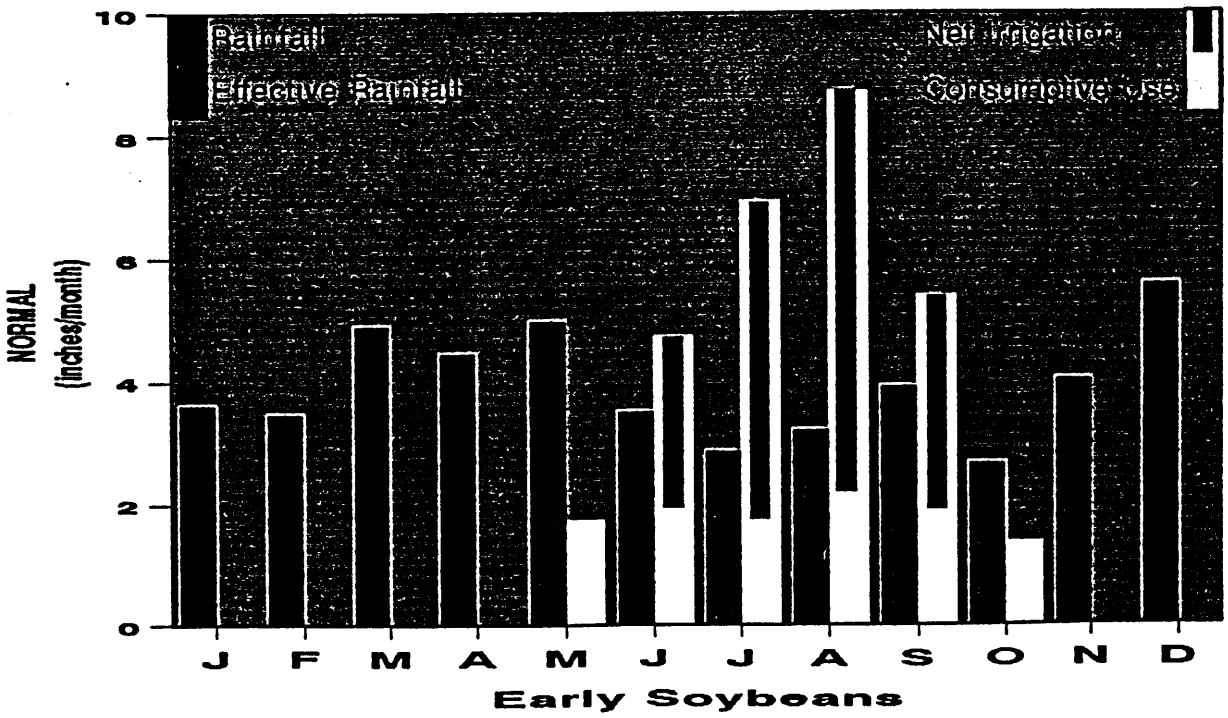
(THE NET IRRIGATION REQUIREMENT IS COMPUTED LEAVING THE END OF SEASON SOIL MOISTURE AT 50% OF AVAILABLE WATERHOLDING CAPACITY-THE INITIAL SOIL MOISTURE OF 3.00 INCHES WAS 75% OF AVAILABLE CAPACITY OF 4.00 INCHES)

EFFECT RAIN	0.00	0.00	0.00	0.00	1.74	2.27	2.15	2.61	2.57	1.37	0.00	0.00	12.70
NET IRR REQ	0.00	0.00	0.00	0.00	0.00	2.46	4.79	6.10	1.80	0.00	0.00	0.00	15.15

CONSUMPTIVE USE
Stuttgart, Arkansas



RAINFALL - NET IRRIGATION
Stuttgart, Arkansas



USDA

SOIL CONSERVATION SERVICE

MODIFIED BLANEY-CRIDDLE CONSUMPTIVE USE
using a- 1 -HUMID AREA ADJUSTMENT FACTOR

STATION USED- STUTTGART, AR LATITUDE- 34 DEGREES 30 MINUTES
BEGINING OR PLANTING DATE-JUNE 20 ENDING OR HARVEST DATE-NOV 1 NET IRRIG APPLIC.= 2 IN.
CROP-SOYBEANS ---------GSC # 46

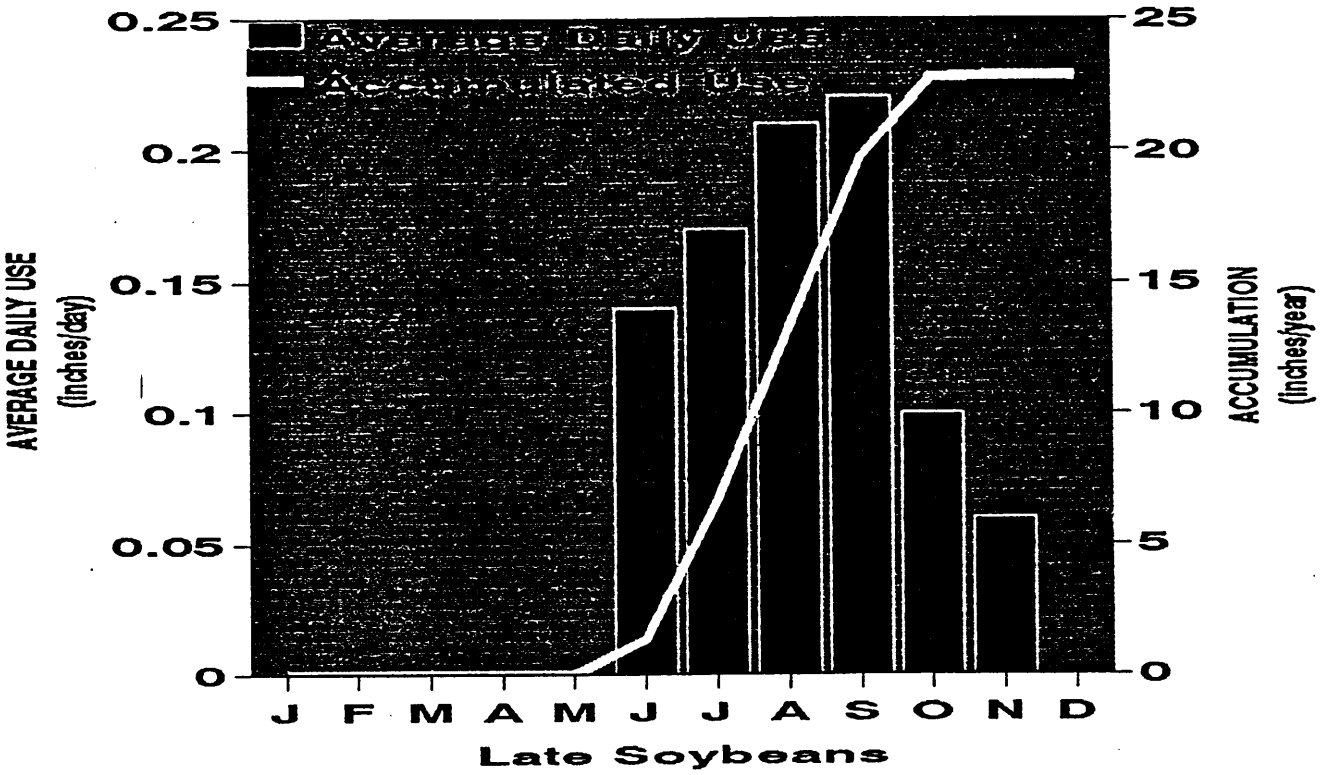
MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
MEAN TEMP	42.9	47.0	54.5	64.8	72.1	79.1	82.7	81.6	75.3	64.6	53.4	45.9	
MEAN PRECIP	3.63	3.49	4.92	4.46	4.99	3.53	2.88	3.21	3.91	2.68	4.05	5.61	47.36
INCHES/NO	0.00	0.00	0.00	0.00	0.00	1.38	5.28	6.59	6.47	3.07	0.06	0.00	
CUM INCHES	0.00	0.00	0.00	0.00	0.00	1.38	6.66	13.26	19.73	22.79	22.85	0.00	22.85
INCHES/DAY	0.00	0.00	0.00	0.00	0.00	0.14	0.17	0.21	0.22	0.10	0.06	0.00	

PEAK USE 0.25 (INCHES/DAY)

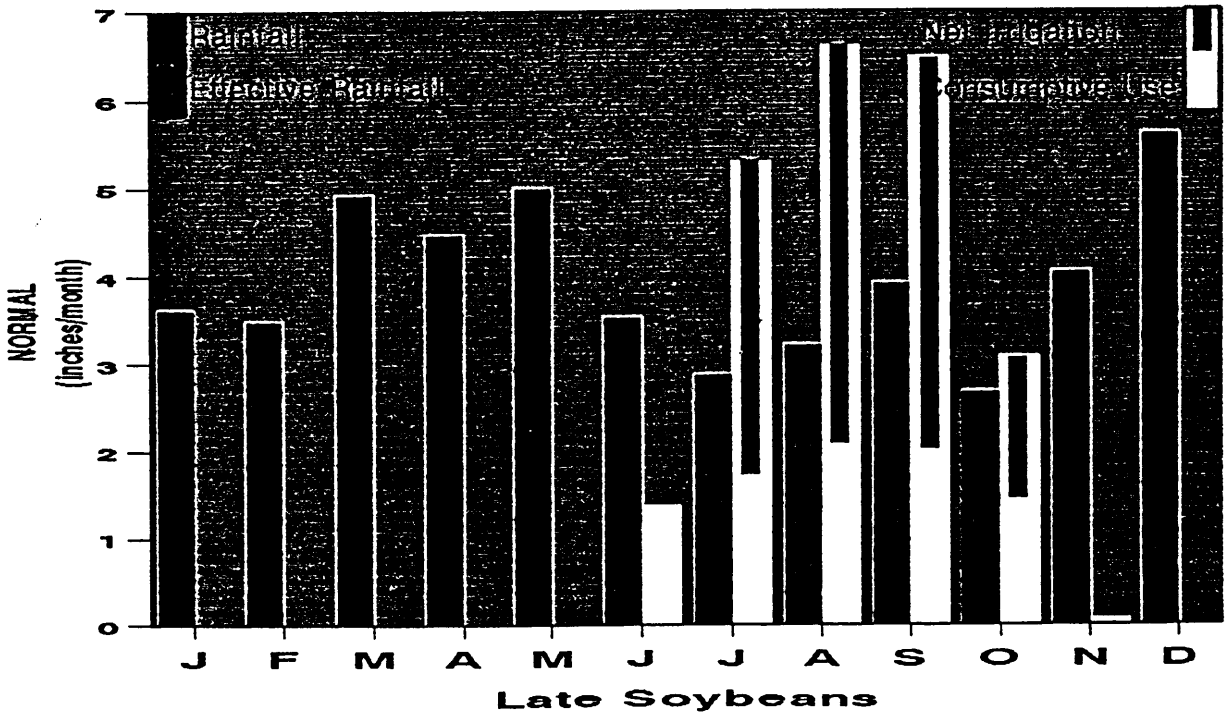
(THE NET IRRIGATION REQUIREMENT IS COMPUTED LEAVING THE END OF SEASON SOIL MOISTURE AT 50% OF AVAILABLE WATERHOLDING CAPACITY-THE INITIAL SOIL MOISTURE OF 3.00 INCHES WAS 75% OF AVAILABLE CAPACITY OF 4.00 INCHES)

EFFECT RAIN	0.00	0.00	0.00	0.00	0.00	1.38	1.96	2.32	2.73	1.62	0.06	0.00	10.07
NET IRR REQ	0.00	0.00	0.00	0.00	0.00	0.00	3.32	4.28	3.74	0.45	0.00	0.00	11.78

CONSUMPTIVE USE
Stuttgart, Arkansas



RAINFALL - NET IRRIGATION
Stuttgart, Arkansas



USDA

SOIL CONSERVATION SERVICE

MODIFIED BLANEY-CRIDDLE CONSUMPTIVE USE
using a- 1 -HUMID AREA ADJUSTMENT FACTOR

STATION USED- STUTTGART, AR LATITUDE- 34 DEGREES 30 MINUTES
BEGINING OR PLANTING DATE-JAN 1 ENDING OR HARVEST DATE-DEC 31 NET IRRIG APPLIC.= 2 IN.
CROP-SOD-grass --------GSC # 44

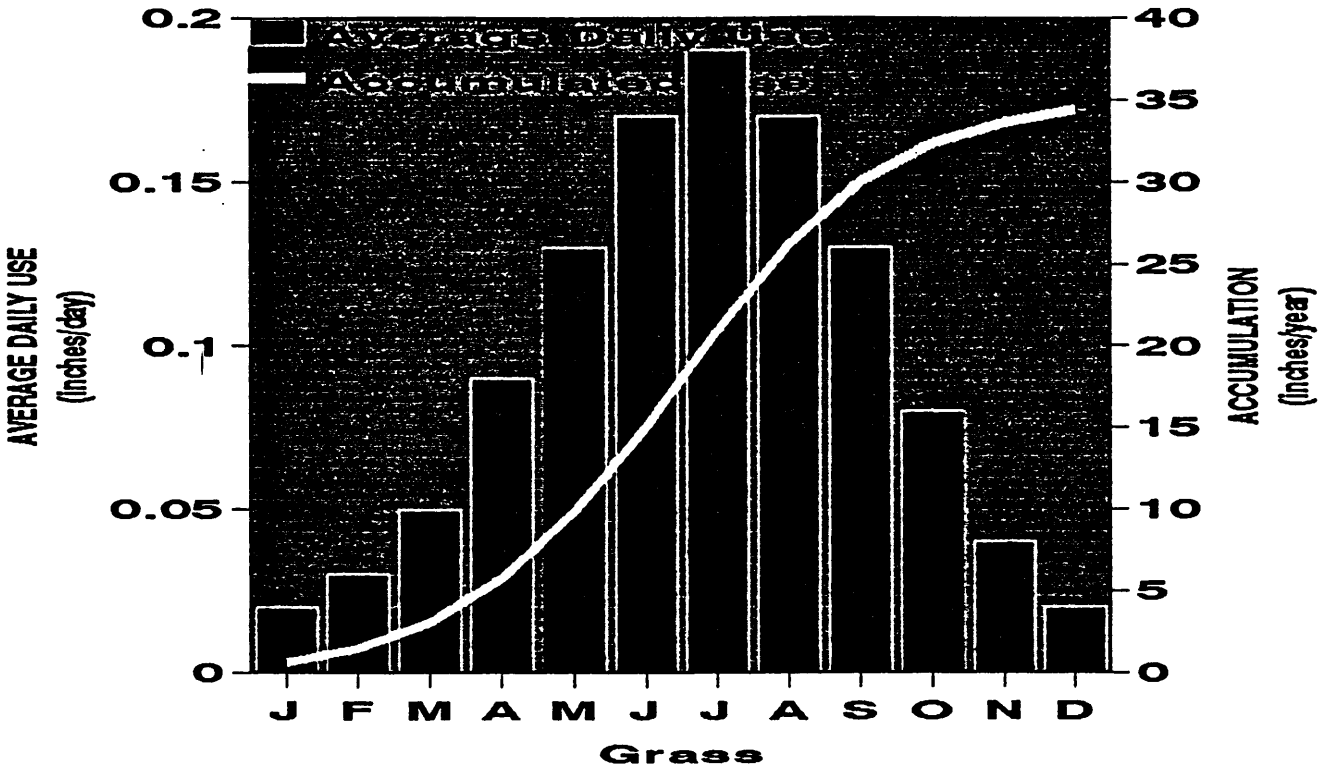
MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
MEAN TEMP	42.9	47.0	54.5	64.8	72.1	79.1	82.7	81.6	75.3	64.6	53.4	45.9	
MEAN PRECIP	3.63	3.49	4.92	4.46	4.99	3.53	2.88	3.21	3.91	2.68	4.05	5.61	47.36
INCHES/MO	0.67	0.86	1.58	2.73	4.07	5.20	5.88	5.23	3.78	2.39	1.25	0.76	
CUM INCHES	0.67	1.53	3.11	5.84	9.91	15.11	20.98	26.22	30.00	32.39	33.64	34.40	34.40
INCHES/DAY	0.02	0.03	0.05	0.09	0.13	0.17	0.19	0.17	0.13	0.08	0.04	0.02	

PEAK USE 0.22 (INCHES/DAY)

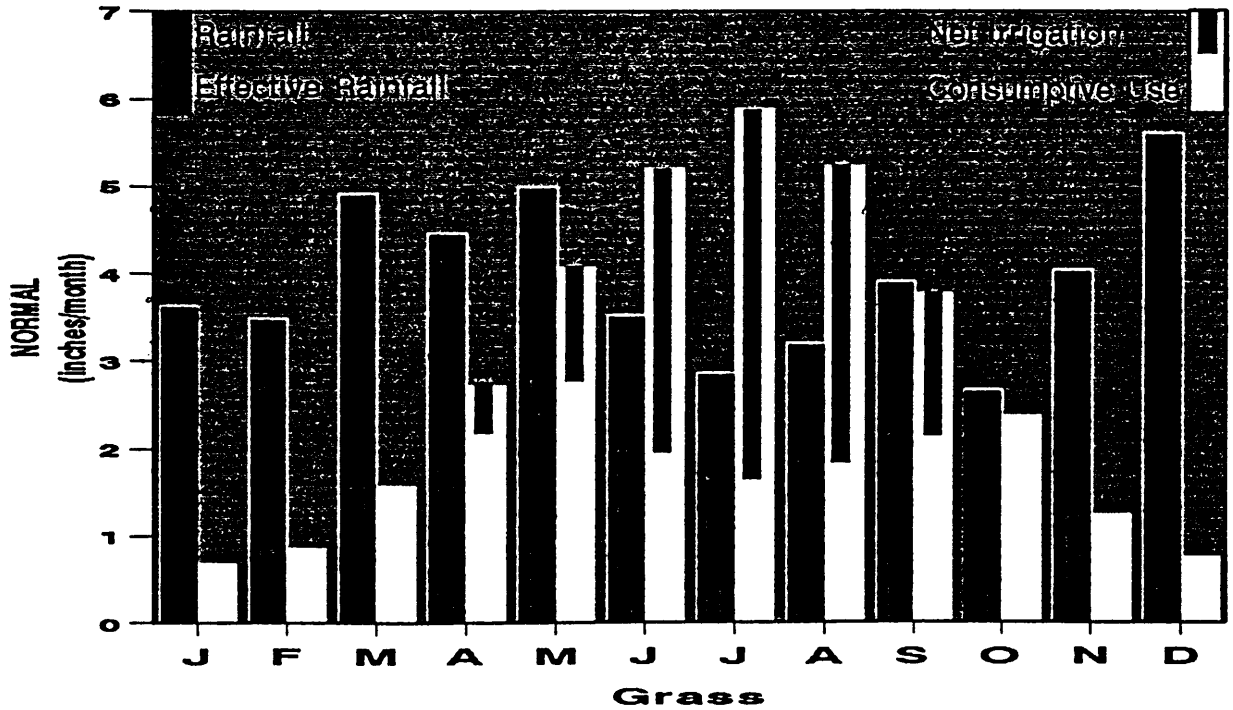
(THE NET IRRIGATION REQUIREMENT IS COMPUTED LEAVING THE END OF SEASON SOIL MOISTURE AT 50% OF AVAILABLE WATERHOLDING CAPACITY-THE INITIAL SOIL MOISTURE OF 3.00 INCHES WAS 75% OF AVAILABLE CAPACITY OF 4.00 INCHES)

EFFECT RAIN	0.67	0.86	1.58	2.49	2.95	2.33	2.02	2.15	2.35	1.56	1.25	0.76	20.98
NET IRR REQ	0.00	0.00	0.00	0.24	1.12	2.87	3.85	3.09	1.26	0.00	0.00	0.00	12.43

CONSUMPTIVE USE
Stuttgart, Arkansas



RAINFALL - NET IRRIGATION
Stuttgart, Arkansas



USDA

SOIL CONSERVATION SERVICE

MODIFIED BLANEY-CRIDDLE CONSUMPTIVE USE
using a- 1 -HUMID AREA ADJUSTMENT FACTOR

STATION USED- STUTTGART, AR LATITUDE- 34 DEGREES 30 MINUTES
BEGINING OR PLANTING DATE-APR 1 ENDING OR HARVEST DATE-AUG 20 NET IRRIG APPLIC.= .5 IN.
CROP-RICE ----------GSC # 43

MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
MEAN TEMP	42.9	47.0	54.5	64.8	72.1	79.1	82.7	81.6	75.3	64.6	53.4	45.9	
MEAN PRECIP	3.63	3.49	4.92	4.46	4.99	3.53	2.88	3.21	3.91	2.68	4.05	5.61	47.36
INCHES/MO	0.00	0.00	0.00	2.26	7.06	9.04	9.65	4.86	0.00	0.00	0.00	0.00	
CUM INCHES	0.00	0.00	0.00	2.26	9.32	18.36	28.01	32.87	0.00	0.00	0.00	0.00	32.87
INCHES/DAY	0.00	0.00	0.00	0.08	0.23	0.30	0.31	0.24	0.00	0.00	0.00	0.00	

PEAK USE 0.43 (INCHES/DAY)

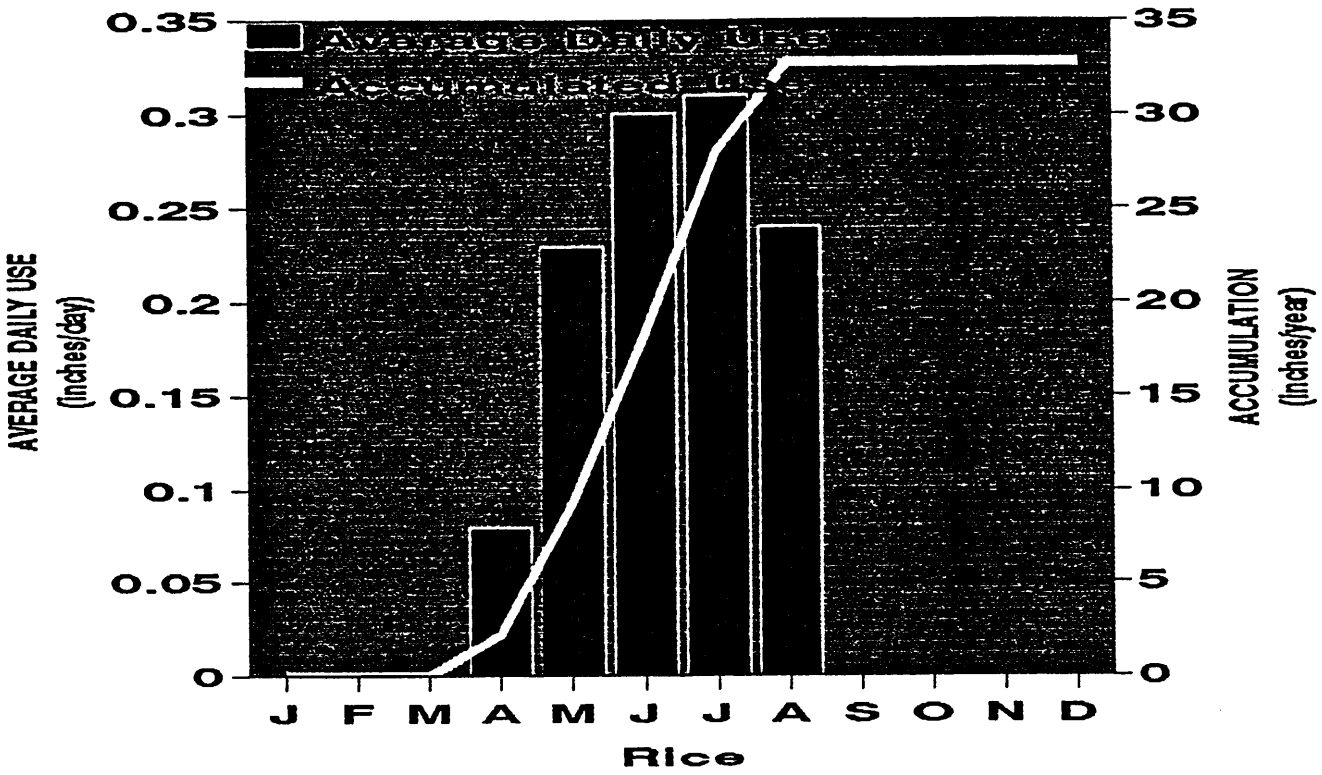
(THE NET IRRIGATION REQUIREMENT IS COMPUTED LEAVING THE END OF SEASON SOIL MOISTURE AT 50% OF AVAILABLE WATERHOLDING CAPACITY-THE INITIAL SOIL MOISTURE OF 3.00 INCHES WAS 75% OF AVAILABLE CAPACITY OF 4.00 INCHES)

EFFECT RAIN	0.00	0.00	0.00	1.83	2.52	2.08	1.80	1.59	0.00	0.00	0.00	0.00	9.82
NET IRR REQ	0.00	0.00	0.00	0.43	4.54	6.96	7.84	2.27	0.00	0.00	0.00	0.00	22.05

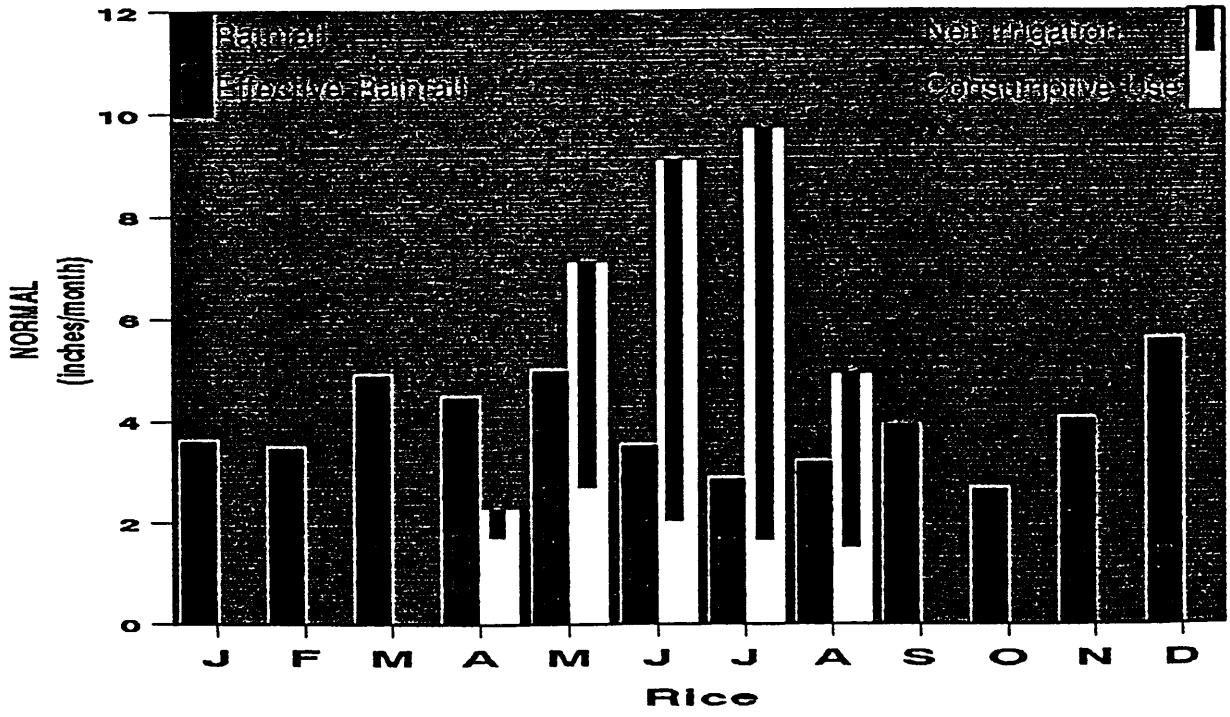
$$Q_{RICE} = \left(\frac{.43\ in}{DAY}\right)\left(\frac{FT}{12\ in}\right)\left(43{,}560\ FT^2/Ac\right)\left(\frac{7.48\ GAL}{FT^3}\right)\left(\frac{DAY}{20\ HRS}\right)\left(\frac{HR}{60\ MIN}\right)\left(\frac{1}{.70\ EFF}\right)$$

$$\approx 13.9\ GPM/Ac\ (PEAK)$$

CONSUMPTIVE USE
Stuttgart, Arkansas



RAINFALL - NET IRRIGATION
Stuttgart, Arkansas



APPENDIX B

CLIMATIC DATA

RAINFALL DATA 1965 TO 1981

Avg year run

day	Month	avg/day	10dy avg	30dy avg
1	Jan 1	0.08		
2		0.14		
3		0.20		
4		0.17		
5		0.04		
6		0.15		
7		0.16		
8		0.05		
9		0.15		
10		0.28	1.41	
11		0.25		
12		0.06		
13		0.01		
14		0.16		
15		0.00		
16		0.06		
17		0.10		
18		0.04		
19		0.04		
20		0.27	1.00	
21		0.21		
22		0.10		
23		0.15		
24		0.19		
25		0.12		
26		0.09		
27		0.10		
28		0.12		
29		0.03		
30		0.13	1.22	3.63
31		0.06		
32	Feb 1	0.25		
33		0.22		
34		0.08		
35		0.04		
36		0.06		
37		0.09		
38		0.06		
39		0.15		
40		0.14	1.15	
41		0.42		
42		0.15		
43		0.17		
44		0.15		
45		0.01		
46		0.12		
47		0.15		
48		0.01		
49		0.09		
50		0.05	1.33	
51		0.12		
52		0.08		
53		0.20		
54		0.18		

Select Year to run DRY YEAR 1969

day	Month	daily	10 day	30 day
1	Jan 1	0.00		
2		0.00		
3		0.10		
4		TRACE		
5		0.00		
6		0.00		
7		0.00		
8		TRACE		
9		0.00		
10		0.00	0.10	
11		0.00		
12		0.00		
13		0.00		
14		0.00		
15		0.00		
16		TRACE		
17		0.37		
18		0.31		
19		0.02		
20		TRACE	0.70	
21		TRACE		
22		0.15		
23		0.13		
24		0.00		
25		0.00		
26		0.00		
27		0.06		
28		0.02		
29		0.12		
30		1.64	2.12	2.92
31		0.39		
32	Feb 1	1.13		
33		1.30		
34		TRACE		
35		0.00		
36		0.00		
37		0.22		
38		0.00		
39		0.11		
40		0.00	3.15	
41		0.00		
42		0.00		
43		0.00		
44		0.00		
45		0.00		
46		0.82		
47		0.22		
48		0.03		
49		0.00		
50		0.00	1.07	
51		0.00		
52		0.01		
53		0.67		
54		0.01		

Day	Month	Avg/day	Avg/10day	Avg/30day	Day	Month	Daily	Avg10day	Avg30day
55		0.09			55		0.00		
56		0.11			56		0.00		
57		0.02			57		0.00		
58		0.04			58		0.00		
59		0.08			59		0.01		
60		0.09	1.01	3.49	60			0.70	4.92
61	March 1	0.11			61	March 1	0.00		
62		0.08			62		0.00		
63		0.19			63		0.00		
64		0.29			64		0.00		
65		0.07			65		0.00		
66		0.11			66		0.39		
67		0.11			67		0.01		
68		0.13			68		0.04		
69		0.08			69		TRACE		
70		0.20	1.37		70		0.00	0.44	
71		0.11			71		0.00		
72		0.46			72		0.00		
73		0.21			73		0.00		
74		0.10			74		0.00		
75		0.03			75		0.00		
76		0.17			76		0.00		
77		0.27			77		0.00		
78		0.08			78		0.54		
79		0.05			79		0.07		
80		0.07	1.56		80		0.00	0.61	
81		0.31			81		0.00		
82		0.13			82		0.00		
83		0.12			83		0.27		
84		0.24			84		1.94		
85		0.21			85		0.00		
86		0.21			86		0.00		
87		0.07			87		0.00		
88		0.21			88		0.00		
89		0.27			89		0.18		
90		0.22	1.99	4.92	90		0.04	2.43	3.48
91		0.12			91		TRACE		
92	April 1	0.01			92	April 1	0.00		
93		0.28			93		0.00		
94		0.10			94		0.00		
95		0.17			95		0.00		
96		0.04			96		0.30		
97		0.00			97		0.01		
98		0.02			98		0.00		
99		0.05			99		0.00		
100		0.10	0.89		100		TRACE	0.31	
101		0.06			101		0.88		
102		0.10			102		0.00		
103		0.21			103		0.00		
104		0.12			104		0.14		
105		0.20			105		0.45		
106		0.00			106		0.00		
107		0.10			107		0.00		

Day	Month	Avg/day	Avg/10day	Avg/30day	Day	Month	Daily	Avg10day	Avg30day
108		0.11			108		0.00		
109		0.24			109		0.42		
110		0.12	1.27		110		TRACE	1.89	
111		0.29			111		0.00		
112		0.28			112		0.00		
113		0.07			113		0.00		
114		0.57			114		0.00		
115		0.24			115		0.00		
116		0.24			116		0.00		
117		0.36			117		0.00		
118		0.11			118		0.00		
119		0.06			119		0.60		
120		0.10	2.30	4.46	120		0.00	0.60	2.80
121		0.09			121		0.00		
122	May 1	0.35			122	May 1	0.00		
123		0.26			123		0.00		
124		0.23			124		0.00		
125		0.30			125		0.00		
126		0.09			126		0.35		
127		0.21			127		TRACE		
128		0.20			128		TRACE		
129		0.03			129		0.05		
130		0.13	1.89		130		0.58	0.98	
131		0.13			131		0.00		
132		0.08			132		0.00		
133		0.21			133		0.00		
134		0.22			134		0.02		
135		0.36			135		0.00		
136		0.33			136		0.00		
137		0.15			137		0.00		
138		0.28			138		0.00		
139		0.13			139		0.90		
140		0.02	1.90		140		0.26	1.18	
141		0.14			141		0.00		
142		0.03			142		0.00		
143		0.20			143		0.00		
144		0.09			144		0.00		
145		0.03			145		0.04		
146		0.08			146		0.03		
147		0.19			147		0.00		
148		0.17			148		0.00		
149		0.09			149		0.00		
150		0.17	1.20	4.99	150		0.00	0.07	2.23
151		0.10			151		0.06		
152		0.06			152		0.00		
153	June 1	0.35			153	June 1	0.00		
154		0.30			154		0.57		
155		0.28			155		0.00		
156		0.08			156		TRACE		
157		0.03			157		0.00		
158		0.17			158		0.00		
159		0.30			159		0.00		
160		0.11	1.78		160		0.00	0.63	

Day	Month	Avg/day	Avg/10day	Avg/30day	Day	Month	Daily	Avg10day	Avg30day
161		0.05			161		0.00		
162		0.19			162		0.83		
163		0.00			163		0.00		
164		0.04			164		0.00		
165		0.01			165		0.00		
166		0.07			166		0.17		
167		0.14			167		0.00		
168		0.13			168		0.00		
169		0.07			169		0.00		
170		0.05	0.74		170		0.00	1.00	
171		0.18			171		0.01		
172		0.10			172		0.00		
173		0.07			173		0.05		
174		0.15			174		0.95		
175		0.02			175		0.00		
176		0.09			176		0.33		
177		0.12			177		0.00		
178		0.12			178		0.00		
179		0.05			179		0.00		
180		0.12	1.01	3.53	180		0.00	1.34	2.97
181		0.08			181		0.00		
182		0.19			182		0.68		
183	July 1	0.06			183	July 1	0.00		
184		0.18			184		0.00		
185		0.07			185		0.28		
186		0.05			186		0.00		
187		0.05			187		0.00		
188		0.01			188		0.00		
189		0.04			189		0.00		
190		0.11	0.84		190		0.00	0.96	
191		0.15			191		0.00		
192		0.27			192		0.00		
193		0.10			193		0.00		
194		0.06			194		0.00		
195		0.04			195		0.00		
196		0.00			196		0.00		
197		0.02			197		0.00		
198		0.13			198		0.00		
199		0.11			199		0.00		
200		0.01	0.91		200		0.00	0.00	
201		0.03			201		0.00		
202		0.08			202		0.00		
203		0.08			203		0.00		
204		0.02			204		0.00		
205		0.04			205		0.15		
206		0.14			206		0.03		
207		0.11			207		0.68		
208		0.38			208		0.00		
209		0.06			209		0.06		
210		0.19	1.13	2.88	210		0.82	1.74	2.70
211		0.24			211		0.00		
212		0.26			212		0.00		
213		0.04			213		0.00		

Day	Month	Avg/day	Avg/10day	Avg/30day	Day	Month	Daily	Avg10day	Avg30day
214	Aug 1	0.05			214	Aug 1	0.00		
215		0.16			215		0.00		
216		0.26			216		0.00		
217		0.06			217		0.00		
218		0.04			218		0.00		
219		0.02			219		0.00		
220		0.08	1.23		220		0.00	0.00	
221		0.14			221		0.00		
222		0.01			222		0.00		
223		0.39			223		0.00		
224		0.11			224		0.00		
225		0.05			225		0.00		
226		0.03			226		0.00		
227		0.14			227		0.00		
228		0.01			228		0.00		
229		0.06			229		TRACE		
230		0.21	1.14		230		2.55	2.55	
231		0.14			231		0.44		
232		0.08			232		0.67		
233		0.01			233		0.00		
234		0.01			234		0.00		
235		0.13			235		0.30		
236		0.35			236		0.00		
237		0.05			237		0.00		
238		0.04			238		0.00		
239		0.01			239		0.00		
240		0.03	0.85	3.21	240		0.00	1.41	3.96
241		0.00			241		0.00		
242		0.23			242		0.00		
243		0.14			243		0.00		
244		0.10			244		0.00		
245	Sept 1	0.07			245	Sept 1	TRACE		
246		0.11			246		0.00		
247		0.14			247		0.04		
248		0.10			248		0.68		
249		0.14			249		0.03		
250		0.11	1.15		250		0.00	0.75	
251		0.14			251		0.00		
252		0.05			252		0.00		
253		0.15			253		0.00		
254		0.01			254		0.00		
255		0.35			255		0.00		
256		0.12			256		0.00		
257		0.05			257		0.00		
258		0.33			258		0.00		
259		0.35			259		0.00		
260		0.19	1.74		260		0.00	0.00	
261		0.16			261		0.00		
262		0.10			262		0.00		
263		0.08			263		0.00		
264		0.06			264		0.03		
265		0.25			265		TRACE		
266		0.06			266		TRACE		

Day	Month	Avg/day	Avg/10day	Avg/30day	Day	Month	Daily	Avg10day	Avg30day
267		0.11			267		0.00		
268		0.07			268		TRACE		
269		0.08			269		0.00		
270		0.05	1.02	3.91	270		0.00	0.03	0.78
271		0.05			271		0.00		
272		0.21			272		0.00		
273		0.16			273		0.00		
274		0.10			274		0.00		
275	Oct 1	0.07			275	Oct 1	0.00		
276		0.00			276		0.00		
277		0.01			277		0.00		
278		0.05			278		0.00		
279		0.07			279		0.00		
280		0.16	0.88		280		0.00	0.00	
281		0.06			281		0.79		
282		0.17			282		0.00		
283		0.06			283		0.00		
284		0.02			284		0.00		
285		0.00			285		TRACE		
286		0.07			286		0.00		
287		0.09			287		0.15		
288		0.16			288		0.05		
289		0.15			289		0.00		
290		0.09	0.86		290		0.00	0.99	
291		0.06			291		0.00		
292		0.26			292		0.00		
293		0.05			293		0.00		
294		0.04			294		0.00		
295		0.00			295		0.00		
296		0.04			296		0.00		
297		0.14			297		0.00		
298		0.05			298		0.00		
299		0.21			299		0.00		
300		0.07	0.94	2.68	300		0.01	0.01	1.00
301		0.19			301		TRACE		
302		0.07			302		0.00		
303		0.18			303		0.00		
304		0.09			304		0.01		
305		0.25			305		0.66		
306	Nov 1	0.04			306	Nov 1	0.02		
307		0.20			307		0.00		
308		0.11			308		0.07		
309		0.08			309		0.04		
310		0.12	1.32		310		0.00	0.80	
311		0.00			311		0.00		
312		0.38			312		0.00		
313		0.04			313		0.01		
314		0.12			314		0.00		
315		0.09			315		0.00		
316		0.09			316		0.00		
317		0.03			317		0.22		
318		0.04			318		0.00		
319		0.15			319		0.00		

Day	Month	Avg/day	Avg/10day	Avg/30day	Day	Month	Daily	Avg10day	Avg30day
320		0.15	1.09		320		0.00	0.23	
321		0.17			321		0.00		
322		0.23			322		0.36		
323		0.21			323		2.18		
324		0.29			324		1.13		
325		0.06			325		0.00		
326		0.16			326		0.00		
327		0.21			327		0.00		
328		0.12			328		0.00		
329		0.08			329		0.00		
330		0.12	1.65	4.05	330		0.00	3.67	4.70
331		0.11			331		0.00		
332		0.27			332		TRACE		
333		0.23			333		0.15		
334		0.17			334		0.00		
335		0.20			335		0.00		
336	Dec 1	0.08			336	Dec 1	0.00		
337		0.09			337		0.00		
338		0.16			338		0.00		
339		0.26			339		0.00		
340		0.01	1.58		340		0.00	0.15	
341		0.21			341		1.09		
342		0.20			342		0.53		
343		0.19			343		0.00		
344		0.38			344		0.00		
345		0.21			345		0.00		
346		0.13			346		0.01		
347		0.19			347		0.00		
348		0.26			348		0.00		
349		0.09			349		0.00		
350		0.15	2.01		350		0.00	1.63	
351		0.11			351		0.00		
352		0.05			352		0.00		
353		0.05			353		0.00		
354		0.03			354		0.05		
355		0.10			355		0.00		
356		0.25			356		0.94		
357		0.13			357		0.12		
358		0.12			358		0.00		
359		0.18			359		0.00		
360		0.18	1.20	4.79	360		0.66	1.77	3.55
361		0.06			361		0.00		
362		0.06			362		0.00		
363		0.17			363		0.06		
364		0.20			364		2.66		
365		0.16			365		0.81		
366		0.16	0.82	0.82	366		0.24	3.77	3.77
367					367				
Totals		47.36	47.36	47.36	Totals		39.78	39.78	39.78
Avg crop season		0.12	1.23	3.70	Avg crop season		0.08	0.84	2.53

Day Month	Avg/day	Avg/10day	Avg/30day	Day Month	Daily	Avg10day	Avg30day
Sum crop season	18.95	18.52	18.52	Sum crop season	12.64	12.64	12.64
Sum off-season	28.41	28.84	28.84	Sum off-season	27.14	27.14	27.14
Summary avg year	1 day	10 day	30 day	Summary 1969	1 day	10 day	30 day

AVG 1965 TO 1981 PAN EVAPORATION DATA

AVG 1965 TO 1981 PAN EVAPORATION DATA

Month	Day	Avg/day	10 DY AV	30 DY AV
Jan 1	1	0.05		
	2	0.10		
	3	0.08		
	4	0.00		
	5	0.07		
	6	0.05		
	7	0.02		
	8	0.05		
	9	0.06		
	10	0.19	0.66	
	11	0.10		
	12	0.04		
	13	0.03		
	14	0.02		
	15	0.02		
	16	0.01		
	17	0.11		
	18	0.04		
	19	0.14		
	20	0.04	0.54	
	21	0.10		
	22	0.08		
	23	0.07		
	24	0.10		
	25	0.11		
	26	0.08		
	27	0.06		
	28	0.09		
	29	0.07		
Feb 1	30	0.07	0.81	2.01
	31	0.12		
	32	0.08		
	33	0.09		
	34	0.03		
	35	0.02		
	36	0.14		
	37	0.13		
	38	0.09		
	39	0.11		
	40	0.05	0.86	
	41	0.06		
	42	0.11		
	43	0.09		
	44	0.04		
	45	0.09		
	46	0.07		
	47	0.14		
	48	0.04		
	49	0.07		
	50	0.18	0.88	

Month	Day	Avg/day	10 day	30 day
	51	0.09		
	52	0.11		
	53	0.09		
	54	0.16		
	55	0.13		
	56	0.10		
	57	0.11		
	58	0.11		
	59	0.13		
Mar 1	60	0.20	1.23	2.97
	61	0.07		
	62	0.11		
	63	0.07		
	64	0.09		
	65	0.14		
	66	0.12		
	67	0.10		
	68	0.10		
	69	0.20		
	70	0.12	1.13	
	71	0.13		
	72	0.18		
	73	0.15		
	74	0.13		
	75	0.14		
	76	0.17		
	77	0.16		
	78	0.16		
	79	0.15		
	80	0.15	1.52	
	81	0.18		
	82	0.15		
	83	0.17		
	84	0.15		
	85	0.16		
	86	0.16		
	87	0.11		
	88	0.15		
	89	0.17		
Apl 1	90	0.14	1.54	4.19
	91	0.18		
	92	0.20		
	93	0.22		
	94	0.21		
	95	0.22		
	96	0.18		
	97	0.21		
	98	0.20		
	99	0.21		
	100	0.20	2.01	
	101	0.20		
	102	0.20		
	103	0.21		
	104	0.22		
	105	0.18		

Month	Day	Avg/day	10 day	30 day
	107	0.23		
	108	0.23		
	109	0.22		
	110	0.20	2.06	
	111	0.21		
	112	0.21		
	113	0.17		
	114	0.24		
	115	0.21		
	116	0.23		
	117	0.20		
	118	0.22		
	119	0.21		
May 1	120	0.22	2.12	6.19
	121	0.18		
	122	0.22		
	123	0.17		
	124	0.22		
	125	0.21		
	126	0.19		
	127	0.22		
	128	0.20		
	129	0.21		
	130	0.24	2.07	
	131	0.22		
	132	0.23		
	133	0.24		
	134	0.21		
	135	0.25		
	136	0.30		
	137	0.24		
	138	0.24		
	139	0.19		
	140	0.25	2.37	
	141	0.26		
	142	0.27		
	143	0.22		
	144	0.25		
	145	0.26		
	146	0.26		
	147	0.26		
	148	0.24		
	149	0.24		
Jun 1	150	0.24	2.51	6.94
	151	0.25		
	152	0.27		
	153	0.27		
	154	0.26		
	155	0.26		
	156	0.28		
	157	0.26		
	158	0.24		
	159	0.31		
	160	0.26	2.66	

Month	Day	Avg/day	10 day	30 day
	163	0.28		
	164	0.31		
	165	0.29		
	166	0.30		
	167	0.31		
	168	0.28		
	169	0.29		
	170	0.28	2.87	
	171	0.28		
	172	0.27		
	173	0.26		
	174	0.31		
	175	0.29		
	176	0.26		
	177	0.29		
	178	0.30		
	179	0.27		
Jul 1	180	0.30	2.82	8.35
	181	0.27		
	182	0.33		
	183	0.29		
	184	0.25		
	185	0.28		
	186	0.31		
	187	0.29		
	188	0.27		
	189	0.28		
	190	0.27	2.84	
	191	0.28		
	192	0.28		
	193	0.31		
	194	0.29		
	195	0.30		
	196	0.30		
	197	0.30		
	198	0.30		
	199	0.24		
	200	0.29	2.88	
	201	0.29		
	202	0.27		
	203	0.26		
	204	0.24		
	205	0.26		
	206	0.25		
	207	0.28		
	208	0.25		
	209	0.23		
Aug 1	210	0.26	2.59	8.31
	211	0.24		
	212	0.26		
	213	0.24		
	214	0.26		
	215	0.23		
	216	0.25		
	217	0.24		

Month	Day	Avg/day	10 day	30 day
	219	0.26		
	220	0.26	2.47	
	221	0.23		
	222	0.25		
	223	0.26		
	224	0.23		
	225	0.24		
	226	0.23		
	227	0.22		
	228	0.23		
	229	0.25		
	230	0.25	2.39	
	231	0.23		
	232	0.23		
	233	0.24		
	234	0.24		
	235	0.24		
	236	0.27		
	237	0.21		
	238	0.23		
	239	0.23		
Sep 1	240	0.25	2.36	7.22
	241	0.24		
	242	0.22		
	243	0.20		
	244	0.23		
	245	0.21		
	246	0.19		
	247	0.17		
	248	0.16		
	249	0.19		
	250	0.18	1.98	
	251	0.20		
	252	0.20		
	253	0.21		
	254	0.20		
	255	0.18		
	256	0.17		
	257	0.18		
	258	0.20		
	259	0.20		
	260	0.18	1.93	
	261	0.18		
	262	0.16		
	263	0.16		
	264	0.15		
	265	0.18		
	266	0.17		
	267	0.16		
	268	0.17		
	269	0.15		
Oct 1	270	0.15	1.65	5.57
	271	0.15		
	272	0.14		
	273	0.15		

Month	Day	Avg/day	10 day	30 day
	275	0.18		
	276	0.18		
	277	0.19		
	278	0.19		
	279	0.17		
	280	0.17	1.68	
	281	0.14		
	282	0.13		
	283	0.14		
	284	0.15		
	285	0.17		
	286	0.16		
	287	0.17		
	288	0.12		
	289	0.17		
	290	0.15	1.51	
	291	0.11		
	292	0.13		
	293	0.14		
	294	0.13		
	295	0.12		
	296	0.16		
	297	0.13		
	298	0.14		
	299	0.13		
Nov 1	300	0.09	1.28	4.47
	301	0.12		
	302	0.12		
	303	0.09		
	304	0.10		
	305	0.12		
	306	0.11		
	307	0.11		
	308	0.10		
	309	0.09		
	310	0.09	1.05	
	311	0.09		
	312	0.09		
	313	0.08		
	314	0.13		
	315	0.12		
	316	0.08		
	317	0.08		
	318	0.11		
	319	0.10		
	320	0.07	0.95	
	321	0.13		
	322	0.09		
	323	0.10		
	324	0.07		
	325	0.10		
	326	0.13		
	327	0.07		
	328	0.06		
	329	0.06		

Month		Day	Avg/day	10 day	30 day
		331	0.11		
		332	0.09		
		333	0.09		
		334	0.06		
		335	0.07		
		336	0.05		
		337	0.11		
		338	0.07		
		339	0.03		
		340	0.10	0.81	
		341	0.08		
		342	0.05		
		343	0.05		
		344	0.03		
		345	0.12		
		346	0.07		
		347	0.08		
		348	0.10		
		349	0.05		
		350	0.07	0.71	
		351	0.05		
		352	0.04		
		353	0.09		
		354	0.09		
		355	0.05		
		356	0.06		
		357	0.08		
		358	0.07		
		359	0.05		
		360	0.09	0.67	2.18
		361	0.06		
		362	0.03		
		363	0.08		
		364	0.04		
		365	0.09		
		366	0.06	0.36	0.36
AVG 55.11	TOTALS		61.63	61.63	61.63
	CROP SEA		36.38	36.38	36.38
	OFFR-SEA		25.25	25.25	25.25

AVG DAILY TEMP 1965 TO 1981

AVG YEAR DATA

DAY	MONTH	DAILY	10 DAY	30 DAY
1.00	Jan 1	39.88		
2.00		38.44		
3.00		37.76		
4.00		35.24		
5.00		33.47		
6.00		35.56		
7.00		36.97		
8.00		35.24		
9.00		33.76		
10.00		33.38	35.97	
11.00		34.68		
12.00		34.50		
13.00		35.03		
14.00		37.56		
15.00		36.71		
16.00		37.68		
17.00		37.68		
18.00		38.91		
19.00		38.65		
20.00		40.44	12.39	
.00		39.21		
		41.82		
		43.41		
24.00		43.65		
25.00		43.21		
26.00		43.41		
27.00		40.38		
28.00		42.26		
29.00		41.63		
30.00		39.29	41.83	38.33
31.00		38.76		
32.00	Feb 1	39.97		
33.00		39.12		
34.00		36.71		
35.00		36.97		
36.00		41.50		
37.00		41.09		
38.00		39.03		
39.00		36.38		
40.00		36.50	38.60	
41.00		37.29		
42.00		41.94		
43.00		41.68		
44.00		40.35		
45.00		42.85		
.00		45.91		
		43.68		
.00		39.94		

AVG DAILY TEMP 1965 TO 1981

SPECIFIC YEAR DATA 1969.00

DAY	MONTH	DAILY	10 DAY	30 DAY
1.00	Jan 1	33.85		
2.00		34.71		
3.00		38.09		
4.00		29.88		
5.00		29.21		
6.00		32.09		
7.00		37.32		
8.00		37.71		
9.00		37.41		
10.00		31.79	34.21	
11.00		31.79		
12.00		31.97		
13.00		33.03		
14.00		35.82		
15.00		38.74		
16.00		41.85		
17.00		47.65		
18.00		51.00		
19.00		42.12		
20.00		42.56	13.22	
21.00		41.62		
22.00		49.06		
23.00		51.32		
24.00		41.85		
25.00		39.24		
26.00		39.79		
27.00		39.56		
28.00		43.56		
29.00		54.09		
30.00		52.94	45.30	39.72
31.00		42.94		
32.00	Feb 1	43.12		
33.00		44.62		
34.00		39.41		
35.00		37.68		
36.00		41.68		
37.00		44.06		
38.00		43.21		
39.00		43.91		
40.00		40.76	42.14	
41.00		38.12		
42.00		42.71		
43.00		43.97		
44.00		39.38		
45.00		41.29		
46.00		45.44		
47.00		40.97		
48.00		38.74		

DAY	MONTH	DAILY	10 DAY	30 DAY	DAY	MONTH	DAILY	10 DAY	30 DAY
49.00		41.53			49.00		39.76		
50.00		43.03	41.82		50.00		40.71	41.11	
51.00		43.76			51.00		43.53		
52.00		46.00			52.00		47.29		
53.00		45.97			53.00		50.56		
54.00		43.74			54.00		43.76		
55.00		44.79			55.00		44.47		
56.00		44.03			56.00		27.28		
57.00		45.00			57.00		46.03		
58.00		45.03			58.00		48.88		
59.00		48.85			59.00		49.24		
60.00		52.50	45.97	42.13	60.00		34.00	43.50	42.25
61.00	March 1	48.74			61.00	March 1	48.00		
62.00		48.97			62.00		45.65		
63.00		47.68			63.00		44.76		
64.00		46.26			64.00		43.35		
65.00		47.21			65.00		45.94		
66.00		45.68			66.00		44.65		
67.00		48.06			67.00		42.71		
68.00		49.38			68.00		44.97		
69.00		49.06			69.00		42.00		
70.00		51.04	48.21		70.00		42.72	44.47	
71.00		52.75			71.00		44.22		
72.00		52.56			72.00		43.24		
73.00		53.00			73.00		45.34		
74.00		52.35			74.00		47.21		

DAY	MONTH	DAILY	10 DAY	30 DAY	DAY	MONTH	DAILY	10 DAY	30 DAY
75.00		52.53			75.00		49.71		
76.00		52.24			76.00		50.18		
77.00		51.21			77.00		51.00		
78.00		53.35			78.00		56.03		
79.00		52.59			79.00		52.44		
80.00		55.09	52.77		80.00		58.00	49.74	
81.00		53.82			81.00		51.91		
82.00		51.38			82.00		52.59		
83.00		53.53			83.00		56.38		
84.00		52.91			84.00		56.53		
85.00		48.82			85.00		49.82		
86.00		49.15			86.00		45.68		
87.00		51.26			87.00		48.12		
88.00		56.35			88.00		55.24		
89.00		59.88			89.00		58.44		
90.00		55.91	53.30	51.43	90.00		50.71	52.54	48.92
91.00		56.24			91.00		50.82		
92.00	April 1	57.94			92.00	April 1	54.19		
93.00		59.19			93.00		62.66		
94.00		60.53			94.00		64.75		
95.00		60.28			95.00		66.00		
96.00		55.84			96.00		64.66		
97.00		56.22			97.00		58.97		
98.00		59.84			98.00		59.56		
99.00		62.84			99.00		64.72		
100.00		61.72	59.06		100.00		66.59	61.29	

DAY	MONTH	DAILY	10 DAY	30 DAY	DAY	MONTH	DAILY	10 DAY	30 DAY
101.00		61.06			101.00		65.31		
102.00		62.41			102.00		64.00		
103.00		64.00			103.00		64.56		
104.00		64.47			104.00		66.22		
105.00		61.28			105.00		63.16		
106.00		61.91			106.00		62.66		
107.00		64.75			107.00		67.53		
108.00		67.88			108.00		69.69		
109.00		68.09			109.00		66.28		
110.00		67.31	64.32		110.00		61.91	65.13	
111.00		66.38			111.00		59.84		
112.00		65.50			112.00		61.63		
113.00		64.63			113.00		64.44		
114.00		67.75			114.00		63.38		
115.00		65.19			115.00		59.34		
116.00		64.41			116.00		59.19		
117.00		62.22			117.00		61.78		
118.00		63.00			118.00		66.53		
119.00		64.25			119.00		63.56		
120.00		64.84	64.82	62.73	120.00		60.91	62.06	62.83
121.00		64.50			121.00		59.97		
122.00	May 1	67.72			122.00	May 1	63.69		
123.00		63.84			123.00		63.94		
124.00		64.66			124.00		67.59		
125.00		64.75			125.00		67.53		
126.00		66.09			126.00		68.88		

DAY MONTH	DAILY	10 DAY	30 DAY	DAY MONTH	DAILY	10 DAY	30 DAY
127.00	67.69			127.00	70.47		
128.00	68.22			128.00	70.28		
129.00	69.09			129.00	71.53		
130.00	68.91	66.55		130.00	64.34	66.82	
131.00	66.50			131.00	64.09		
132.00	68.34			132.00	61.91		
133.00	69.78			133.00	64.22		
134.00	68.19			134.00	67.38		
135.00	68.69			135.00	68.91		
136.00	68.81			136.00	69.59		
137.00	67.91			137.00	71.16		
138.00	69.69			138.00	72.88		
139.00	69.44			139.00	72.19		
140.00	71.84	68.92		140.00	72.72	68.50	
141.00	71.50			141.00	70.13		
142.00	72.63			142.00	73.38		
143.00	72.63			143.00	74.34		
144.00	74.13			144.00	74.84		
145.00	74.31			145.00	74.66		
146.00	73.88			146.00	75.16		
147.00	74.53			147.00	75.88		
148.00	72.38			148.00	73.13		
	73.78			149.00	75.47		
	74.66	73.44	69.64	150.00	77.00	74.40	69.91
151.00	75.59			151.00	76.28		
152.00	75.10			152.00	77.43		

DAY	MONTH	DAILY	10 DAY	30 DAY
153.00	June 1	74.74		
154.00		74.29		
155.00		73.85		
156.00		75.21		
157.00		76.56		
158.00		77.03		
159.00		77.53		
160.00		76.82	75.67	
161.00		77.68		
162.00		77.79		
163.00		77.12		
164.00		77.79		
165.00		78.85		
166.00		79.29		
167.00		78.53		
168.00		77.76		
169.00		77.29		
170.00		77.79	77.99	
171.00		79.50		
172.00		79.29		
173.00		79.00		
00		78.76		
		79.44		
		79.41		
177.00		79.91		
178.00		79.38		

DAY	MONTH	DAILY	10 DAY	30 DAY
153.00	June 1	76.74		
154.00		71.68		
155.00		68.06		
156.00		72.76		
157.00		71.35		
158.00		74.59		
159.00		77.12		
160.00		77.12	74.31	
161.00		78.79		
162.00		76.09		
163.00		76.06		
164.00		80.47		
165.00		79.97		
166.00		79.88		
167.00		75.12		
168.00		72.32		
169.00		72.62		
170.00		75.91	76.72	
171.00		79.09		
172.00		78.12		
173.00		77.91		
174.00		78.18		
175.00		80.97		
176.00		78.41		
177.00		81.09		
178.00		82.00		

DAY	MONTH	DAILY	10 DAY	30 DAY
179.00		78.97		
180.00		79.12	79.28	77.65
181.00		80.94		
182.00		81.91		
183.00	July 1	81.41		
184.00		81.09		
185.00		81.41		
186.00		81.24		
187.00		80.79		
188.00		80.18		
189.00		80.00		
190.00		81.03	81.00	
191.00		81.53		
192.00		82.62		
193.00		82.94		
194.00		82.29		
195.00		82.03		
196.00		82.50		
197.00		81.82		
198.00		82.12		
199.00		81.18		
0.00		82.09	82.11	
		82.44		
		82.65		
203.00		80.91		
204.00		80.26		

DAY	MONTH	DAILY	10 DAY	30 DAY
179.00		81.94		
180.00		82.65	80.04	77.02
181.00		83.34		
182.00		83.21		
183.00	July 1	83.62		
184.00		83.29		
185.00		81.12		
186.00		83.21		
187.00		83.44		
188.00		83.24		
189.00		82.65		
190.00		83.97	83.11	
191.00		83.50		
192.00		84.29		
193.00		84.59		
194.00		84.62		
195.00		84.71		
196.00		84.15		
197.00		83.97		
198.00		84.79		
199.00		81.97		
200.00		82.68	83.93	
201.00		83.24		
202.00		81.76		
203.00		82.15		
204.00		82.38		

DAY	MONTH	DAILY	10 DAY	30 DAY
205.00		81.71		
206.00		81.97		
207.00		81.82		
208.00		81.65		
209.00		80.91		
210.00		80.50	81.48	81.53
211.00		80.62		
212.00		79.32		
213.00		79.18		
214.00	Aug 1	79.56		
215.00		78.56		
216.00		78.76		
217.00		78.53		
218.00		78.47		
219.00		79.06		
220.00		80.12	79.22	
221.00		79.03		
222.00		80.41		
223.00		79.94		
224.00		78.65		
225.00		78.38		
.00		78.18		
		78.53		
		80.09		
229.00		81.00		
230.00		79.91	79.41	

DAY	MONTH	DAILY	10 DAY	30 DAY
205.00		83.12		
206.00		81.59		
207.00		80.21		
208.00		81.44		
209.00		82.03		
210.00		77.85	81.58	82.87
211.00		78.21		
212.00		78.21		
213.00		78.24		
214.00	Aug 1	78.44		
215.00		78.44		
216.00		74.91		
217.00		75.18		
218.00		75.56		
219.00		76.53		
220.00		77.79	77.15	
221.00		78.38		
222.00		80.18		
223.00		80.79		
224.00		76.56		
225.00		76.24		
226.00		75.18		
227.00		78.12		
228.00		78.65		
229.00		79.56		
230.00		77.56	78.12	

DAY	MONTH	DAILY	10 DAY	30 DAY	DAY	MONTH	DAILY	10 DAY	30 DAY
231.00		79.35			231.00		79.06		
232.00		79.09			232.00		79.85		
233.00		80.00			233.00		82.71		
234.00		80.41			234.00		81.88		
235.00		79.76			235.00		80.24		
236.00		78.44			236.00		77.47		
237.00		78.03			237.00		77.88		
238.00		78.68			238.00		78.53		
239.00		79.32			239.00		78.44		
240.00		79.03	79.21	79.28	240.00		78.50	79.46	78.24
241.00		78.06			241.00		77.50		
242.00		77.24			242.00		79.00		
243.00		76.94			243.00		76.06		
244.00		77.82			244.00		77.91		
245.00	Sept 1	76.85			245.00	Sept 1	77.85		
246.00		76.41			246.00		76.03		
247.00		76.88			247.00		77.76		
248.00		76.32			248.00		77.56		
249.00		76.44			249.00		76.65		
250.00		75.53	76.85		250.00		77.65	77.40	
251.00		76.15			251.00		78.71		
[illegible].00		76.53			252.00		76.91		
		76.24			253.00		73.85		
		75.35			254.00		70.59		
255.00		72.18			255.00		67.06		
256.00		72.53			256.00		68.85		

DAY	MONTH	DAILY	10 DAY	30 DAY	DAY	MONTH	DAILY	10 DAY	30 DAY
257.00		74.06			257.00		71.24		
258.00		74.56			258.00		73.26		
259.00		73.15			259.00		72.62		
260.00		72.94	74.37		260.00		73.24	72.63	
261.00		73.68			261.00		74.03		
262.00		72.12			262.00		73.03		
263.00		72.47			263.00		72.00		
264.00		72.15			264.00		72.26		
265.00		72.56			265.00		73.56		
266.00		70.50			266.00		70.71		
267.00		69.79			267.00		70.18		
268.00		69.09			268.00		71.03		
269.00		68.71			269.00		65.71		
270.00		69.53	71.06	74.09	270.00		66.38	70.89	73.64
271.00		70.26			271.00		67.38		
272.00		68.88			272.00		67.26		
273.00		67.18			273.00		65.03		
274.00		67.68			274.00		64.82		
275.00	Oct 1	68.62			275.00	Oct 1	67.09		
276.00		67.24			276.00		65.50		
277.00		65.09			277.00		65.15		
278.00		65.06			278.00		69.62		
		65.50			279.00		71.62		
		64.21	66.97		280.00		71.88	67.54	
281.00		63.38			281.00		67.53		
282.00		62.91			282.00		61.62		

DAY	MONTH	DAILY	10 DAY	30 DAY
283.00		63.35		
284.00		63.32		
285.00		63.82		
286.00		65.56		
287.00		66.74		
288.00		64.56		
289.00		64.35		
290.00		64.03	64.20	
291.00		60.53		
292.00		59.41		
293.00		59.12		
294.00		56.68		
295.00		58.59		
296.00		62.15		
297.00		60.94		
298.00		59.79		
299.00		55.82		
300.00		56.53	58.96	63.38
301.00		57.74		
302.00		55.74		
303.00		55.68		
304.00		57.21		
305.00		60.32		
306.00	Nov 1	60.56		
307.00		57.82		
308.00		56.32		

DAY	MONTH	DAILY	10 DAY	30 DAY
283.00		62.09		
284.00		63.82		
285.00		72.97		
286.00		74.82		
287.00		68.59		
288.00		60.53		
289.00		55.71		
290.00		55.41	64.31	
291.00		58.00		
292.00		56.76		
293.00		57.85		
294.00		58.21		
295.00		63.00		
296.00		60.24		
297.00		57.09		
298.00		54.85		
299.00		53.18		
300.00		59.00	57.82	63.22
301.00		60.03		
302.00		51.85		
303.00		53.18		
304.00		56.44		
305.00		61.03		
306.00	Nov 1	55.38		
307.00		52.53		
308.00		50.38		

DAY MONTH	DAILY	10 DAY	30 DAY	DAY MONTH	DAILY	10 DAY	30 DAY
309.00	53.62			309.00	49.82		
310.00	53.00	56.80		310.00	47.44	53.81	
311.00	54.94			311.00	51.85		
312.00	55.26			312.00	56.53		
313.00	54.71			313.00	59.15		
314.00	55.74			314.00	54.88		
315.00	53.59			315.00	54.18		
316.00	51.09			316.00	55.29		
317.00	50.97			317.00	53.21		
318.00	51.15			318.00	55.59		
319.00	51.79			319.00	45.62		
320.00	50.15	52.94		320.00	41.76	52.81	
321.00	50.44			321.00	45.12		
322.00	52.18			322.00	52.35		
323.00	51.41			323.00	58.09		
324.00	51.09			324.00	46.15		
325.00	51.24			325.00	46.65		
326.00	49.74			326.00	47.06		
327.00	49.38			327.00	48.32		
328.00	48.74			328.00	50.68		
329.00	49.71			329.00	52.41		
0.00	48.03	50.19	53.31	330.00	53.09	49.99	52.20
	49.59			331.00	48.47		
	51.38			332.00	50.38		
333.00	45.85			333.00	42.88		
334.00	42.74			334.00	39.35		

DAY	MONTH	DAILY	10 DAY	30 DAY	DAY	MONTH	DAILY	10 DAY	30 DAY
335.00		43.71			335.00		39.91		
336.00	Dec 1	44.00			336.00	Dec 1	41.68		
337.00		45.97			337.00		44.32		
338.00		45.68			338.00		44.24		
339.00		45.59			339.00		43.62		
340.00		45.41	45.99		340.00		44.15	43.90	
341.00		48.03			341.00		46.88		
342.00		45.53			342.00		46.21		
343.00		44.32			343.00		41.97		
344.00		42.09			344.00		41.91		
345.00		42.29			345.00		42.12		
346.00		43.35			346.00		43.03		
347.00		43.53			347.00		40.35		
348.00		45.09			348.00		42.79		
349.00		44.56			349.00		47.15		
350.00		43.15	44.19		350.00		43.82	43.62	
351.00		41.50			351.00		39.97		
352.00		39.91			352.00		39.24		
353.00		39.82			353.00		41.03		
354.00		43.62			354.00		44.74		
355.00		44.56			355.00		42.47		
[illegible]4.00		42.15			356.00		42.38		
		42.03			357.00		42.53		
		43.12			358.00		43.59		
359.00		44.56			359.00		40.38		
360.00		40.32	42.16	44.11	360.00		40.12	41.64	43.06

DAY MONTH	DAILY	10 DAY	30 DAY	DAY MONTH	DAILY	10 DAY	30 DAY
361.00	38.26			361.00	38.03		
362.00	40.50			362.00	40.32		
363.00	41.97			363.00	43.68		
364.00	41.41			364.00	44.53		
365.00	42.18			365.00	41.59		
366.00	42.26	41.10	41.10	366.00	39.82	41.33	41.33

AVG YEAR DATA		DRY YEAR DATA 1969	
vg Day yerly Temp	61.13 Deg F	Avg Day yerly Temp	60.83 Deg F
Avg Day crop seas	76.31 Deg F	Avg Day crop seas	76.18 Deg F
.vg Day off-seas	50.79 Deg F	Avg Day off-seas	50.35 Deg F

APPENDIX C

PROCEDURE FOR DETERMINING RUNOFF CAPTURE

PROCEDURE FOR DETERMINING RUNOFF CAPTURE

The amount of runoff per month is computed as a fixed percent of the selected monthly rainfall and is established based on previous analysis of stream gage data in Eastern Arkansas. The monthly runoff used is as follows:

Monthly Runoff as Percent of Monthly Rainfall

Month	Runoff Percent (% of Precipitation)	Runoff Potentially Captured
January	38	62
February	58	42
March	76	24
April	40	60
May	26	74
June	14	86
July	14	86
August	14	86
September	16	84
October	4	96
November	4	96
December	17	83

Likewise the amount of runoff that can practically be captured with a tailwater recovery system is estimated as a varying percent of the runoff value. The monthly percentage used in this analysis is estimated as being inversely proportional to the percent of rain that produces runoff and is shown in the above table.

The runoff capture values are used in the SCS water budget program to determine the supply effects of tailwater recovery.

APPENDIX D

TYPICAL PLANTING
AND
HARVEST DATES

UNITED STATES
DEPT of AGRICULTURE

SOIL CONSERVATON SERIVCE

DATE: July 29,1992

Mr. Larry Farris
CONSERVATION AGRONOMIST
LITTLE ROCK, AR 72201

Larry I have need for some information on crop planting and harvesting dates for the Grand Prairie Irrigation Project. This will affect the irrigation needs for this project.

This is a list for the following crops needed:

crop	planting date	harvest date
early soybeans	May 15	October 15
late soybeans	June 20	November 1
rice	April 1	August 20
grain sorghum	March 20	August 20
corn-grain	March 15	August 25
winter wheat	November 1	June 10
sod-grass (Bermuda grass)	Greenup May 1	→ Frost

This information is needed within 10 calender days and sent to the Dewitt Field Office attn: Randy Brown. Thank you in your asistance in this matter.

Signature: Larry D. Farris

Date: 8-3-92

Randy Brown
Randy Brown
Project Engineer

APPENDIX E

PRINTED SAMPLE OF ALLDATA.XLS DATA FILE

ALLDATA.DAT DATA FILE PRINTOUT AND HEADING EXPLANATION

The following information lists the column heading, the column title, the units of the data, and an explanation of the data for the ALLDATA.DAT data file. This file was utilized by the GP.SS program to compute the import water requirement for individual tracts of land located within the project boundary.

trno - tract number (no) - A unique number used to identify a parcel of land within the project area. (See Section for a detailed explanation of tract numbers.)

tfrmlnd - tract farmland (ac) - The total area of the tract.

tcrplnd - tract cropland (ac) - The area of the tract used to produce crops in 1991 (including grass and hay).

fno - farm number (no) - A number assigned by county ASCS personnel to one or more tracts operated by one individual or a group of individuals. Farm numbers are unique within county boundaries.

ffrmlnd - farm farmland (ac) - The combined total area of all tracts listed under this farm number.

fcrplnd - farm cropland (ac) - The combined total cropland (tcrplnd) acreage for all tracts listed under this farm number.

frice - farm rice (ac) - The combined total base rice acreage for all tracts listed under this farm number.

fwht - farm wheat (ac) - The combined total base wheat acreage for all tracts listed under this farm number.

foats - farm oats (ac) - The combined total base oat acreage for all tracts listed under this farm number.

fcorn - farm corn (ac) - The combined total base corn acreage for all tracts listed under this farm number.

fgrsrg - farm grain sorghum (ac) - The combined total base grain sorghum acreage for all tracts listed under this farm number.

fother - farm other (ac) - The combined total acreage for all other cultivated base crops for all tracts listed under this farm number.

crp - conservation reserve program (ac) - The tract cropland currently enrolled in the Conservation Reserve Program which requires the establishment of permanent vegetative cover such as grass or trees.

cacres - c acres (ac) - The tract cropland acres currently reported as permanent pasture, hayland, or other non-irrigated crops.

fpa - fish pond acres (ac) - The total surface area of commercial fish ponds on the tract.

fpd - fish pond depth (ft) - The estimated average depth of commercial fish ponds on the tract.

irgsa - irrigation storage acres (ac) - The total surface area of existing irrigation storage reservoirs on the tract.

irgsd - irrigation storage depth (ft) - The estimated average depth of irrigation storage reservoirs on the tract.

fwa - fish and wildlife acres (ac) - The total surface area of water bodies on the tract used primarily for fish and wildlife habitat.

fwd - fish and wildlife depth (ft) - The estimated average depth of water bodies on the tract used primarily for fish and wildlife habitat.

oa - other acres (ac) - The total surface area of any other water bodies on the tract.

TRNO	TFRMLND	TCRPLND	FNO	FFRMLND	FCRPLND	FRICE	FWHT	FOATS	FCORN
101630	38.5	38.5	573	38.5	38.5	15.0			
103050	168.0	164.0	229	168.0	164.0		34.2		
103120	406.0	367.5	243	406.0	367.5	116.7	48.7		
103210	40.0	16.4	1833	40.0	16.4				
103220	370.0	242.2	2144	370.0	242.2	97.8			
103230	444.0	406.1	308	444.0	406.1	134.0	73.5		
103290	643.0	559.8	328	643.0	559.8	191.6			
103390	13.0	11.8	352	13.0	11.8				
103400	720.0	281.8	1834	720.0	281.8	107.0			
103550	280.0	247.4	305	280.0	247.4	131.5			
103690	417.0	355.3	1966	417.0	355.3	137.2	88.3		
103730	147.0	142.5	469	147.0	142.5	84.0	23.5		
103810	35.0	32.1	453	35.0	32.1	29.4			
103820	458.0	317.8	455	458.0	317.8	153.3			
104210	119.0	69.5	2144	119.0	69.5				
104271	712.8	283.1	394	712.8	283.1	101.8	58.6		
104272	516.2	205.0	394	516.2	205.0	73.7	42.4		
104280	301.0	0.0	397	301.0	0.0				
104331	602.1	491.6		602.1	491.6	150.0			
104332	328.0	328.0		328.0	328.0	100.0			
104333	119.0	119.0		119.0	119.0	40.0			
104460	85.0	85.0		85.0	85.0	30.0			
104480	284.0	265.2	2144	284.0	265.2		107.6		
104491	191.4	187.2	2142	191.4	187.2				
104492	28.6	28.0	2142	28.6	28.0				
105130	740.0	649.0	269	740.0	649.0	347.5			
105250	240.0	216.8	278	240.0	216.8	84.3	72.5		
107640	1033.0	0.0		1033.0	0.0				
107650	357.0	180.0		357.0	180.0	60.0			
108990	223.0	65.5	1970	223.0	65.5				
109040	40.0	19.2	521	40.0	19.2	19.2			
109130	200.0	79.8	528	200.0	79.8				
109280	55.0	52.6	1919	55.0	52.6				
109590	120.0	11.1	558	120.0	11.1				
109600	60.0	21.8	558	60.0	21.8				
109610	80.0	14.2	558	80.0	14.2				
109620	761.0	85.9	558	761.0	85.9				
109630	194.0	93.5	598	194.0	93.5	83.8			
109770	122.0	61.9	573	122.0	61.9	40.0			
109810	250.0	143.7	1959	250.0	143.7	82.0			
110280	80.0	40.0	665	80.0	40.0	30.0	10.0		
110300	10.0	9.8	669	10.0	9.8		9.8		
110310	40.0	37.2	669	40.0	37.2				
110330	173.0	168.1	669	173.0	168.1	69.0			

FGRSRG	FOTHER	CRP	CACRES	FPA	FPD	IRGSA	IRGSD	FWA	FWD	OA
		0.0								
		0.0								
		0.0	16.1							
		0.0								
		0.0	2.0							
		0.0				21.6	6.0			
		0.0								
		0.0								
		0.0				2.7	6.0			
		0.0	2.0							
		0.0				30.5	6.0			
		0.0								
		0.0								
		0.0	1.7							
		0.0	7.4							
		0.0	18.1							
		0.0	13.1							
		0.0								
		0.0				19.6	6.0			
		0.0								
		0.0								
		0.0								
		0.0								
		0.0								
		0.0								
		0.0	15.0			22.3	6.0			
		0.0								
		0.0						175.0	5.0	
		0.0								
		0.0								
		0.0								
		0.0								
		0.0								
		0.0								
		0.0								
		0.0								
		0.0								
		0.0								
		0.0	9.7							
		0.0								
		0.0								
		0.0								
		0.0								
37.2		0.0								
		0.0								

APPENDIX F

PRINTED SAMPLE OF WATER BUDGET DATA OUTPUT

OUTPUT FILE HEADING EXPLANATION

The following information lists the column heading, the column title, the units of the data, and an explanation of the data for the output file produced from the GP.SS computer program. This program processes data and calculates water requirements on an individual tract basis. The data in this file represent the "with project" results unless otherwise noted.

trno - tract number (no) - A unique number used to identify a parcel of land within the project area.

scrac - summary cropland acres (ac) - the amount of cropland (including CRP and grassland) remaining in the tract after computing the reservoir requirements. All new reservoirs are planned to be constructed on cultivated cropland.

strac - summary tract acres (ac) - The total amount of land in the tract.

sirgac - summary irrigated acres (ac) - The amount of irrigated cropland in the tract. This value is equivalent to scrac less CRP and grassland.

isdmd - in-season demand (af) - The total water requirement during the period of May through September after conservation measures are installed.

osdmd - off-season demand (af) - The total water requirement during the period from October through April. This value includes fish and wildlife, and irrigation reservoir recharge requirements.

pmoaf - peak monthly acre feet (af) - The maximum total amount of water required during any calendar month of the period of May through September.

pmogpmac - peak monthly gallons per minute per acre (gpm/ac) - The maximum monthly flow rate necessary to supply the total water requirement during the peak use period of the year.

effrice - efficiency of rice (%) - The estimated average efficiency for rice irrigation in the project area.

effother - efficiency of other (%) - The estimated average efficiency for the irrigation of crops other than rice in the project area.

strgexst - storage existing (ac-ft) - The estimated storage volume of all existing irrigation storage reservoirs located on an individual tract.

strgpln - storage planned (ac-ft) - The volume of additional storage reservoirs planned in excess of existing storage reservoirs on an individual tract.

strgtot - storage total (ac-ft) - The total storage volume of existing and planned storage reservoirs on an individual tract.

strgusd - storage used (ac-ft) - The total storage volume used for irrigation on an individual tract. It includes water from existing, planned and off-tract reservoirs. This water comes from off-season import and off-season capture.

twcap - tailwater capture (ac-ft) - The volume of tailwater and runoff captured from the irrigated cropland on an individual tract. (In-season only.)

gw - groundwater (ac-ft) - The volume of groundwater used for irrigation of an individual tract without depletion of the resource.

oswi - off-season water import (ac-ft) - The volume of surface water to be imported for an individual tract during the months of October through April.

iswi - in-season water import (ac-ft) - The volume of surface water to be imported for an individual tract during the months of May through September.

pdevaf - peak delivery acre feet (ac-ft/mo) - The maximum monthly volume of water to be imported for an individual tract during the growing season.

pdevgpm - peak delivery gallons per minute (gpm/ac) - The flow rate required to supply the peak delivery acre feet (pdevaf) during a 30 day, 20 hour/day period.

mxdevq - maximum delivery q (cfs) - The peak delivery gallons per minute (pdevgpm) expressed in cubic feet per second.

fish - fish (ac) - The existing surface area of commercial fish ponds located on the tract.

rice - rice (ac) - The rice acreage on the tract after any reductions for planned storage reservoirs. Planned reservoir acreage is taken first from early soybean acreage, second from late soybean acreage, and last from rice acreage.

lbeans - late beans (ac) - The double crop soybean/wheat acreage on the tract after any reductions for planned storage reservoirs. Planned reservoir acreage is taken first from early soybean acreage, second from late soybean acreage, and last from rice acreage.

ebeans - early beans (ac) - The full season soybean acreage on the tract after any reductions for planned storage reservoirs. Planned reservoir acreage is taken first from early soybean acreage, second from late soybean acreage, and last from rice acreage.

corn - corn(ac) - The existing corn acreage on the tract.

grsrg - grain sorghum (ac) - The existing grain sorghum acreage on the tract.

oirg - other irrigated (ac) - Any cropland on the tract not included in the primary crop categories.

totcrop - total cropland (ac) - The cropland on the tract after any reductions for planned storage reservoirs.

wflcrplnd - wildlife flooded cropland (ac) - The cropland on the tract planned for waterfowl flooding from October through December. This value is set as a constant percentage of totcrop.

irgres - irrigation reservoirs (ac) - The total surface area of all existing and planned irrigation storage reservoirs on the tract.

tothoh - total water (ac) - The total surface area of all existing and planned water bodies on an individual tract.

offseaq - off-season q (cfs) - The maximum flow rate required on the tract during the months of October through April for filling reservoirs or flooding for wildlife.

priorcrop - prior cropland (ac) - The amount of existing cropland on the tract, including grassland and Conservation Reserve Program (CRP) acres.

priorirrg - prior irrigated (ac) - The amount of existing cropland on the tract, excluding grassland and CRP acres.

pctofftr - percent off-tract (%) - The percentage of the volume of a reservoir located on another tract used on this tract.

offtrno - off-tract number (no) - The tract number of a tract with a reservoir from which this tract receives water.

priebns - prior early beans (ac) - The existing full season soybean acreage on the tract.

offtraf - off-tract acre feet (ac-ft) - The total volume of storage in a reservoir located on another tract from which this tract receives water.

offtraaf - off-tract available acre feet (ac-ft) - The volume of storage in a reservoir located on another tract to be used on this tract.

fwac - fish and wildlife acres (ac) - The surface area of water bodies located on the tract with a primary purpose of providing fish and wildlife habitat.

ontrstgusd - on-tract storage used (ac-ft) - The volume of storage in a reservoir located on this tract to be used on this tract. Note: Some reservoirs supply water to more than one tract.

potstrgav - potential storage available (ac-ft) - The total volume of storage available for use on the tract. This includes existing reservoirs on the tract which are larger than needed or storage on another tract which is used on this tract.

insea24q - in-season 24 hour q (cfs) - The maximum sustained flow rate required to deliver the planned in-season import water without system interruptions.

ontrstrgac - on-tract storage acres (ac) - The total surface area of existing and planned storage reservoirs on the tract.

ontrstrgdp - on-tract storage depth (ft) - The average depth of existing and planned storage reservoirs on the tract.

pcontrstrgusd - percent on-tract storage used (%) - The percentage of water stored in reservoirs on the tract to be used on the tract. Note: Some reservoirs supply water to more than one tract.

Year	SCRAC	STRAC	SIRGAC	ISDMD	OSDMD	PMOAF
1939-40	306150	412139	267980	588865	214547	202824
1940-41	306150	412139	267980	576745	217018	196763
1941-42	306150	412139	267980	577083	208196	196533
1942-43	306150	412139	267980	582274	197959	201412
1943-44	306150	412139	267980	598975	218863	199602
1944-45	306150	412139	267980	588246	198049	202642
1945-46	306150	412139	267980	568920	185519	201817
1946-47	306150	412139	267980	585302	236146	198708
1947-48	306150	412139	267980	590966	204921	199746
1948-49	306150	412139	267980	556549	196413	196041
1949-50	306150	412139	267980	576450	199736	198121
1950-51	306150	412139	267980	568004	219916	198956
1951-52	306150	412139	267980	578599	204187	198797
1952-53	306150	412139	267980	594897	208801	203184
1953-54	306150	412139	267980	587828	210874	202312
1954-55	306150	412139	267980	595230	216874	201242
1955-56	306150	412139	267980	584499	213183	197769
1956-57	306150	412139	267980	584172	197811	198548
1957-58	306150	412139	267980	549018	182663	191754
1958-59	306150	412139	267980	576599	209568	201405
1959-60	306150	412139	267980	584564	209399	200789
1960-61	306150	412139	267980	582400	212518	201418
1961-62	306150	412139	267980	580147	198219	196622
1962-63	306150	412139	267980	566416	230941	197162
1963-64	306150	412139	267980	596611	218693	204486
1964-65	306150	412139	267980	597597	181409	199610
1965-66	306150	412139	267980	577043	243107	197669
1966-67	306150	412139	267980	582369	201776	199423
1967-68	306150	412139	267980	573255	209644	197261
1968-69	306150	412139	267980	578612	224910	203785
1969-70	306150	412139	267980	596087	213801	199971
1970-71	306150	412139	267980	584122	209823	199188
1971-72	306150	412139	267980	568767	237500	201482
1972-73	306150	412139	267980	589117	197431	203862
1973-74	306150	412139	267980	587093	184923	199047
1974-75	306150	412139	267980	561900	203295	200876
1975-76	306150	412139	267980	569835	222303	200152
1976-77	306150	412139	267980	575243	218996	201221
1977-78	306150	412139	267980	589053	215344	199191
1978-79	306150	412139	267980	571267	214703	201498
1979-80	306150	412139	267980	579517	200922	199321
1980-81	306150	412139	267980	605080	217493	204603
1981-82	306150	412139	267980	577508	225245	201119
1982-83	306150	412139	267980	574155	200582	200077
1983-84	306150	412139	267980	592999	197329	200154
1984-85	306150	412139	267980	581423	202480	197297
1985-86	306150	412139	267980	593521	218484	200481
1986-87	306150	412139	267980	586419	207840	201189
1987-88	306150	412139	267980	582860	215068	201069
1988-89	306150	412139	267980	593632	202368	200245
1989-90	306150	412139	267980	562211	211192	194066
1990-91	306150	412139	267980	575647	200580	197965
1991-92	306150	412139	267980	581829	179488	200152
1992-93	306150	412139	267980	572029	230257	196077
1993-94	306150	412139	267980	595144	199385	201785
1994-95	306150	412139	267980	568440	228564	193563
1995-96	306150	412139	267980	600489	212067	202829
1996-97	306150	412139	267980	572750	209864	201096
1997-98	306150	412139	267980	591473	191698	200796
1998-99	306150	412139	267980	592828	215979	199058
Averages:	306150	412139	267980	581678	209281	199764

EFFRICE	EFFOTHER	STRGEXST	STRGPLN	STRGTOT	STRGUSD	TWCAP	GW
70	70	30429	82004	112429	100838	51207	232377
70	70	30429	82089	112511	101113	52857	229875
70	70	30429	82208	112633	101214	49214	239393
70	70	30429	82117	112541	101081	47391	233653
70	70	30429	82727	113151	101465	30502	240582
70	70	30429	82637	113061	101642	49882	236959
70	70	30429	81492	111915	100418	77422	217253
70	70	30429	82804	113228	101810	46242	238225
70	70	30429	82978	113403	102069	44398	238099
70	70	30429	80771	111196	99469	81645	214123
70	70	30429	82301	112725	101269	56037	229365
70	70	30429	81977	112401	100981	68888	225736
70	70	30429	82385	112810	101469	56603	233114
70	70	30429	82671	113095	101679	38758	238734
70	70	30429	82713	113138	101795	47884	242898
70	70	30429	82942	113366	101710	34617	242034
70	70	30429	82395	112820	101406	49149	234976
70	70	30429	82416	112840	101405	51167	231892
70	70	30429	80136	110561	98581	88880	201404
70	70	30429	82343	112768	101449	60228	232861
70	70	30429	82364	112787	101351	54219	228304
70	70	30429	82818	113243	101841	68259	226073
70	70	30429	82536	112961	101581	50325	236542
70	70	30429	81407	111831	100279	75531	216279
70	70	30429	82616	113042	101411	35012	239005
70	70	30429	82388	112812	101376	28921	241686
70	70	30429	82508	112933	101646	57433	229027
70	70	30429	82305	112728	101236	55969	232658
70	70	30429	82361	112786	101421	64238	229279
70	70	30429	82131	112555	101207	61865	233868
70	70	30429	82404	112828	101323	35385	240294
70	70	30429	82685	113109	101729	42132	239730
70	70	30429	82149	112573	101075	69665	223022
70	70	30429	82290	112716	101185	37906	238561
70	70	30429	82724	113148	101691	42657	234736
70	70	30429	81636	112059	100401	88995	213971
70	70	30429	82624	113048	101657	58146	234259
70	70	30429	82552	112976	101582	57851	227691
70	70	30429	81876	112302	100796	38392	237425
70	70	30429	82492	112915	101527	68246	226428
70	70	30429	82765	113190	101768	58782	234677
70	70	30429	82855	113279	101584	26855	245199
70	70	30429	82885	113310	101853	59066	235130
70	70	30429	82253	112677	101263	55086	230084
70	70	30429	82797	113221	101879	43800	241690
70	70	30429	82717	113142	101772	52886	235677
70	70	30429	82377	112801	101314	36384	238514
70	70	30429	82954	113379	101974	43053	238397
70	70	30429	82632	113056	101656	47862	233911
70	70	30429	82547	112972	101634	38593	242053
70	70	30429	82057	112481	100920	74894	220820
70	70	30429	82763	113188	101882	53066	234995
70	70	30429	82312	112735	101311	52564	229523
70	70	30429	82243	112667	101272	58148	230225
70	70	30429	82820	113246	101903	34191	242650
70	70	30429	82116	112539	101127	59925	224723
70	70	30429	82581	113005	101517	27843	245132
70	70	30429	82401	112825	101434	69527	223654
70	70	30429	82645	113069	101708	41509	239421
70	70	30429	82180	112605	101030	40153	235036
70	70	30429	82365	112789	101333	52472	232732

OSWI	ISWI	PDEVAF	PDEVGPM	MXDEVQ	FISH	RICE	LBEANS	EBEANS
151837	204422	163914	131167326	2732	22079	81479	40581	105723
149470	192868	155703	125142319	2595	22079	81479	40581	105723
132834	187216	152164	123954576	2535	22079	81479	40581	105723
133176	200106	171414	141336120	2857	22079	81479	40581	105723
158251	226425	183597	139683138	3060	22079	81479	40581	105723
125961	199764	168060	133804234	2801	22079	81479	40581	105723
113937	173748	155839	133068986	2597	22079	81479	40581	105723
196092	199006	174691	135538307	2911	22079	81479	40581	105723
130233	206363	160736	128175444	2680	22079	81479	40581	105723
130110	161272	164711	133253049	2745	22079	81479	40581	105723
130670	189718	154677	130037976	2578	22079	81479	40581	105723
157265	172413	166328	137661988	2772	22079	81479	40581	105723
125565	187454	163538	136008604	2726	22079	81479	40581	105723
134396	215735	160610	128604286	2677	22079	81479	40581	105723
140396	195195	158400	127051851	2640	22079	81479	40581	105723
152319	216855	168929	135365762	2815	22079	81479	40581	105723
144817	198897	162432	129762692	2707	22079	81479	40581	105723
119469	199674	164264	137661904	2737	22079	81479	40581	105723
106035	160130	141873	117611928	2365	22079	81479	40581	105723
137626	182029	167131	135365681	2785	22079	81479	40581	105723
134400	200699	166680	131507910	2778	22079	81479	40581	105723
152327	186201	168846	139866472	2814	22079	81479	40581	105723
131982	191632	174790	138488775	2913	22079	81479	40581	105723
179638	174313	168479	138807007	2808	22079	81479	40581	105723
148751	221174	168145	136372794	2802	22079	81479	40581	105723
119061	225584	164123	134398341	2735	22079	81479	40581	105723
207372	188919	177397	140151536	2957	22079	81479	40581	105723
139953	192488	167666	138580504	2795	22079	81479	40581	105723
142620	178297	165758	135365683	2763	22079	81479	40581	105723
172425	181645	167060	136376074	2784	22079	81479	40581	105723
146398	219031	161622	130936563	2694	22079	81479	40581	105723
137005	200459	156160	127260856	2602	22079	81479	40581	105723
196387	174993	171935	140087350	2865	22079	81479	40581	105723
132587	211439	164707	135916653	2745	22079	81479	40581	105723
111786	207994	155171	126475878	2586	22079	81479	40581	105723
130017	158546	159234	131048477	2654	22079	81479	40581	105723
159695	175669	165977	136894278	2766	22079	81479	40581	105723
156852	188100	167494	136748297	2791	22079	81479	40581	105723
149640	212431	163567	135090100	2726	22079	81479	40581	105723
148392	175024	167942	135273830	2799	22079	81479	40581	105723
132722	184277	153680	126018012	2561	22079	81479	40581	105723
165816	231435	180859	138213414	3014	22079	81479	40581	105723
161471	181458	172861	136621281	2881	22079	81479	40581	105723
132868	187687	158098	127570469	2635	22079	81479	40581	105723
128498	205595	159524	131140296	2659	22079	81479	40581	105723
135403	191046	168757	136008634	2812	22079	81479	40581	105723
164811	217285	163456	132429088	2724	22079	81479	40581	105723
146170	202994	171743	134398619	2862	22079	81479	40581	105723
164002	199427	179711	139682968	2995	22079	81479	40581	105723
139753	211341	179652	139682935	2994	22079	81479	40581	105723
142055	165556	164446	138304891	2740	22079	81479	40581	105723
129232	185697	156361	124685612	2606	22079	81479	40581	105723
112286	198374	139358	111670110	2323	22079	81479	40581	105723
177479	182406	177697	137394607	2961	22079	81479	40581	105723
122709	216386	164266	130535905	2738	22079	81479	40581	105723
175325	182625	164715	131992786	2745	22079	81479	40581	105723
147175	225996	166222	133896720	2770	22079	81479	40581	105723
139848	178148	168512	134447171	2808	22079	81479	40581	105723
116768	208797	167468	138029355	2792	22079	81479	40581	105723
153720	216552	174574	141336216	2909	22079	81479	40581	105723
144264	195117	165229	133499377	2754	22079	81479	40581	105723

CORN	GRSRG	OIRG	TOTCROP	WFLCRPLND	IRGREST	TOTHOH	OFFSEAQ	PRIORCROP	PRIORIRRG
2369	1384	36446	306150	26798	13768	35847	823	318704	280534
2369	1384	36446	306150	26798	13768	35847	746	318704	280534
2369	1384	36446	306150	26798	13768	35847	726	318704	280534
2369	1384	36446	306150	26798	13768	35847	840	318704	280534
2369	1384	36446	306150	26798	13768	35847	954	318704	280534
2369	1384	36446	306150	26798	13768	35847	842	318704	280534
2369	1384	36446	306150	26798	13768	35847	728	318704	280534
2369	1384	36446	306150	26798	13768	35847	900	318704	280534
2369	1384	36446	306150	26798	13768	35847	764	318704	280534
2369	1384	36446	306150	26798	13768	35847	838	318704	280534
2369	1384	36446	306150	26798	13768	35847	737	318704	280534
2369	1384	36446	306150	26798	13768	35847	814	318704	280534
2369	1384	36446	306150	26798	13768	35847	767	318704	280534
2369	1384	36446	306150	26798	13768	35847	771	318704	280534
2369	1384	36446	306150	26798	13768	35847	753	318704	280534
2369	1384	36446	306150	26798	13768	35847	835	318704	280534
2369	1384	36446	306150	26798	13768	35847	801	318704	280534
2369	1384	36446	306150	26798	13768	35847	785	318704	280534
2369	1384	36446	306150	26798	13768	35847	656	318704	280534
2369	1384	36446	306150	26798	13768	35847	808	318704	280534
2369	1384	36446	306150	26798	13768	35847	815	318704	280534
2369	1384	36446	306150	26798	13768	35847	825	318704	280534
2369	1384	36446	306150	26798	13768	35847	907	318704	280534
2369	1384	36446	306150	26798	13768	35847	843	318704	280534
2369	1384	36446	306150	26798	13768	35847	795	318704	280534
2369	1384	36446	306150	26798	13768	35847	769	318704	280534
2369	1384	36446	306150	26798	13768	35847	898	318704	280534
2369	1384	36446	306150	26798	13768	35847	815	318704	280534
2369	1384	36446	306150	26798	13768	35847	808	318704	280534
2369	1384	36446	306150	26798	13768	35847	806	318704	280534
2369	1384	36446	306150	26798	13768	35847	782	318704	280534
2369	1384	36446	306150	26798	13768	35847	744	318704	280534
2369	1384	36446	306150	26798	13768	35847	877	318704	280534
2369	1384	36446	306150	26798	13768	35847	795	318704	280534
2369	1384	36446	306150	26798	13768	35847	726	318704	280534
2369	1384	36446	306150	26798	13768	35847	753	318704	280534
2369	1384	36446	306150	26798	13768	35847	799	318704	280534
2369	1384	36446	306150	26798	13768	35847	820	318704	280534
2369	1384	36446	306150	26798	13768	35847	784	318704	280534
2369	1384	36446	306150	26798	13768	35847	828	318704	280534
2369	1384	36446	306150	26798	13768	35847	733	318704	280534
2369	1384	36446	306150	26798	13768	35847	928	318704	280534
2369	1384	36446	306150	26798	13768	35847	869	318704	280534
2369	1384	36446	306150	26798	13768	35847	776	318704	280534
2369	1384	36446	306150	26798	13768	35847	739	318704	280534
2369	1384	36446	306150	26798	13768	35847	843	318704	280534
2369	1384	36446	306150	26798	13768	35847	782	318704	280534
2369	1384	36446	306150	26798	13768	35847	866	318704	280534
2369	1384	36446	306150	26798	13768	35847	938	318704	280534
2369	1384	36446	306150	26798	13768	35847	928	318704	280534
2369	1384	36446	306150	26798	13768	35847	811	318704	280534
2369	1384	36446	306150	26798	13768	35847	737	318704	280534
2369	1384	36446	306150	26798	13768	35847	619	318704	280534
2369	1384	36446	306150	26798	13768	35847	928	318704	280534
2369	1384	36446	306150	26798	13768	35847	797	318704	280534
2369	1384	36446	306150	26798	13768	35847	829	318704	280534
2369	1384	36446	306150	26798	13768	35847	793	318704	280534
2369	1384	36446	306150	26798	13768	35847	842	318704	280534
2369	1384	36446	306150	26798	13768	35847	788	318704	280534
2369	1384	36446	306150	26798	13768	35847	850	318704	280534
2369	1384	36446	306150	26798	13768	35847	808	318704	280534

ONTRSTGUSD	POTSTRGAV	INSEA24Q	ONTRSTRGAC	ONTRSTRGDP
107206	107206	2267	13768	7
107206	107206	2154	13768	7
107206	107206	2104	13768	7
107206	107206	2371	13768	7
107206	107206	2540	13768	7
107206	107206	2325	13768	7
107206	107206	2156	13768	7
107206	107206	2416	13768	7
107206	107206	2223	13768	7
107206	107206	2278	13768	7
107206	107206	2139	13768	7
107206	107206	2300	13768	7
107206	107206	2262	13768	7
107206	107206	2222	13768	7
107206	107206	2191	13768	7
107206	107206	2337	13768	7
107206	107206	2246	13768	7
107206	107206	2272	13768	7
107206	107206	1963	13768	7
107206	107206	2312	13768	7
107206	107206	2306	13768	7
107206	107206	2336	13768	7
107206	107206	2418	13768	7
107206	107206	2331	13768	7
107206	107206	2326	13768	7
107206	107206	2270	13768	7
107206	107206	2454	13768	7
107206	107206	2319	13768	7
107206	107206	2292	13768	7
107206	107206	2311	13768	7
107206	107206	2236	13768	7
107206	107206	2160	13768	7
107206	107206	2378	13768	7
107206	107206	2278	13768	7
107206	107206	2147	13768	7
107206	107206	2203	13768	7
107206	107206	2296	13768	7
107206	107206	2317	13768	7
107206	107206	2263	13768	7
107206	107206	2323	13768	7
107206	107206	2126	13768	7
107206	107206	2502	13768	7
107206	107206	2392	13768	7
107206	107206	2187	13768	7
107206	107206	2207	13768	7
107206	107206	2334	13768	7
107206	107206	2261	13768	7
107206	107206	2376	13768	7
107206	107206	2486	13768	7
107206	107206	2485	13768	7
107206	107206	2275	13768	7
107206	107206	2163	13768	7
107206	107206	1928	13768	7
107206	107206	2458	13768	7
107206	107206	2272	13768	7
107206	107206	2278	13768	7
107206	107206	2299	13768	7
107206	107206	2331	13768	7
107206	107206	2317	13768	7
107206	107206	2415	13768	7
107206	107206	2286	13768	7

APR_TEN	APR_TWENTY	APR_THIRTY	MAY_TEN	MAY_TWENTY	MAY_THIRTY	JUN_TEN	JUN_TWENTY	JUN_THIRTY
1357	1128	1953	547	648	568	755	666	653
1362	1234	1721	421	598	548	737	728	780
1475	1315	1394	208	619	648	709	753	735
960	2039	877	515	559	674	763	699	804
1503	1298	2344	336	696	538	845	922	889
1179	1328	2019	180	705	163	809	862	864
1106	1599	1348	195	354	690	744	615	790
1986	1457	2153	415	164	412	771	830	822
1576	1239	1518	607	238	527	758	872	859
1132	1218	1992	21	386	415	626	617	685
1663	1529	1624	362	633	491	727	767	639
1771	1888	1711	39	481	675	726	776	776
1430	1811	1274	452	637	662	599	769	769
1636	1315	1811	560	498	641	831	876	876
1242	1463	1152	97	11	740	805	801	680
1967	1470	1852	345	576	429	841	887	890
1369	1301	1895	435	655	222	781	831	831
1191	1867	1375	490	521	708	762	653	807
774	1265	1176	484	341	394	520	688	672
1970	1679	886	17	564	692	738	765	647
1345	1550	1962	633	514	531	796	831	822
1909	1987	1434	131	453	664	739	810	537
1428	1296	2222	11	567	664	712	662	791
1783	1973	1795	273	599	621	596	614	627
1486	1852	1038	479	736	314	872	905	847
836	1666	390	624	733	753	837	897	898
1994	2029	2053	501	614	631	690	704	798
1964	1931	508	244	325	701	763	798	798
1960	1497	1188	26	510	622	652	764	733
1736	1840	1705	269	18	706	790	833	743
1386	1588	1802	598	561	736	799	858	830
1600	1236	1598	191	609	704	711	808	807
1906	2027	1955	457	231	472	651	631	731
1745	1737	1756	402	680	737	819	863	809
1510	755	1009	351	503	522	812	859	859
1739	1460	1239	123	332	439	259	737	745
1784	1876	1454	298	422	587	458	660	738
1983	1863	1243	201	526	568	709	681	731
1376	1776	1712	513	685	708	796	799	827
1941	1591	1822	19	450	487	460	800	739
1084	1440	1405	30	519	143	648	791	789
1908	1173	2272	612	134	726	902	957	911
1240	1863	2054	347	143	392	345	787	788
1142	1143	1766	484	500	447	717	653	737
1148	1575	1028	541	47	689	808	871	699
1302	1783	2017	0	623	319	750	822	822
1845	1633	875	599	649	658	799	804	849
1334	1285	2068	616	504	491	445	784	824
1811	1868	2300	571	609	531	596	787	656
1574	1296	2281	155	725	739	837	886	886
1560	1905	1755	20	507	552	587	687	619
1305	1385	1592	219	317	585	716	802	802
1190	898	949	345	640	692	776	831	673
1872	1727	2253	562	215	570	669	691	755
1230	1295	1898	351	559	737	835	890	874
1741	1652	1936	349	485	591	699	747	710
1911	1172	1104	433	723	703	828	862	881
1906	1632	1953	358	513	602	528	768	768
850	1888	890	460	694	601	792	689	828
1679	2067	1559	504	730	739	831	893	894
1528	1561	1599	344	496	575	715	782	777

JUL_TEN	JUL_TWENTY	JUL_THIRTY	AUG_TEN	AUG_TWENTY	AUG_THIRTY	SEP_TEN	SEP_TWENTY	SEP_THIRTY
797	797	670	797	790	705	696	594	534
681	784	786	786	707	679	646	585	177
758	672	669	689	759	504	668	570	400
790	807	807	684	693	694	656	379	482
927	904	912	924	899	807	628	645	448
868	868	726	751	868	709	443	627	544
764	793	664	793	793	624	452	315	102
829	831	702	804	834	735	731	599	468
877	863	876	877	875	642	757	651	36
691	634	628	658	630	597	598	439	439
772	759	745	772	726	510	646	422	513
781	781	717	683	720	472	501	134	357
660	773	773	773	686	579	688	274	281
856	880	879	708	795	776	748	636	223
848	853	853	853	852	750	729	632	257
894	848	842	844	894	769	775	583	425
836	720	822	721	831	730	695	614	221
799	797	779	810	810	524	455	595	474
654	692	692	622	623	599	436	326	264
793	793	757	793	768	623	711	248	193
860	860	696	860	860	743	661	346	21
814	814	802	814	814	618	719	219	363
795	790	740	795	715	691	554	565	531
738	681	711	738	739	633	421	273	451
930	930	914	927	912	733	636	368	557
849	902	902	901	834	612	765	445	328
802	802	754	802	802	562	701	105	177
795	774	778	672	666	701	707	417	487
665	769	662	769	769	669	664	124	516
838	838	691	772	802	738	722	95	227
862	862	713	862	713	751	687	624	495
790	812	804	759	756	591	636	586	457
736	736	644	642	736	481	635	515	452
852	867	807	867	789	661	618	383	413
864	799	864	772	854	763	486	553	538
749	749	632	749	633	658	421	490	209
742	742	647	646	742	653	653	334	467
738	794	793	793	793	680	405	583	406
841	777	707	818	840	739	683	473	413
805	805	802	788	795	709	438	105	551
788	795	674	792	795	638	689	586	537
963	963	905	943	945	828	761	653	367
792	792	768	791	734	701	595	529	565
777	777	666	746	758	687	675	303	453
876	876	821	876	876	774	761	645	115
826	803	686	815	826	690	723	489	357
715	853	787	853	852	681	729	563	482
829	829	829	800	823	721	700	539	413
792	792	787	792	792	637	687	491	450
839	845	776	890	890	724	734	115	524
632	693	661	693	693	413	588	446	490
807	736	722	775	807	714	739	323	218
836	836	736	836	802	717	434	369	401
722	706	758	658	758	639	649	568	200
894	894	849	732	894	784	772	553	199
756	662	699	756	757	583	590	269	476
735	887	762	886	887	780	767	619	528
770	771	659	640	771	622	666	398	73
852	852	850	852	852	613	738	633	131
875	892	898	781	822	787	610	94	477
800	803	761	783	791	669	641	444	372

OCT_TEN	OCT_TWENTY	OCT_THIRTY	NOV_TEN	NOV_TWENTY	NOV_THIRTY	DEC_TEN	DEC_TWENTY	DEC_THIRTY
175	246	225	94	43	44	0	43	0
406	184	225	177	0	8	15	0	32
420	132	28	41	200	29	2	0	0
427	246	225	0	128	50	0	48	4
425	35	170	126	59	188	0	0	0
358	246	225	185	0	13	0	0	0
74	246	25	94	0	47	0	0	0
383	139	0	65	0	71	29	0	49
417	246	162	57	0	58	22	0	66
397	149	225	0	1	0	0	0	20
135	0	0	185	200	188	0	0	0
424	122	152	136	5	52	0	38	66
438	246	50	0	55	70	0	0	0
343	65	225	185	18	0	0	53	1
425	246	92	182	200	8	0	0	57
292	47	170	38	200	165	7	0	63
169	188	225	140	116	25	0	53	48
215	246	121	0	70	55	29	0	0
376	125	10	165	0	0	29	0	0
252	246	177	156	11	52	0	6	26
163	57	209	32	55	188	6	0	0
364	27	137	73	0	174	0	0	61
304	246	225	0	57	0	9	0	0
421	0	59	180	153	44	0	53	0
441	246	225	149	194	33	3	53	66
225	128	160	92	54	38	0	0	57
379	227	225	152	68	182	29	0	43
178	26	123	160	64	156	0	0	16
397	23	175	71	178	136	0	0	0
216	220	225	91	150	120	0	0	0
316	198	219	68	164	0	0	7	0
441	2	17	105	28	127	29	0	0
423	162	208	185	149	52	0	0	43
380	214	0	18	0	0	0	0	0
391	0	225	55	193	0	0	53	0
417	221	225	0	37	18	0	0	0
438	246	58	108	193	147	0	0	4
335	232	0	58	168	62	8	0	18
196	104	162	8	25	38	0	0	47
434	166	186	185	27	0	0	0	28
434	229	86	37	70	0	29	0	0
147	246	6	61	0	31	0	0	65
441	129	0	52	200	188	0	16	22
173	69	178	74	179	0	0	0	0
441	105	0	94	158	0	0	0	0
164	0	0	111	43	65	0	0	0
359	246	16	63	66	64	0	0	66
369	195	0	66	0	0	18	0	0
409	243	42	185	0	0	5	0	0
289	228	22	145	29	0	0	31	0
186	184	204	75	148	73	29	33	54
174	0	12	75	50	160	0	52	0
380	211	160	0	172	20	0	0	10
441	38	95	42	100	52	10	0	0
304	233	0	103	126	0	0	0	18
413	49	67	119	61	132	9	0	33
438	246	14	59	58	153	5	0	0
316	246	0	33	65	0	0	0	0
441	235	16	5	63	188	0	0	0
187	246	41	175	142	70	0	0	0
332	159	113	90	83	64	5	9	18

JAN_TEN	JAN_TWENTY	JAN_THIRTY	FEB_TEN	FEB_TWENTY	FEB_THIRTY	MAR_TEN	MAR_TWENTY	MAR_THIRTY
247	125	319	523	34	49	572	383	30
154	329	113	65	209	162	423	357	292
55	475	424	79	148	23	278	74	45
19	134	434	78	441	402	111	15	20
24	167	462	338	91	21	25	616	15
7	127	21	431	42	11	17	77	7
4	1	106	221	2	325	479	9	8
28	258	61	501	484	301	472	721	642
18	154	93	39	5	131	20	675	13
12	410	4	7	375	12	515	21	12
14	4	326	5	12	152	468	9	18
33	5	454	31	182	27	294	376	90
117	294	107	39	53	107	57	72	56
123	203	42	79	14	76	217	303	11
130	14	17	70	437	16	414	693	157
15	100	359	338	18	24	442	24	24
461	461	51	12	24	22	311	129	237
109	433	23	3	23	34	57	93	28
230	76	16	389	364	140	80	63	20
215	37	65	459	119	34	165	301	22
98	56	137	26	138	163	37	34	463
28	190	319	449	208	16	153	73	8
13	26	11	134	259	2	66	283	14
327	501	198	317	97	422	363	100	194
483	121	283	316	53	161	61	67	102
52	13	69	454	2	294	217	641	561
288	184	263	248	9	251	444	722	574
20	168	297	98	453	85	115	417	217
41	23	118	113	458	367	341	22	20
184	467	94	14	388	69	565	506	29
11	174	373	83	383	30	22	464	31
53	353	193	462	70	33	399	54	45
29	333	461	203	372	403	128	554	225
49	101	10	17	8	489	88	11	4
84	13	159	42	293	13	512	169	111
19	62	231	21	148	150	489	6	15
99	392	40	505	149	56	287	30	119
397	30	249	393	125	350	57	188	81
331	25	18	257	151	471	205	133	440
28	122	19	182	113	27	22	387	136
260	148	48	175	78	537	459	109	4
458	234	309	154	111	258	117	704	29
110	182	130	46	82	415	152	364	389
18	262	232	26	121	183	117	686	270
363	397	114	154	24	443	19	295	63
70	248	119	17	124	82	103	499	21
277	455	257	34	134	576	559	226	486
185	244	217	86	443	65	16	689	24
15	101	87	77	208	186	417	212	33
15	2	368	16	8	8	27	643	2
20	369	47	3	73	170	180	12	20
22	12	231	476	84	12	83	650	81
317	68	279	374	205	336	8	19	15
166	176	53	568	190	164	154	733	36
228	101	64	18	18	22	104	358	16
460	95	26	449	493	204	91	186	550
32	313	147	390	478	44	215	531	43
135	132	51	14	106	32	12	244	113
255	9	127	216	153	50	126	257	65
27	373	96	26	192	474	233	24	71
135	185	167	189	171	170	220	289	124

GLOSSARY

GLOSSARY

ACRE-FOOT - The volume of water required to cover one acre to a depth of one foot.

Farm Service Agency (FSA) - A U.S. Department of Agriculture (USDA) agency responsible for administering farm price and income support programs as well as some conservation and forestry cost-sharing programs.

BASE ACRES - The acres on a farm that are eligible for federal program payments. Base acres for each year are calculated as the average number of acres enrolled in a specific commodity program during the previous 5 years.

CHANNEL - A natural stream or manmade canal utilized for the delivery of water.

TRACT - The smallest designation on which ASCS records are maintained and is a contiguous piece of property with single or group ownership.

TRACT NUMBER - An identifier for the tract. No two tracts in a county have the same identifier.

TOTAL FARMLAND ACRES - This is the total acres recorded for a farm. This can include crops, farm headquarters, woods, etc. This area can be composed of several tracts under a unique ownership.

CROPLAND ACRES - This is the total crop acres available on the tract.

CUPCP/GRASS/OTHER C ACRES - Cropland on tracts that have grass or other than irrigated crops.

CONSERVATION RESERVE PROGRAM (CRP) - A program authorized under the Food Security Act of 1985 that allows up to 45 million acres of highly erodible land to be placed into a 10 year reserve. Land in the reserve must be under grass or tree cover to protect it from erosion. It is not allowed to be used for hay production or livestock grazing.

CORPS of ENGINEERS PHOTO - The identifying number for each of the 1:24,000 aerial photography photos for the project area.

CROP ROTATION - The successive planting of different crops in the same field over a period of years. Farmers using rotations typically plant a part of their land to each crop in the rotation. A common 2-year rotation in the project area is rice-soybeans.

FARM NUMBER - An identifier for the owner/owners for the farm and the farm number has a list of the associated tracts on the farm. A tract is the smallest unit that is used in this evaluation.

BASE ACREAGE - The acreage per crop allocated by ASCS for yearly farm production by farm. These are rice, wheat, oats, corn and grain Sorghum. Cropland acres minus base acreage plus wheat acres.

FISH POND ACRES - The acres of fish pond/ponds on a specific tract planimetered from the Corps of Engineers aerial photography.

FISH POND DEPTH - The average estimated depth of the fish pond/ponds on a specific tract.

IRRIGATION STORAGE ACRES - The acres of the irrigation water storage on a specific tract planimetered from the Corps of Engineers aerial photography.

IRRIGATION STORAGE DEPTH - The average estimated depth of the irrigation water storage on a specific tract.

F/W LAKE ACRES - Fish and wildlife acres of lakes or reservoirs in a specific tract.

F/W LAKE DEPTH - Fish and wildlife lakes or reservoirs average estimated depth.

RECHARGE - The replenishment of an aquifer with water from the land's surface.

ROW CROPS - Crops that require planting each year and are grown in rows, such as corn, soybeans, and sorghum.

WATER-HOLDING CAPACITY - The ability of a soil and crop system to hold water in the root zone.