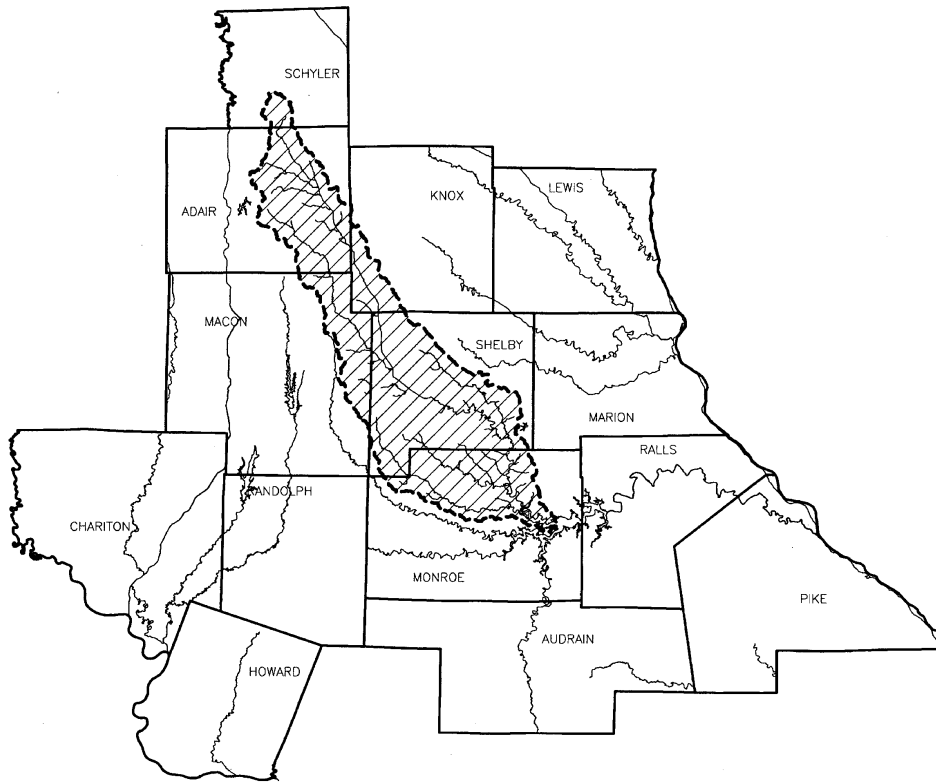


# *The North Fork Project*

## *Watershed Education and Information for Decision Makers*

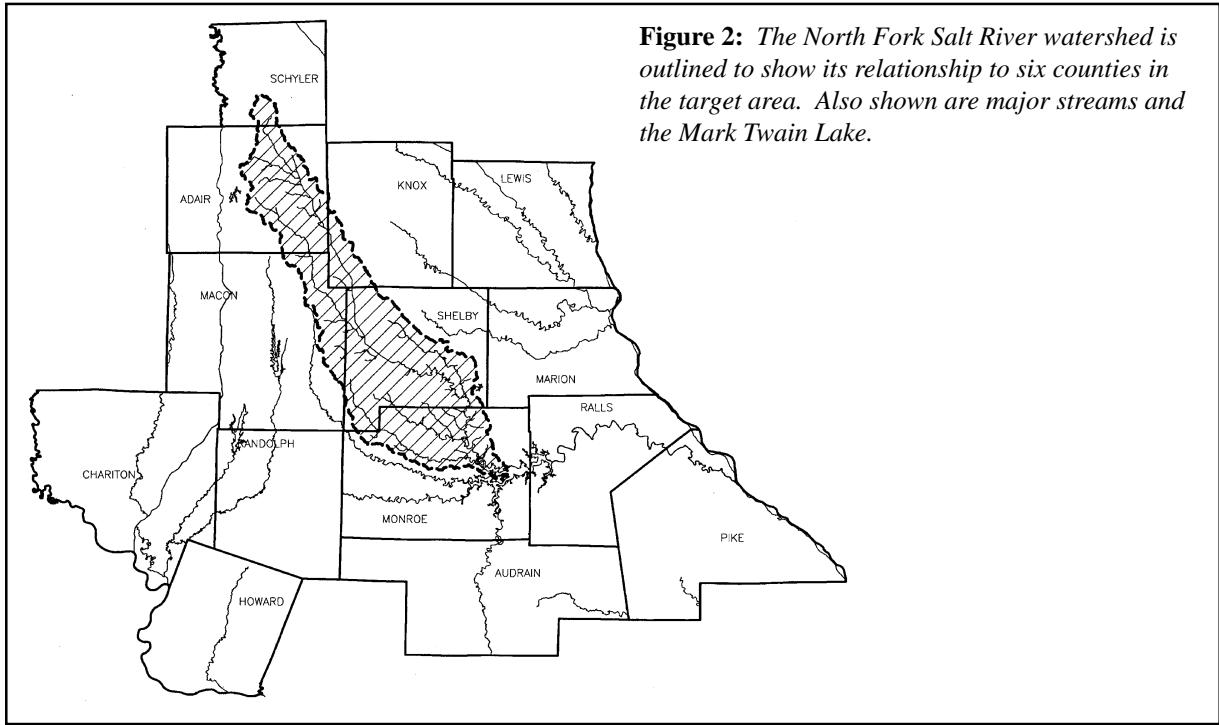
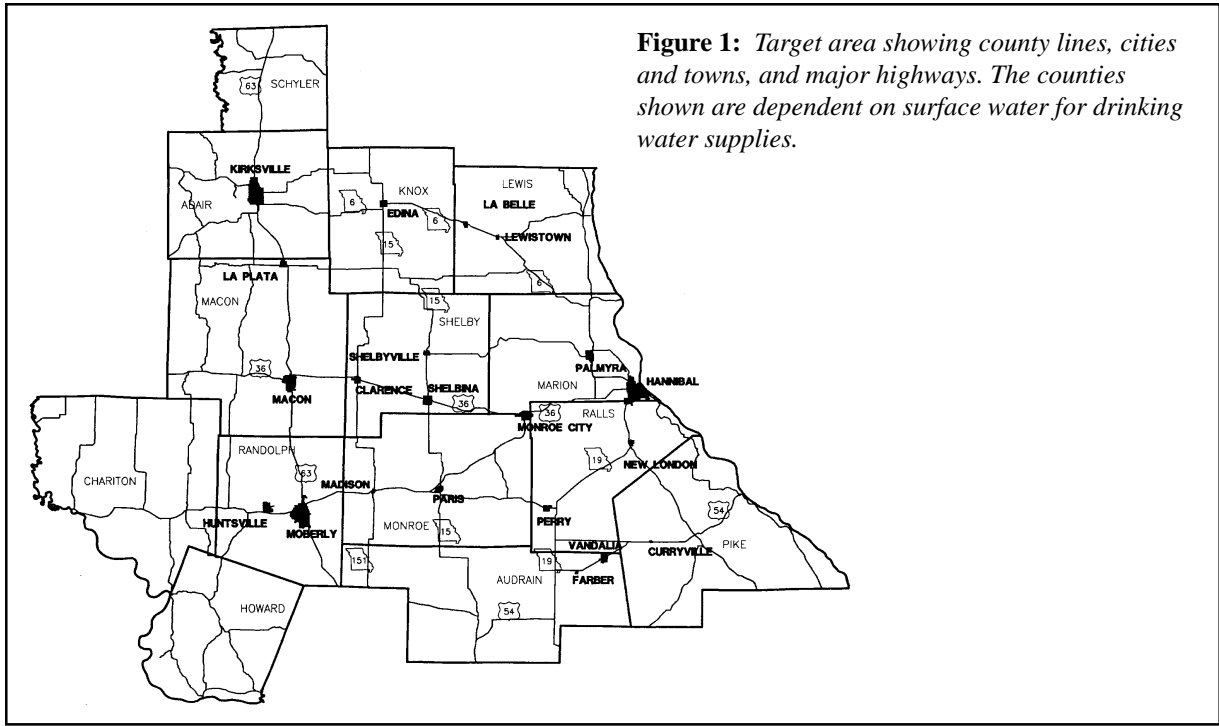


### *Watershed Restoration Action Strategies (WRAS) for the North Fork Salt River*

*The North Fork Project*  
*Watershed Education and Information for Decision Makers*  
*Watershed Restoration Action Strategies for the North Fork Salt River*

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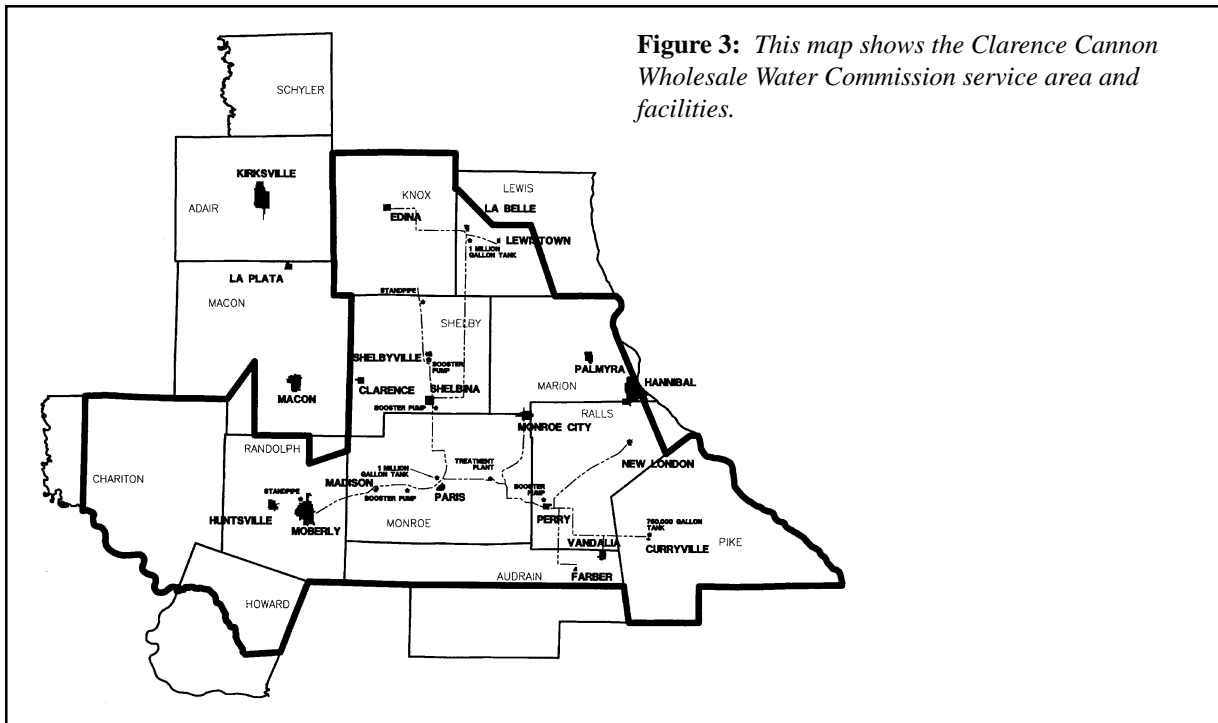
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**Political Boundaries:** The watershed for the North Fork Salt River includes portions of six counties with a total population of 65,380 (2000 Census). None of these counties is located completely within the watershed (county population shown in parentheses): Adair (24,977), Knox (4361), Macon (15,762), Monroe (9311), Schuyler (4170) and Shelby (6799).

Cities and towns located within or in part of the watershed include the following (population in parentheses): Brashear (280), Clarence (915), Gibbs (100), Greentop (427), Hunnewell (227), Kirksville (16,988), LaPlata (1486), Leonard (66), Millard (75), Queen City (638), Shelbina (1943), Shelbyville (682), and Stoutsville (44). The area also includes many unincorporated communities.

The only political subdivisions with municipal public-drinking-water supply systems are Kirksville and Shelbina. The remaining communities have access to rural water service through the Clarence Cannon Wholesale Water Commission, a public-water-supply cooperative. The Commission draws raw water from the Mark Twain Lake and currently provides three million gallons of drinking water daily to its customer communities.



**Figure 3:** This map shows the Clarence Cannon Wholesale Water Commission service area and facilities.

**Land Use:** According to the United States Geological Survey (USGS), the 8 digit hydrologic unit 0711 0005 has a total area of 2,312,748,900 square meters. USGS is also the source for the following land use statistics:

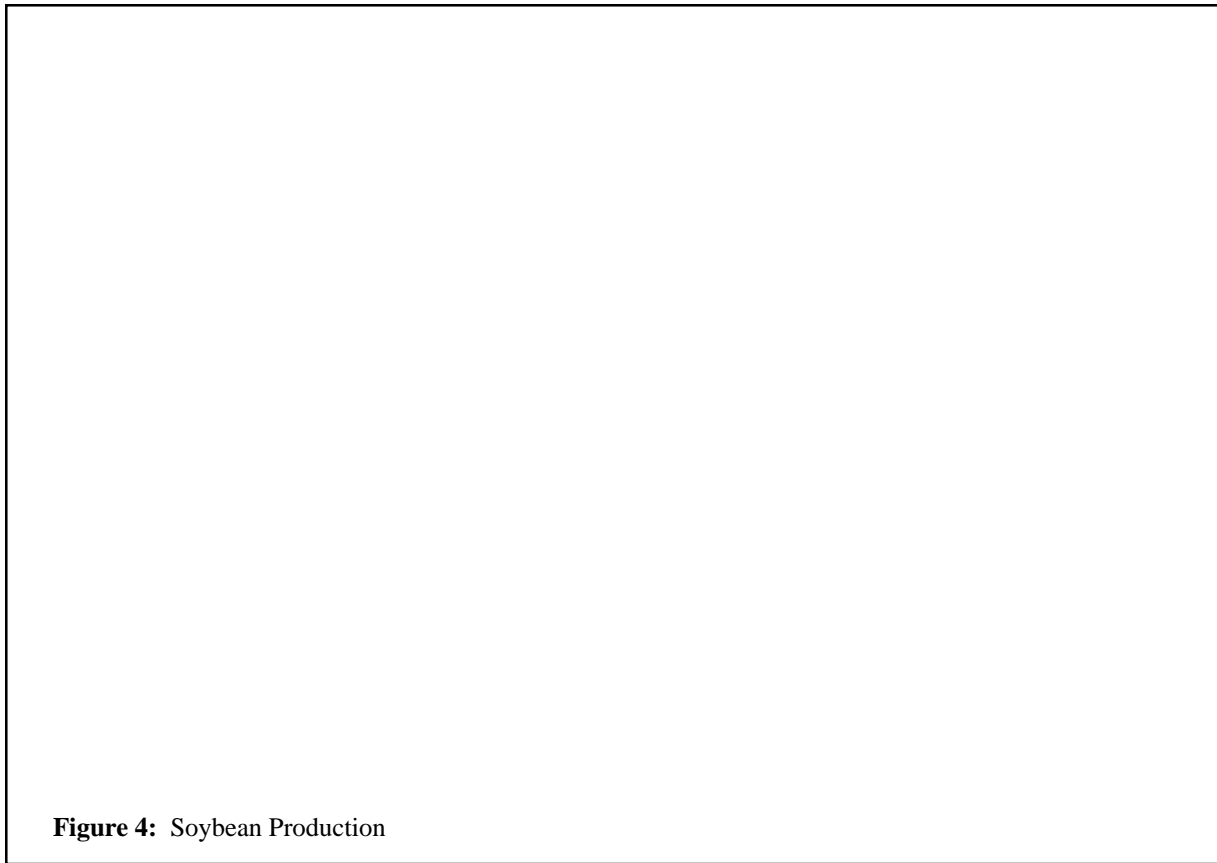
Land Use	Square Meters	Percentages
Urban Impervious	234,900	.01
Urban Vegetated	16,626,600	1
Barren or Sparsely Vegetated	55,800	0
Row and Close Grown Crops	1,014,538,500	44
Cool-Season Grassland	975,607,200	42
Warm Season Grassland	0	0
Glade Complex	0	0
Eastern Redcedar and Redcedar		
Deciduous Forest and Woodland	3,758,400	0
Deciduous Woodland	51,514,200	2
Deciduous Forest	171,130,500	7
Shortleaf Pine-Oak		
Forest and Woodland	0	0
Shortleaf Pine Forest		
And Woodland	0	0
Bottomland Hardwood		
Forest and Woodland	51,037,200	2
Swamp	0	0
Marsh and Wet Herbaceous Vegetation	3,354,300	0
Open Water	24,891,300	1

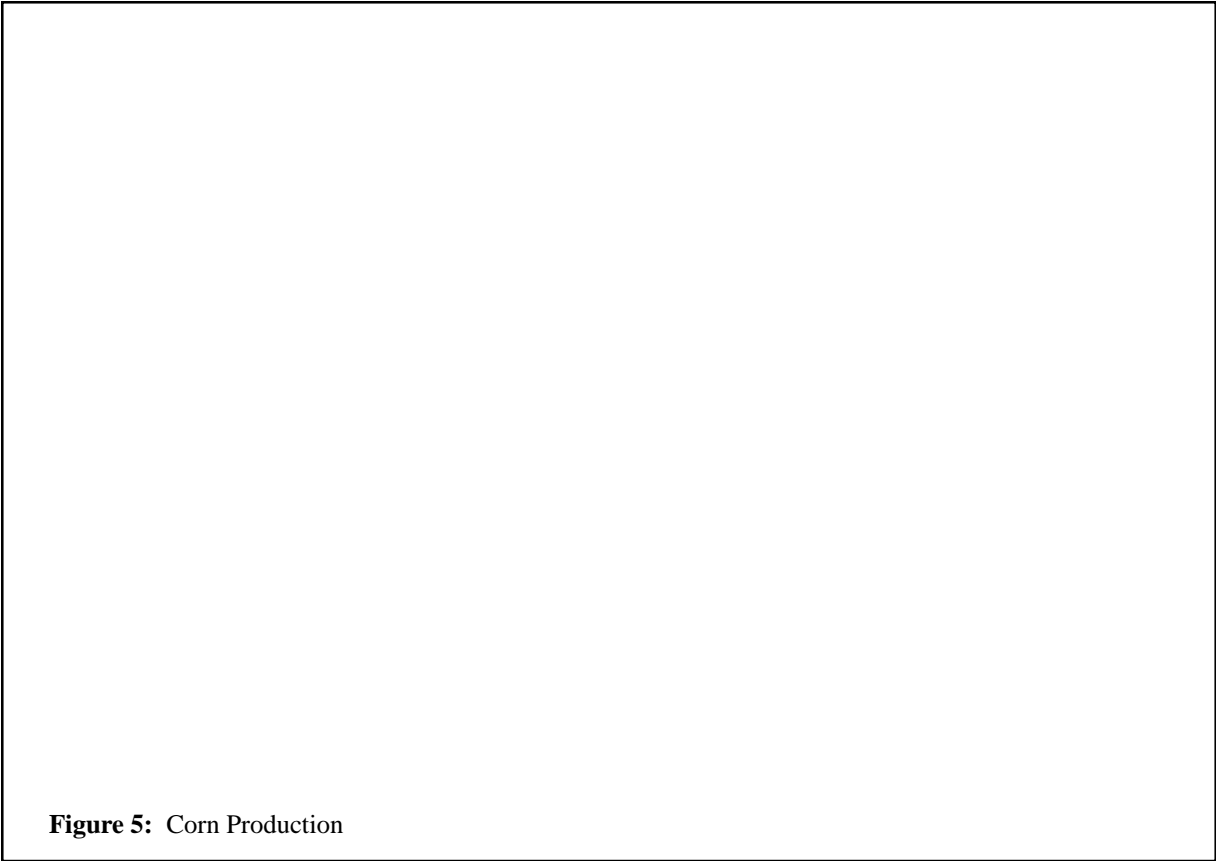
Resource problems in the agricultural landscape include management of confined livestock operations, grasslands, nutrients, pesticides, sediment as well as challenges from decreased farm income.

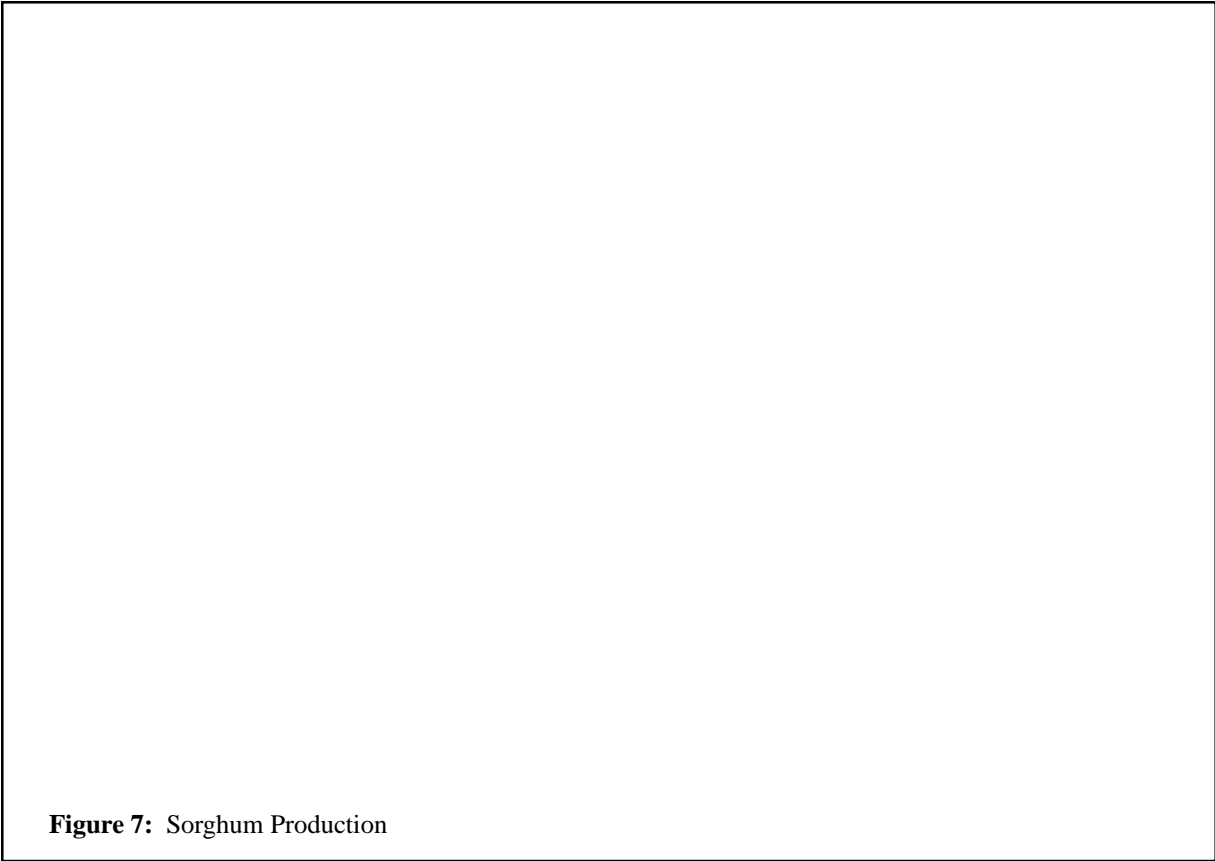
The conservation provisions of the 1996 Farm Bill address high-priority environmental-protection goals. Under the Environmental Quality Incentives Program (EQIP), only land that poses a serious problem to soil, water or related resources is eligible for EQIP contracts. The geographic area impacted by the North Fork Project is a target area for both educational and technical assistance.

Although not perceived as abundant in the area, forests are a significant component enhancing water quality, wildlife habitat and alternative sources of income. Threats to this resource include grazing by cattle and other livestock, conversion of forest land to other uses, improper harvesting practices, and landowner perceptions of their value.

Farming is the main occupation in the area and this is also a major source of income for farm-related enterprises such as banks, elevators, and implement, fertilizer, and chemical suppliers. Major crops grown are soybeans, corn, sorghum (milo), wheat, and hay. See Figures 4 through 8 for 1999 county yields.





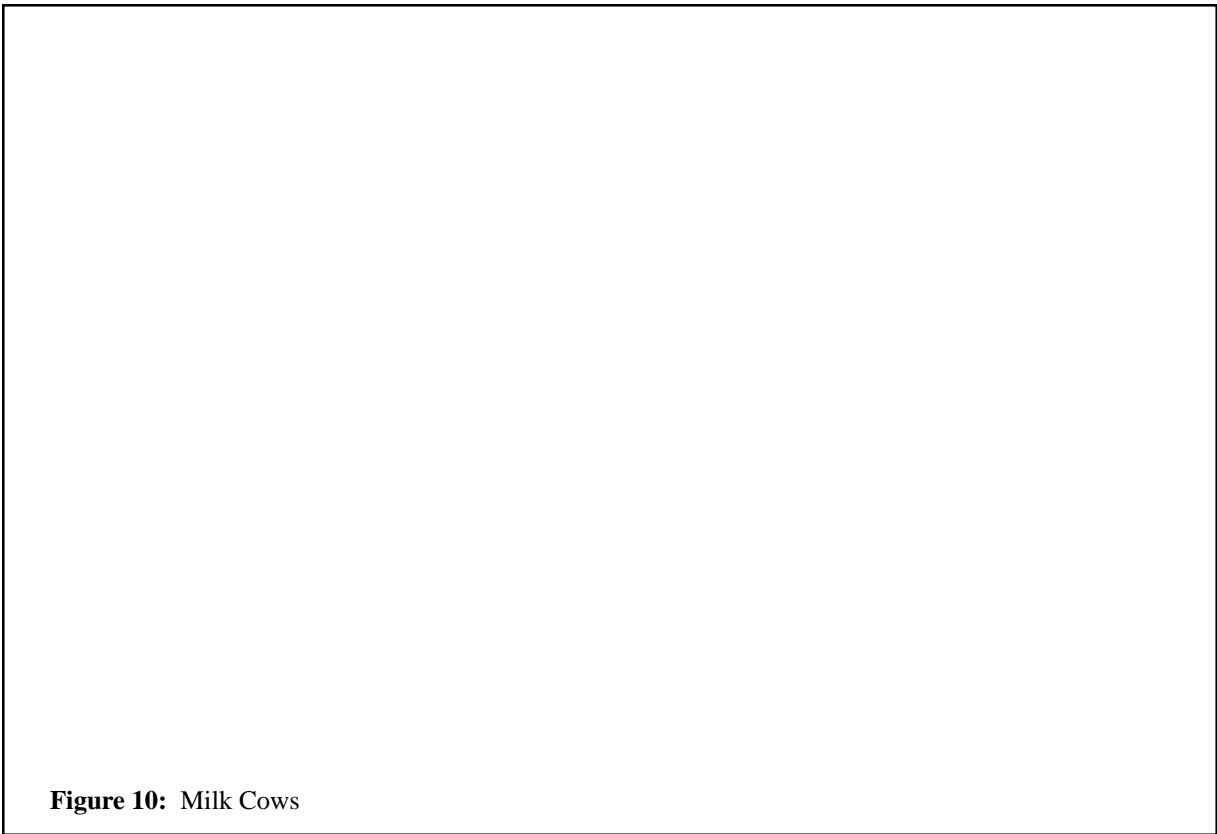
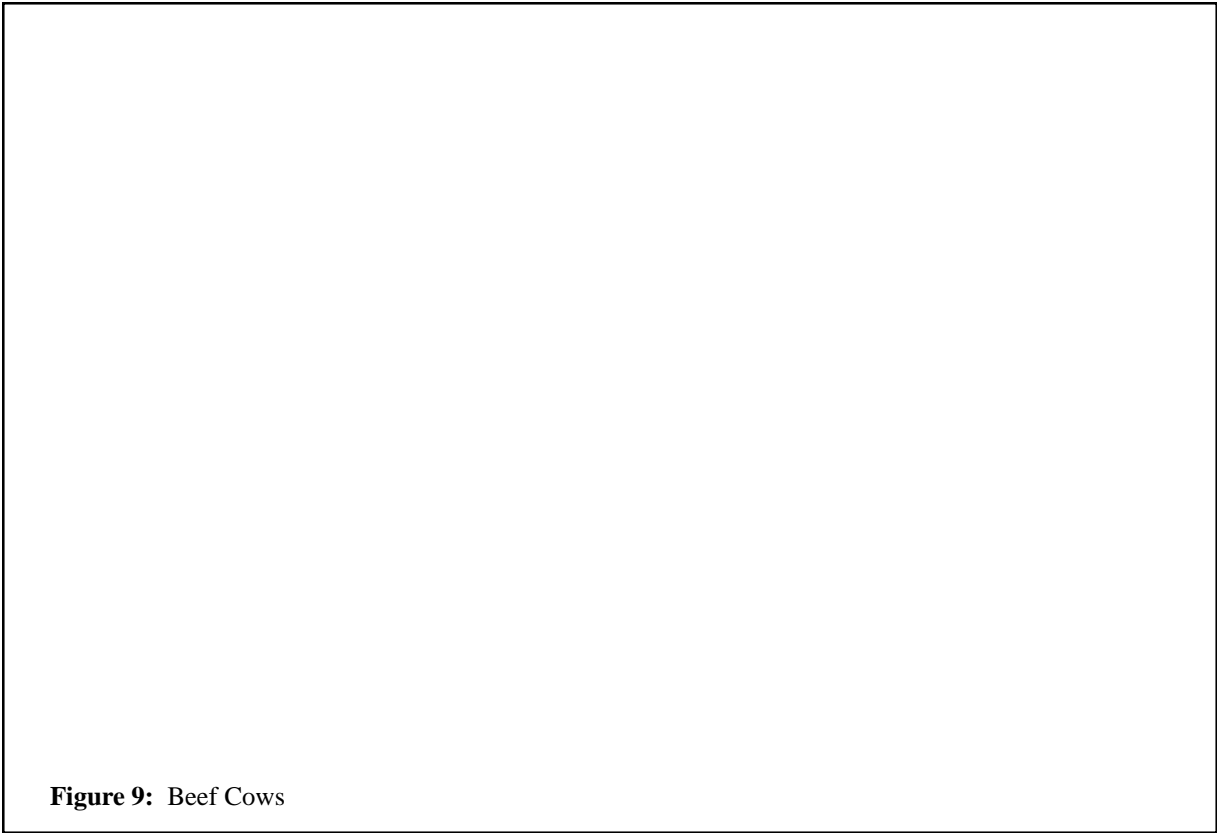


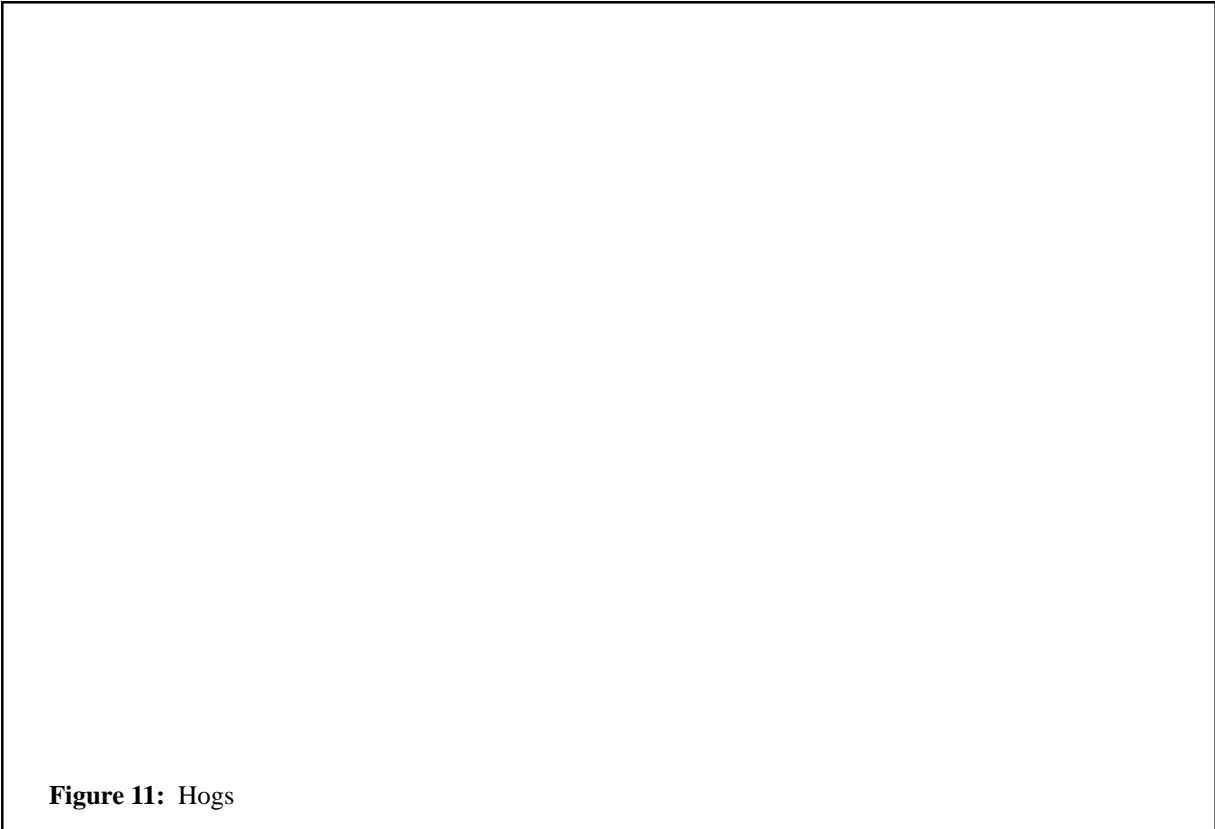
**Figure 7:** Sorghum Production



**Figure 8:** Hay

Livestock production and dairy farming are also part of the farm economy; see the following for numbers by county.



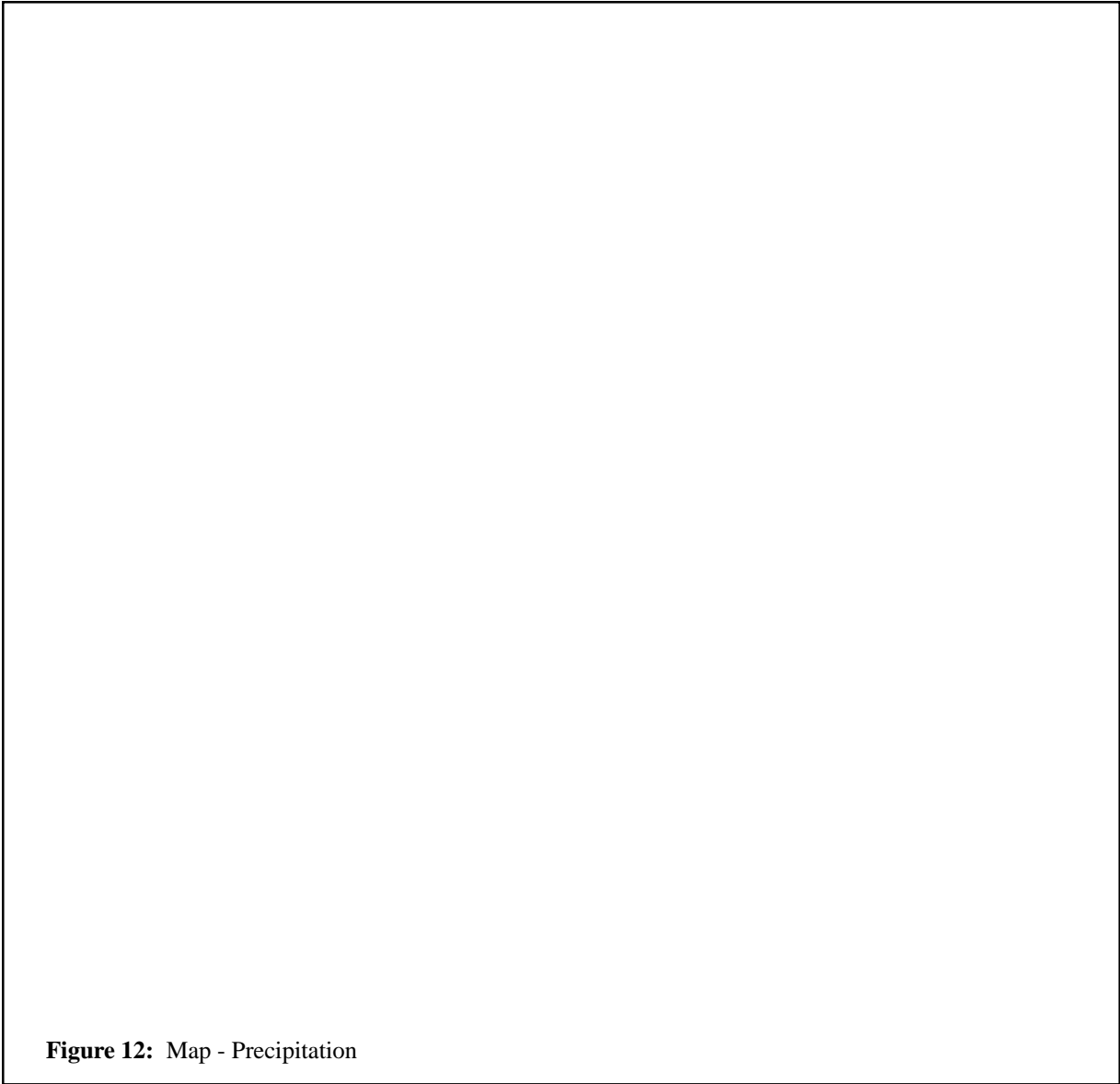
A large, empty rectangular box with a black border, intended for a map or chart showing the distribution of hogs. The box is currently blank.

**Figure 11: Hogs**

Although agriculture is the major industry in the area, there is also a number of small manufacturing industries located throughout the region. Tourism and recreation have become important industries in the region primarily due to the development of the Mark Twain Lake and surrounding area.

Federal highways 24, 36, and 63 along with several state highways and county roads provide the transportation system for the area. Three railroads supply the area with freight and passenger service.

**Precipitation:** Average annual rainfall for counties in the project region reflects the state average of 37.52 inches. See Figure 12 for annual inches of precipitation by county.



Precipitation, crop yields and livestock numbers given are those shown in 2000 Missouri Farm Facts compiled by the Missouri Agricultural Statistics Service.

**III. WATER QUALITY CONCERNS**

**Soils of the North Fork Salt River Watershed:** This watershed is almost entirely in the Central Claypan Major Land Resource Area. Most of the area is a nearly level to gently sloping till plain, mantled with loess of variable thickness. Soils on the nearly level interfluvies include the Mexico and Adco series, with Leonard soils in concave head slopes. These soils are poorly drained, typically with silt loam surface layers and silty clay subsoils formed in loess. Such soils are commonly referred to as “claypan” soils in Missouri. The gently sloping sideslopes are typically Armstrong and Gara soils, with clay loam subsoils formed in glacial till. Floodplain soils in the watershed include the Fatima, Arbela and Vesser series.

Northeast Missouri is heavily dependent on surface runoff for drinking water supplies. Claypan soils are predominant in the region and this contributes to nonpoint source (NPS) pollution from runoff of sediment, nutrients and crop-protection chemicals. “Claypan” soils are all in Hydrologic Soil Group D, which are soils with very high runoff potential. The sideslope soils, such as Armstrong, are mostly in Group C (moderately high runoff potential). This is an estimate of total runoff volume, not runoff rate. So, most of the precipitation on the claypan

soils is subject to runoff, due to low permeability and seasonal saturation, even though they are nearly level.

**Water Quality Concerns:** The 1998 list of waters designated under section 303(d) of the Clean Water Act includes several waters in the Mark Twain watershed and Northeast Missouri. Mark Twain Lake is on the 303(d) list due to elevated atrazine levels. Other water quality problems include high total organic carbon loads, high turbidity spikes after rainfall events, and sedimentation in the lake. Since these are nonpoint source (NPS) pollutants which are largely unregulated, these waters are not expected to attain established standards through currently required control technology. Without a water quality management plan, these watersheds are subject to a total maximum daily load (TMDL).

According to a 1995 water quality study done for the CCWWC by Montgomery Watson Engineering, the raw water quality in Mark Twain Lake is “of high quality” in terms of microbiological and inorganic constituents.

Cryptosporidium and giardia were not found in samples taken. The concentration of total organic carbon (TOC) is high, ranging from 4.75 to 9.5 mg/l with an average of 6.5 mg/l. Average TOC for surface water sources across the nation is 3 to 4 mg/l. This high TOC is of concern due to the formation potential of disinfection byproducts that are created when chlorine (or any other type of disinfectant) reacts with organics in the water. These compounds are carcinogenic, and regulations place strict levels on the concentration allowed in drinking water.

The Unified Watershed Assessment (UWA) Framework requires that states establish rankings for restoration priorities of impaired watersheds; several northeast Missouri watersheds are on the list of restoration priorities including the Lower and North Salt River Basins.

**Water Quality Goals:** The overall goal is to improve the water quality in the North Fork watershed, remove offending water bodies from the 303(d) list, and maintain this status in the years to come. Project staff and advisory groups feel that restoration of this watershed to acceptable NPS pollution levels is an ambitious but achievable goal when approached as a partnership of efforts.

#### IV. PUBLIC OUTREACH

**Situation:** Numerous projects exist with programs of work dedicated to management of some aspect of the North Fork watershed. Observation and interaction lead the authors to believe that there is limited public knowledge of the watershed concept and awareness of these projects. It is their belief that these projects would achieve even more impact in a coordinated communications and outreach network.

Feedback and surveys also suggest that a holistic view of watershed planning and management is lacking along with a narrow perception of the role of various stakeholders, decision makers, and agency professionals.

**Objectives for public outreach are as follows:**

- ***To build a region-wide network that supports local approaches.*** The North Fork Project is pursuing this objective by developing and/or hosting frequent opportunities for dialogue and communication.
- ***To create a collaborative approach to planning and management of the North Fork and neighboring watersheds.*** Efforts are being made to maximize the use of public- and private-sector resources and to avoid duplication of effort. Since many of the neighboring watersheds have similar problems and watershed management projects underway, the North Fork Project routinely includes these areas in mailings and other outreach efforts.
- ***To strengthen capabilities to address water quality issues.*** As a group, or network, it will be possible to identify and provide needed training and resources. Systematic program evaluations will also help to pinpoint topics that need to be further developed.
- ***To establish a network that can serve as an authoritative voice on regional water-quality issues now and beyond the life of the project.*** Combined action will 1) demonstrate a watershed-wide (and regional) commitment to water quality stewardship and 2) result in impact sufficient to remove lakes, streams, and rivers from the list of “impaired” water bodies.
- ***To conduct educational/informational outreach to keep the target audience informed and to meet needs***

*for continuing education and training.* Project milestones require that the following be developed and implemented:

1. *Regional watershed conference* with format designed to develop a sense of “community” and regional cooperation in the protection of water resources and content developed to look at problems and solutions in the planning and management of water resources.
2. *Quarterly newsletter* to showcase partners and keep them informed.
3. *Training for water-treatment professionals* to enhance the professional skills of those responsible for drinking-water supplies.
4. *Workshops and seminars* to bring cutting edge information to regional decision makers.

**Whom We Targeted:** The target audience for the North Fork Project is that individual or group who by action, appointment, election, membership, or profession has a decision-making role in the quality of water resources in the North Fork and neighboring watersheds. This includes elected officials (local, state and national); economic developers and planners including regional councils of government; landowners including agricultural producers; agribusiness including ag lenders; representatives of community organizations, watershed committees, Soil and Water Conservation District (SWCD) boards, University Extension councils, Farm Bureaus and commodity groups; power suppliers; water-treatment professionals; and allied professionals and agencies.

Since many of the neighboring watersheds have similar problems and watershed management projects underway, the North Fork Project routinely includes these areas in mailings and other outreach efforts.

**Advisory Input:** The North Fork Project has an active steering committee and technical resource panel. These groups have been key in setting the tone for collaboration and coordination of effort. In addition to a general advisory function to the project, they serve in a variety of ways including program planning for workshops and conferences, issues/problem identification, and suggestions for project direction. Members of these two groups are shown in Appendix 1 of this document.

**Information Gathering:** Like any new project, staff has presented information to local organizations and has networked with existing groups. The first of these sharing sessions took place at a gathering of representatives of the major projects at work in the North Fork watershed. This was the first time the entire group had gathered to share details of their programs of work. Many of these individuals now serve on the technical resource panel or as general support to the project. An agenda and copy of the roster for this meeting is included in Appendix 2.

- **Survey:** The first major task of the project was to survey the target audience to determine 1) what they perceived as water quality issues and 2) where they perceived informational and/or educational voids.

In January 2000, an introductory letter and survey (questionnaire) was sent to nearly 700 individuals described in the target group above. There was an immediate response from about 10% of this group, many of them volunteering to serve the project in some way. The responses could be categorized as one of the following (in alphabetical order): agricultural issues, chemicals/toxic materials, supply and demand, residential runoff, siltation/sedimentation, and solid waste. Other issues included confined animal feeding operations (CAFOs), compliance with regulations, financing improvements, golf course management, land use, stormwater management, stream-bank stabilization, and the importance of involving “people” in watershed management. A copy of the survey results is shown in Appendix 3.

- **Conference Evaluations:** The second major opportunity for gaining input came from the evaluations received following the regional watershed conference. Suggestions for topics that should be developed as workshops and/or for continuing education are (in order of frequency mentioned): community watershed planning, nutrients/pesticide management, buffer strips, stream bank stabilization, rural sewer districts, stormwater management, grant writing, capital improvements/financing, web site building, and golf course management. See Appendix 4 for a summary of evaluations.
- **Survey of Programs of Work:** The third attempt to accumulate information was directed to the many groups and agencies having NPS water quality projects and programs of work in the North Fork Salt River watershed. A questionnaire was used to obtain descriptions of efforts and proposed actions in three issue areas: agriculture/natural resources management, community/watersheds, and water/wastewater. Respondents to this survey have participated in the development of this WRAS. Appendix 5 includes the cover letter, instructions, and list of those contacted for program of work details.

## **V. WATER QUALITY MONITORING AND EVALUATION ACTIVITIES**

As a supplier of drinking water, CCWWC maintains a testing protocol as required by the Department of Natural Resources (DNR) to meet Missouri safe drinking water standards. The Commission also collaborates with Syngenta in the collection and testing for total triazines as required by DNR and contracts with Montgomery Laboratories for periodic testing of certain other pollutants. Raw and finished water is tested as part of this protocol.

The communities in the watershed are also required by DNR to test and monitor their wastewater outflow. This process control, along with communication and networking with other public drinking water suppliers, serves to highlight areas of concern for program development and outreach to focus on issues where public education is needed.

The North Fork Project deals with information and education and therefore does not include a monitoring component. Although several of the projects at work in the area do include water monitoring, it is not anticipated that this WRAS will include outside monitoring and evaluation components separate and apart from activities already in place.

## **VI. WATERSHED ISSUES, PROPOSED ACTIONS AND DESIRED OUTCOMES**

This strategy document will serve as a partial catalog of projects underway to restore the health of the North Fork Salt River watershed but-more importantly-it will support specific work plans in years to come. The document could also be used as a resource manual to assist various entities in identifying on-going programs and resource personnel in the North Fork Salt River watershed. Each contributor will receive a copy for use in program development and direction and for documenting need for future funding.

Several important information/education activities are planned to be in progress throughout the life of the project. Comprehensive coordination of these efforts is aimed at restoration of the health of the target watershed. The communications and networking fostered by the North Fork Project through the WRAS process will provide a systematic approach to this effort. The following action plans provide a profile of (some of the) projects underway in the watershed, their direction, and future needs. Working from this profile, contributors have also made specific recommendations for long-term strategies that will continue to correct and eliminate future NPS problems as shown below:

### **NPS ISSUE: AGRICULTURE/NATURAL RESOURCE MANAGEMENT**

**Proposed Actions/Programs of Work:** Contributors to this issue and its solutions include the City of Shelbina Lake and Watershed Project; County Soil and Water Conservation Districts (SWCDs) and Natural Resource Conservation (NRCS) Units; the Mark Twain Water Quality Initiative (MTWQI); the Mark Twain Lake Corps of Engineers (COE); Missouri Department of Conservation (MDC); Iowa State University/University of Missouri Flood Plain Project/UMC Center for Agroforestry (ISU/UMC/UMCA); UMC Department of Entomology; the Crooked Creek Project; University Outreach and Extension (UOE); UMC Greenley Research Farm; the Missouri Corn Growers Association (MCGA); and the North Fork Project. These entities will also involve allied agencies and professionals throughout the state and region. Planned action over the next five years includes a variety of activities, events, programs and/or research to target concerns related to the following:

- Erosion and sedimentation
- Nutrient and pesticide runoff
- Livestock nutrient runoff
- Loss of forest, fish, and wildlife resources
- Maintenance of water quality for recreational use

## **Identified Watershed Problems**

### ***1. Erosion/Sedimentation***

#### **Responsibility**

City of Shelbina Lake and Watershed Project

County Soil and Water Conservation Districts/  
Natural Resources Conservation Service Units (SWCDs/NRCS)

Mark Twain Water Quality Initiative/(MTWQI/NRCS)

Mark Twain Lake Corps of Engineers (COE)

Missouri Department of Conservation (MDC)

Iowa State University/  
University of Missouri Flood Plain Project/UMC Center for Agroforestry (ISU/UMC/UMCA)

Crooked Creek Project / University Outreach and Extension (UOE)

North Fork Project  
At Clarence Cannon Wholesale Water Commission

#### **Proposed Action**

Implement best management practices (BMPs) at Shelbina Lake; provide cost incentives for landowners

Target streambank failure, runoff and sedimentation, and overgrazing with cost incentives for Management Intensive Grazing

Provide technical assistance with practices design and layout; promote cost-share incentives through USDA, State of Missouri, Missouri Department of Conservation (MDC) and/or Department of Natural Resources (DNR) grant programs

Implement soil conservation measures, buffer strips, grass waterways, and reforestation; monitor sedimentation through periodic surveys

Provide technical assistance and cost-sharing to landowners to address erosion and sedimentation (ex: riparian corridor restoration, livestock exclusion, and streambank protection)

Promote riparian buffers, streambank stabilization, filter strips, rotational grazing, wetlands, and in-stream structures; analyze responses of aquatic macroinvertebrates to riparian and stream modifications

Promote BMPs (buffers strips, reduced tillage practices); conduct water testing; establish demonstrations and field days; develop and distribute publications

Develop newsletter articles re: ongoing projects; sponsor/promote special interest meetings on identified topics; publicize success stories

### ***2. Nutrient and Pesticide Runoff***

#### **Responsibility**

SWCDs/NRCS

ISU/UMC/UMCA

Crooked Creek Project/UOE

MTWQI/NRCS

#### **Proposed Action**

Promote system management practices available to address this problem; provide technical assistance, cost-share and incentive payments for installing needed systems through Environmental Quality Incentive Program (EQIP); develop and apply nutrient and pest management plans; reach producers with educational workshops

Promote riparian buffers, streambank stabilization, filter strips, rotational grazing, wetlands, and in-stream structures; analyze responses of aquatic macroinvertebrates to improvement in water quality.

Promote BMPs (buffers strips, crop scouting); conduct water testing; establish demonstrations and field days; develop and distribute publications

Provide assistance and Integrated Pest Management (IPM) training for producers; provide incentives through EQIP and DNR grants

University of Missouri at Columbia (UMC) Greenley Research Farm	Conduct research and demonstration on sub-surface drainage to recycle irrigation water to recapture nutrients and pesticides
City of Shelbina, North Fork Project and UMC College of Agriculture Food and Natural Resources (CAFNR)	Co-sponsor workshops on golf course management strategies, expand in 2002 to target all turf managers
Missouri Corn Growers Association (MCGA)	Use Watershed Research Assessment and Stewardship Project (WRASP) research to alter watershed management strategies
North Fork Project At Clarence Cannon Wholesale Water Commission	Develop newsletter articles re: ongoing projects; sponsor/promote special interest meetings on identified topics; publicize success stories

**3. *Livestock Nutrient Runoff***

**Responsibility**

Crooked and Otter Creeks EQIP Conservation Priority Area (CPA)

MTWQI/NRCS

ISU/UMC/UMCA

North Fork Project  
At Clarence Cannon Wholesale Water Commission

**Proposed Action**

Provide cost share for systems upgrade

Provide technical and planning assistance to install manure management systems that will cover production, collection, storage, treatment, transfer and utilization of manure; provide technical assistance for manure management systems design, manure utilization, and odor assessment; promote financial assistance available through EQIP and Missouri Department of Agriculture (MDA) loan programs

Promote riparian buffers, streambank stabilization, filter strips, rotational grazing, wetlands, and in-stream structures; analyze responses of aquatic macroinvertebrates to improvement in water quality.

Develop newsletter articles re: ongoing projects; sponsor/promote special interest meetings on identified topics; publicize success stories

**4. *Loss of Forest, Fish and Wildlife Resources***

**Responsibility**

MTWQI/MDC

Mark Twain Lake COE

MDC

ISU/UMC/UMCA

North Fork Project  
At Clarence Cannon Wholesale Water Commission

**Proposed Action**

Promotion and cost sharing for open-land wildlife (quail, rabbit and songbirds) in selected counties; forest management assistance and cost sharing to enhance wildlife food and cover and alternative income potential from woodlands

Conduct reforestation to promote wildlife diversity and restore ground vegetation; construct North Fork wetland area

Conduct inventory of stream fisheries resources; identify factors affecting fish communities; evaluate and monitor fish populations; develop and apply strategies for improving habitat quality

Promote riparian buffers, streambank stabilization, filter strips, rotational grazing, wetlands, and in-stream structures; analyze changes in aquatic macroinvertebrates communities resulting from riparian and stream habitat and water quality improvements.

Develop newsletter articles re: ongoing projects; sponsor/promote special interest meetings on identified topics; publicize success stories

## 5. Maintenance of Water Quality for Recreational Use

<u>Responsibility</u>	<u>Proposed Action</u>
Mark Twain Lake COE	Increase access to lake; provide on/off site environmental educational programs for the public emphasizing proper land stewardship
MDC	Identify factors limiting recreational use; acquire, plan identify, and develop access sites; conduct angler surveys; develop and apply strategies for improved fishing
UOE	Promote 4H Sportsfishing project and community service projects such as Streets to Streams and Storm Drain Stenciling
North Fork Project At Clarence Cannon Wholesale Water Commission	Develop newsletter articles re: ongoing projects; sponsor/promote special interest meetings on identified topics; publicize success stories

**Outcomes and Impact:** Over the next five years, the expected outcomes will be reduction of sedimentation, nutrients, and pollutants in the groundwater and surface water, improved aquatic habitat, and potential for development of alternative products. The expected soil loss for each acre under EQIP contracts will be at or below "T" and sedimentation will be reduced in the Mark Twain Lake by 900 tons of soil per year. Grazing lands health will be improved using prescribed grazing systems and will result in increasing livestock production by 100%.

It is also anticipated that there will be an increase in the diversity and abundance of pollution-intolerant macroinvertebrate species and a decrease in the abundance of pollution-tolerant macroinvertebrate species. Specifically, the abundance and richness of shredders should increase; whereas the abundance of collector-gatherers should decrease with an improvement in aquatic habitat quality and restoration of riparian vegetation.

System management practices are available to address some of these problems including technical assistance for structural designs, guidance on management practices, and cost-share and incentives to defray some of these costs.

*Specific goals include the following plans:*

**Decrease sediment runoff by 25-50% and improve wildlife habitat and forest production as a result of the following:**

- Assist 20 producers with engineering assistance on erosion practices
- Promote forestry with 150 landowners through on-site visits
- Write 75 forest stewardship plans for landowners
- Implement livestock exclusion from stream and forest with two producers each year
- Produce cropland plans to include at least 6,324 acres of residue management/mulch till to help reduce soil erosion and improve soil quality
- Assist landowners in reducing excessive erosion by providing cost-share for 30 grade stabilization structures and 150,000 feet of terraces.
- Promote the following BMPS: no-till and residue management, livestock exclusion, riparian and grass buffers, alternative water sources, terraces, water ways, grade stabilization structures, timber stand improvement (TSI), crop rotation, and cover crops

**Decrease pesticide runoff by 25 -50% as a result of these activities:**

- Establish three IPM technology demonstration sites
- Conduct six in-field/classroom IPM training workshops
- Provide individual field scouting assistance to 20 producers annually
- Conduct pest scouting workshops and field tours every other year and develop scouting guidebooks for each contract participant

- Reach 50 turf managers yearly with information on pesticide use and management.
- Promote the following BMPs: no-till and residue management, post application of 1lb atrazine, field scouting for pests, riparian and grass buffers, pesticide container recycling, use of genetically modified organisms (GMOs), and spray equipment calibration

**Decrease nutrient runoff by 75-90% through:**

- Establishment of five nitrogen (N) demonstration sites to showcase new management tools and practices that will limit N losses
- Involvement of ten producers each year to conduct soil testing and crop nutrient testing
- Assistance to 15 producers each year with developing nutrient management plans
- Reach 50 turf managers yearly with information on fertilizer/nutrient use and management.
- Work with producers and landowners to have 11,324 acres under a pest and nutrient management plan
- Promotion of the following BMPs: soil testing, realistic yield goals, split application of N, no-till and residue management, crop rotation, cover crops, riparian and grass buffers, global positioning satellite (GPS) variable rate fertilizer, equipment calibration, and manure utilization

**Decrease livestock nutrient runoff by 90 - 95%, reduce odor 25-50%, and decrease commercial fertilizer use 20-50% from better manure utilization through use of the following actions, practices and systems:**

- Assist livestock producers with the design and management of 10 waste management systems
- Assist producers to implement prescribed grazing system on 625 acres to improve grazing lands health
- Assist livestock producers with the design and management of 10 waste management systems

**Evaluation/Monitoring:** Indicators of success will include some combination of the following: registers of participants in workshops and records of other contacts; numbers of requests for additional assistance, information and/or resources; evidence of plan development and implementation through status reviews and other formal means of documentation; evidence of application and maintenance of BMPs; and improved water quality documented through water testing.

**Summary/Recommended Strategies:** The Steering Committee and the Technical Resource Panel for the North Fork Project recommend the following short and long-term strategies to minimize the problems outlined in this section on agriculture and natural resource management concerns:

- Carry out actions outlined above under identified watershed problems and coordinate activities to maximize impact and minimize duplication of effort.
- Involve County Soil and Water Conservation District boards and/or employees as steering committee members on local/community efforts related to watershed planning and management.
- Communicate with Federal and State legislators on the need to set up incentives for local landowners/producers who do not qualify for other cost-share programs.
- Develop and implement a local awards/incentive program for producers who do not qualify for other recognition and cost-share programs.

**Resource Needs:** The programs of work included in this section call for needed additional resources of approximately \$300,000.00 *not including dollar resources needed for cost-share incentives especially for buffer strips, nutrient and pesticide management practices, management intensive grazing, and animal waste systems.*

## **NPS ISSUE: COMMUNITY/WATERSHEDS**

**Proposed Actions/Programs of Work:** Contributors to the Community and Watersheds section of this document are: Mark Twain Lake COE, City of Shelbina Lake and Watershed Project, Department of Natural Resources-Northeast Region (DNR-NERO); Mark Twain Regional Council of Governments (MTRCOG); UOE; the Crooked Creek Project; MDC; ISU/UMC/UMCA; Marion, Monroe and Ralls County Health Departments (CHD); NRCS; and the North Fork Project at Clarence Cannon Wholesale Water Commission. These entities will involve allied agencies and professionals throughout the state and region. The following activities, events, and programs are planned to address:

- Lake management issues
- Lack of watershed awareness and ownership
- Need for youth activities/curriculum/materials related to water quality
- Need for adult/professional activities/curriculum/materials related to water quality

### **Identified Watershed Problems**

#### **1. *Lake Management Issues (development and maintenance of recreational areas, eutrophication, nutrient loading from wildlife, shoreline erosion/sedimentation, watershed degradation)***

##### **Responsibility**

##### **Proposed Action**

Mark Twain Lake COE

Conduct water quality monitoring; promote public land stewardship, shoreline erosion control, and recreational use development; expand and improve Spalding Sewage Treatment Area

City of Shelbina Lake and Watershed Project

Conduct assessment/sedimentation study; implement BMPs at Shelbina Lake

Department of Natural Resources - Northeast Regional Office (DNR-NERO)

Facilitate locally led source-water protection efforts

North Fork Project/UOE

Develop newsletter articles re: ongoing projects; sponsor/promote special interest meetings on identified topics; publicize success stories.

#### **2. *Lack of Watershed Awareness and Ownership (stewardship issues, watershed planning and management, information/education outreach, resource development)***

##### **Responsibility**

##### **Proposed Action**

City of Shelbina Lake and Watershed Project

Continue with watershed committee and water quality plan development; conduct information/education outreach; develop related activities

Mark Twain Regional Council of Governments (MTRCOG)

Assist Shelbina and other communities as requested with resource and plan development

North Fork Project/UOE

Sponsor annual watershed conferences for networking and coalition building; supply materials for annual Drinking Water Week celebrations; develop educational/informational responses to expressed needs

Crooked Creek Project/UOE

Form citizen's coalition for development of watershed management plan and educational activities

MDC

Conduct education/information outreach on conservation opportunities in the Mark Twain Lake tributaries

DNR-NERO

Facilitate locally led source-water protection efforts

ISU/UMC/UMCA

Conduct survey of land assessors, bankers and loan officers to determine perceptions of value of riparian areas

### ***3. Need for Youth Educational Activities/Curriculum/Materials Related to Water Quality***

<b><u>Responsibility</u></b>	<b><u>Proposed Action</u></b>
Mark Twain Lake COE	Sponsor annual Environmental Education Day
North Fork Project	Co-sponsor/promote youth activities such as The Missouri Envirothon, outdoor classrooms, Environmental Education Day, Stream Team workshops and training, water festivals, and other events as needed

### ***4. Need for Adult/Professional Educational Activities/Curriculum/Materials Related to Water Quality***

<b><u>Responsibility</u></b>	<b><u>Proposed Action</u></b>
Marion, Monroe and Ralls CHD	Co-sponsor workshops on identified topics; develop formats for professional certification and continuing education
North Fork Project	Co-sponsor workshops with Health Departments; develop formats for professional certification and continuing education; publicize with news articles
NRCS, UOE	Promote EQIP grants for implementation of agricultural practices by landowners

**Outcomes and Impact:** Outreach in this area will be largely directed at increasing awareness and providing education about actions that can be adopted to help minimize NPS pollution. Certain audiences will be targeted to help them to reach objectives related to learning standards, knowledge and skill development, continuing education, and certification needs. Following are the expected outcomes in this issue area:

- Conduct needed assessment/monitoring and corrective action to meet water-quality goals at Mark Twain and Shelbina Lakes
- Involve and assist two additional communities each year with locally led watershed and management projects and plan development
- Reach 3500 children yearly with group environmental education events
- Reach 1000 children yearly with specific programs and projects related to water quality
- Involve 150 decision makers yearly in a regional watershed conference
- Provide certification/continuing education opportunities to 400 persons each year on topics related to water quality
- Implement on-going education/information outreach to raise awareness, publicize successes, and promote resources available for improvements related to water quality

**Evaluation/Monitoring:** Interest and participation will be monitored through some combination of the following: registers of participants and formal evaluation of group events including anecdotal materials and comments, by logging follow up requests for assistance/information/resources, by evidence of increased public participation in watershed planning and management, and improved water quality as documented through water testing.

**Summary/Recommended Strategies:** The Steering Committee and the Technical Resource Panel for the North Fork Project recommend the following short and long-term strategies to solve regional problems related to NPS water pollution.

- Carry out actions outlined above and coordinate activities to maximize impact and minimize duplication of effort.
- Actively promote, support, and strengthen involvement of youth through: in-school activities aimed at fulfilling Missouri Academic Performance (MAP) standards; existing environmental education days, outdoor classrooms, water festivals and other events aimed at large groups of students/young people; involvement in special programs such as the Missouri Envirothon, 4H, Future Farmers of America (FFA), and Scouting programs/projects focused on water quality; and training for facilitators of Project WET, Project WILD and Learning Tree.

- Identify and publicize menu of available resources sources for grants, technical assistance, funding for rural communities seeking solutions to problems related to watershed management, (water/wastewater) issues, and technology and BMPs geared to solutions. This should include a web page with links to Missouri Conservation Assistance Guide (MCAG) and the Missouri Watershed Information Network (MoWIN).
- Establish a Watershed Advisory Council with a web site to promote networking, cooperative programming/ outreach, collaboration in watershed planning and management, and information/education outreach throughout Northeast Missouri. The Council would include the Mark Twain Lake and neighboring watersheds.

**Resource Needs:** The programs of work contributed to this section of the North Fork WRAS include stated needs for approximately \$20,000.00. *This does not include a budget for a proposed Watershed Advisory Council with an interactive web site.*

## **NPS ISSUE: WATER/WASTEWATER**

**Proposed Actions and Programs of Work:** Contributors to the Water/Wastewater Issue include: City of Shelbina Lake and Watershed Project, DNR-NERO, the Mark Twain Lake COE, the North Fork Project, UOE, Marion, Monroe and Ralls CHD, United States Department of Agriculture-Rural Development (USDA-RD) and Northeast Missouri Resource Conservation and Development Council (RC&D). These entities will involve allied agencies and professionals throughout the state and region. A number of activities/events/programs exist to target concerns related to the following:

- Pollutants and public health issues
- Wastewater disposal
- Unsewered communities
- Solid and hazardous waste
- Stormwater runoff
- Increasing the knowledge base for water and wastewater-treatment professionals

### **Identified Watershed Problems**

#### ***1. Pollutants/Public Health Issues***

##### **Responsibility**

City of Shelbina Lake and Watershed Project

Mark Twain Lake COE

North Fork Project/UOE

##### **Proposed Action**

Install carbon feeder to lower total organic compounds (TOC)

Continued ban on restricted use pesticides

Develop newsletter articles re: ongoing projects; sponsor/promote special interest meetings on identified topics; publicize success stories

#### ***2. Wastewater Disposal***

##### **Responsibility**

City of Shelbina Lake and Watershed Project

Mark Twain Lake COE

DNR-NERO

Marion, Monroe and Ralls County Health Departments (CHD)

##### **Proposed Action**

Connect car wash to city sewer to remove NPS pollutants associated with car washing and to redirect wastewater from Shelbina Lake to the water treatment plant.

Expand and improve Spalding Sewage Treatment Area

Serve as technical guidance for meeting regulations and proper handling of wastewater.

Conduct annual workshops re: on-site sewage systems

North Fork Project/UOE

Develop newsletter articles re: ongoing projects; sponsor/promote special interest meetings on identified topics; publicize success stories

### **3. *Unsewered Communities***

#### **Responsibility**

United States Department of Agriculture-Rural Development (USDA-RD)

USDA-RD

DNR-NERO

North Fork Project/UOE

#### **Proposed Action**

With North Fork Project, co-sponsor workshops for water districts on processes and costs of developing rural sewer districts

Assist with resource development and planning to formulate rural sewer districts

Serve as technical guidance for meeting regulations and proper handling of wastewater.

Co-sponsor workshops with USDA-RD; develop newsletter articles re: ongoing projects; sponsor/promote special interest meetings on identified topics; publicize success stories

### **4. *Solid/Hazardous Waste***

#### **Responsibility**

DNR-NERO

Marion, Monroe and Ralls CHD

Marion, Monroe and Ralls CHD

Northeast Missouri Resource Conservation & Development Council (RC&D), Adair and Schuyler County Commissions, UOE

UOE

North Fork Project/UOE

North Fork Project/UOE

#### **Proposed Action**

Serve as technical resource for proper handling, clean up, and disposal and serve as regulatory authority

Conduct annual workshops re: lead hazards in the environment

Conduct lead removal training with the Missouri Department of Health (DOH) and the Missouri Department of Economic Development (DED)

Promote the development of a local or mobile business for the proper disposal of dead animals

Promote the concept of carcass composting for the disposal of dead animals

Promote the Missouri Ag Industries Council (MO-AG) Clean Pesticide Container Recycling program

Co-sponsor workshops with Health Departments; develop newsletter articles re: ongoing projects; sponsor/promote special interest meetings on identified topics; publicize success stories

### **5. *Stormwater Runoff***

#### **Responsibility**

DNR-NERO

North Fork Project/UOE

#### **Proposed Action**

Serve as technical resource and permitting entity. Facilitate grant opportunities.

Sponsor/co-sponsor seminar/workshop on storm water management

### **6. *Lack of Awareness and Knowledge by Water/Wastewater (w/ww) Professionals***

#### **Responsibility**

North Fork Project/UOE

#### **Proposed Action**

Sponsor seminar/workshops on identified topics re: regulations, Best Available Technologies (BATs)

**Outcomes and Impact:** Outreach in these areas will result in lowered levels of pollutants in raw water, greater awareness and knowledge about the sources of NPS pollutants and their effect on drinking water supplies, and the role of recycling to safeguard water quality. Targeted programming will also result in the empowerment of local entities to develop resources for system development. It is also expected that workshops and training will help professionals to meet continuing education goals and contribute to the overall knowledge base regarding watershed management. Specific impacts include these indicators:

- Changed attitudes and practices by 300 installers, real estate professionals, w/ww treatment operators and others who are reached yearly with information on residential wastewater disposal
- Changed attitudes and practices by 300 landlords, lenders, contractors, real estate professionals, w/ww treatment operators and others who are reached yearly with information on lead hazards in the environment
- Increased knowledge and practice implementation by 50 contractors and others reached yearly with information on lead removal
- Increased knowledge and use of appropriate techniques/facilities by 75% of livestock producers on the proper disposal of dead animals
- Increased participation in the MO-AG Clean Pesticide Recycling Program
- Increased knowledge about and ability to plan and develop rural sewer districts by all county commissions and water districts in the watershed; formulation of rural sewer districts in 50% of the water districts.

**Evaluation/Monitoring:** Interest, participation and practice adoption will be monitored by one or more of the following: maintaining registers of participants; numbers of requests for additional assistance/information/resources; evidence of practice adoption and system development through follow-up evaluation; and documenting lowered levels of pollutants in raw water.

**Summary/Recommended Strategies:** The Steering Committee and the Technical Resource Panel for the North Fork Project recommend the following short and long-term strategies to mitigate the problems outlined in this section on water and wastewater concerns.

- Carry out actions outlined above under identified watershed problems and coordinate activities to maximize impact and minimize duplication of effort.
- Serve as a catalyst to promote solid and hazardous waste disposal through local resources; work with UOE, DNR-NERO and Mark Twain Solid Waste District to establish regular hazardous waste pickup/disposal.
- Create awareness of farm and home solid/hazardous waste issues and provide information on clean-up strategies by promoting the UOE Farm\*A\*Syst and Home\*A\*Syst programs.
- Educate the general public about point of contact for Emergency Response Plans; promote county and local emergency response plans.

**Resource Needs:** In the programs of work contributed to this document, there are stated needs for a total of \$303,500.00 in resources to meet project goals. *This does not include \$1000.00 per connection needed in the formation of rural sewer districts.*

## VII. WRAS SUMMARY AND CONCLUSIONS

In rural Missouri, most formal watershed management efforts focus on agriculture. Although these efforts are effective, much of the impact is not translated to non-agricultural sectors. The North Fork Project is attempting to bridge the communication gap between on-going projects and community decision makers including water treatment professionals. This document summarizes the processes and strategies being used to make this happen.

Based only on the programs of work submitted for inclusion in this WRAS, cost for the restoration of the entire 400, 640-acre North Fork Salt River watershed is estimated at \$625,000.00. This does not include undeveloped budgets for such things as additional cost-share opportunities, a regional watershed council with web site, development and connection costs associated with rural sewer districts, total maximum daily loads (TMDL) and/or water quality management plan (WQMP) development, and targeted research.

Non-federal match is available from SWCDs, county health departments, involved cities, water and sewer districts, and various agencies without federal funding. In-kind contributions could be obtained from landowner participation, the Missouri Department of Conservation, UOE, US Army COE, time and effort of steering committee and eligible technical panel representatives, and many other sources.

Restoration of the entire Mark Twain watershed is, in the opinion of the contributors to this document, a worthwhile realistic goal and one that should be pursued, but the cost and total effort is impossible to estimate at this time. Recommendations and estimates can be found in this document for specific steps for a comprehensive effort of this kind.

This WRAS was developed using the most current data and should be regarded as a working plan subject to revision as new information becomes available and/or as new players become partners in the effort. Interest and participation in the objectives and activities of the North Fork project will be used to track and document the direction and success of the project. Electronic updates will be developed periodically throughout the life of the North Fork Project to include additional programs of work and information; these will also be distributed electronically.

## **VIII. CREDITS AND REFERENCES**

Missouri Census Data Center - Census 2000

Population for Missouri's counties, municipalities and legislative districts

Missouri Department of Agriculture and United States Department of Agriculture, National Agricultural Statistics Service

2000 Missouri Farm Facts (precipitation, crops and livestock)

Missouri Department of Natural Resources, Water Pollution Control Program

Content review and editing

United States Department of Agriculture - Natural Resources Conservation Service

Content review

Soils of the North Fork Salt River Watershed

Soil Survey of Knox, Monroe, and Shelby Counties, Missouri

United States Geological Survey

Land Use Statistics

University of Missouri Outreach and Extension and the Missouri Watershed Information Network (MoWIN)

Content review and editing

Glossary (Appendix 6)

U. S. Army Corps of Engineers, Management Office, Mark Twain Lake

North Fork Salt River watershed statistics

***Credit and appreciation is also extended to all those who contributed material to Section VI. Watershed Issues, Proposed Actions and Desired Outcomes. This material is the core of this document.***

## Appendix 1

### North Fork Project: Steering Committee

**\* Sit on both the Steering Committee and Technical Resource Panel**

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**Appendix 2**

**319 MEETING – CCWWC PROJECT**

**SEPTEMBER 29, 1999**

**AGENDA**

- 1. Welcome & Introductions**
- 2. Overview of 319 CCWWC Project and Purpose of Meeting**
- 3. Roundtable Discussion of Projects Represented**
- 4. Summary comments – Putting It All Together**
- 5. Adjourn – Tours of Facility for Those Interested**

## **319 MEETING – CCWWC PROJECT**

**SEPTEMBER 29, 1999**

### **PARTICIPANTS**

<b>NAME</b>	<b>ORGANIZATION</b>
Amy Bross	FAPRI at UMC
Wanda Eubank	Mark Twain Water Quality Initiative/UOE
Vernon Lansford	FAPRI
Todd Farrand	FAPRI
Brian Schweiss	Mark Twain Water Quality Initiative/MDC
Phillip Shatzer	Monroe and Ralls County CHDs
Stephen St. Clair	Marion County CHD
Stewart Blessing	Macon and Shelby CHDs
Dan Downing	UOE – UMC
Bob Broz	UOE – UMC
Chad James	Missouri Corn Growers Association
Bill Helvey	Lincoln U/Extension
Lisa Sowa	MO-DNR, WPCP
John Knudsen	DNR-NERO/PDWP
Bill Kurtz	MU/UOE/MO Water Quality Initiative
Dianne Hall	UMC, Department of Entomology
George Smith	UOE, Pesticide Impact Assessment
Myra Smith	UOE/WQ Program
Allen Mehrer	U.S, Army corps of Engineers
Dennis D. Foss	U.S. COE, Mark Twain Mgmt Office
Liz Grove sion	Clarence Cannon Wholesale Water Commis-
Lonna Trammell	Ameren/UE
Becky Shannon	DNR

## Appendix 3



## Appendix 4







## Appendix 5



## Appendix 5 (continued)

### WRAS Survey Packets Sent to These Persons For Inclusion in North Fork WRAS

Otto Alber, NRCS, Macon	Tod Hudson, DNR
Steve Anderson, UMC	Troy Huntley, NRCS, Macon
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Claire Baffaut, FAPRI, Columbia	Andrea King, NRCS, Paris
Bob Ball, NRCS, Columbia	John Knudsen, DNR, Jeff City
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Bill Bergh, MDC, Kirksville	Mitch Krueger, NRCS, Shelbyville
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Mike Bradley, NRCS, Kirksville	Richard Pemberton, NRCS, Macon
Amy Bross, FAPRI, Columbia	Doug Rainey, MDC, Edina
Bob Broz, UOE, Columbia	Sandy Rikoon, UMC, Columbia
John Brumett, UOE, Monticello	Richard Schultz, Crooked Creek Agroforestry, ISU
Terri Bruner, NRCS, Lancaster	Brian Schweiss, MDC, Macon
Alix Carpenter, UOE, Palmyra	Rick Schwieter, NRCS, Macon
Charles Chaney, UOE, Shelbyville	Phil Shatzer, DOH, Paris
James Cryer, MDC, Paris	David Smith, Newark
Ross Dames, MDC, Hannibal	George Smith, UOE, Columbia
Tom Deberry, NRCS/RC&D, Memphis	Steve St. Clair, DOH, Hannibal
Kim Dickerson, AEI, Clifton Hill	Randall Smoot, Greenley Research Farm
Dan Downing, UOE, Columbia	Pricilla Stotts, DNR Stream Team
Todd Farrand, FAPRI, Columbia	Valerie Tate, Crooked Creek, Macon
Mark Fuqua, MTRCOG, Perry	Steve Taylor/Christie Huffman, MCGA, Jefferson City
Elsa Gallagher, MDC, Macon	Lonna Trammell, Ameren/UE, Mexico
Clark Gantzer, UMC	James Treece, USDA-RD, Kirksville
Dianne Hall, UMC-Agroforestry, Columbia	Rob Trivette, Shelbina
Bill Helvey, UOE-Lincoln, Jeff City	Mark White, MCGA, Macon
Krisitie Hilgedick/Debbie Parman, MO-AG, Jeff City	Don Yoest, MDA, Jeff City
Dave Hill, UOE, Palmyra	
Dave Hoover, MDC, Lancaster	



## Appendix 6

### North Fork Salt River WRAS Glossary

**Best management practices (BMP)** — Agricultural water conservation measures that generally meet one of two criteria: (1) Constitutes an established and generally accepted practice among water purveyors that provides for the more efficient use of existing water supplies or contributes towards the conservation of water; or (2) Practices which provide sufficient data to clearly indicate their value, are technically and economically reasonable, environmentally and socially acceptable, reasonably capable of being implemented by water purveyors and users, and for which significant conservation or conservation-related benefits can be achieved.

**Buffer strips** — Strips of grass or other erosion-resisting vegetation between or below cultivated strips or fields. Also referred to as Buffer zones.

**Calibration** — Fine tuning of an instrument to meet a specific standard value. This helps to ensure data accuracy.

**Carcinogenic** — That which tends to produce or incite cancer

**Claypan** — (1) A dense, compact layer in the subsoil having a much higher clay content than the overlying material from which it is separated by a sharply defined boundary. Such layers are formed by the downward movement of clay or by synthesis of clay in place during soil formation. Claypans are usually hard when dry, and plastic and sticky when wet. They usually impede movement of water and air, and the growth of plant roots.

**Community** — people living within the same district, city, etc., under the same laws

**Concentrated Animal Feeding Operations (CAFOs)** - typically defined as having 1,000 cattle or comparable “animal units” of other livestock.

**Conservation**—(1) Increasing the efficiency of energy use, water use, production, or distribution. (2) The careful and organized management and use of natural resource, for example, the controlled use and systematic protection of natural resources, such as forests, soil, and water systems in accordance with principles that assure their optimum long-term economic and social benefits. Also, preservation of such resources from loss, damage, or neglect.

***Cryptosporidium parvum***—A parasite often found in the intestines of livestock that contaminates water when the animal feces interact with a water source. In healthy individuals, infection may result in an acute diarrheal illness lasting for 2-3 weeks. In immuno-suppressed individuals (e.g., AIDS patients, children, elderly), Cryptosporidiosis, the disease from infection by the parasite, may be life-threatening. While much needs to be learned about the infectious level of crypto, studies have indicated that it takes five to ten cysts to make someone sick. Of particular concern to health officials and public drinking water supplies is that the most widely used agent to disinfect tap water—chlorine—does not kill the parasite. As an additional complication in the detection process, there are several varieties of crypto, but only one—*Cryptosporidium parvum*—is infectious to humans. Currently, the only effective treatment for water supplies is through filtration (crypto oocysts are only 3 to 7 microns in size) and the use of ozone gas rather than chlorine.

**Degradation** —The general lowering of the earth’s surface by erosive processes, such as scouring by flowing water. The removal of channel bed materials and down-cutting of natural stream channels. Such erosion may initiate degradation of tributary channels, causing damage similar to that due to gully erosion and valley trenching.

**Environmental Protection Agency (EPA) 319 Grant** — Under section 319, State, Territories, and Indian Tribes receive grant money which support a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific non-point source implementation projects.

**The Environmental Quality Incentives Program (EQIP)** — was established in the 1996 Farm Bill to provide a voluntary conservation program for farmers and ranchers who face serious threats to soil, water, and related natural resources. Nationally, it provides technical, financial, and educational assistance primarily in designated priority areas; half of the money is targeted to livestock-related natural resource concerns and the remainder to other significant conservation priorities.

**Erosion** — The wearing away of the land surface by wind, water, ice or other geologic agents. Erosion occurs naturally from weather or runoff but is often intensified by human land use practices.

**Eutrophication** — The process of enrichment of water bodies by nutrients. Degrees of eutrophication typically range from Oligotrophic water (maximum transparency, minimum chlorophyll-a, minimum phosphorus) through Mesotrophic, Eutrophic, to Hypereutrophic water (minimum transparency, maximum chlorophyll-a, maximum phosphorus). Eutrophication of a lake normally contributes to its slow evolution into a bog or marsh and ultimately to dry land. Eutrophication may be accelerated by human activities and thereby speed up the aging process.

**Filter strip** — A strip or area of vegetation used for removing sediment, organic matter, and other pollutants from runoff and wastewater.

**Floodplain** — (1) A strip of relatively smooth land bordering a stream, built of sediment carried by the stream and dropped in the slack water beyond the influence of the swiftest current. It is called a Living Flood Plain if it is overflowed in times of high water but a Fossil Flood Plain if it is beyond the reach of the highest flood. (2) The lowland that borders a stream or river, usually dry but subject to flooding. (3) That land outside of a stream channel described by the perimeter of the Maximum Probable Flood. Also referred to as a Flood-Prone Area.

***Giardia lamblia*** - A microorganism frequently found in rivers and lakes, which, if not treated properly, may cause diarrhea, fatigue, and cramps after ingestion.

**Global Positioning System (GPS)** — A system which verifies latitude and longitude of a location on the ground through the use of a transmitter and a remote (satellite) vehicle

**Habitat** — The native environment or specific surroundings where a plant or animal naturally grows or lives. The surroundings include physical factors such as temperature, moisture, and light together with biological factors such as the presence of food or predator organisms. The term can be employed to define surroundings on almost any scale from marine habitat, which encompasses the oceans, to microhabitat in a hair follicle of the skin.

**Holistic** — Emphasizes the importance of community activities as a whole (people, animals, plants, plus related environmental, social and economic components).

**Impaired water bodies** — waters for which existing required pollution controls are not stringent enough to implement state water quality standards. For these waters, states are required to establish total maximum daily loads (TMDLs) according to a priority ranking. The waters listed below are not expected to attain water quality standards through the implementation of any currently required pollution control technology.

**Inorganic** — All chemical compounds in nature, except the compounds of carbon, but including the carbonates.

**Integrated Pest Management (IPM)** — The practice of combining the best of all available techniques – biological, chemical, cultural, physical, and mechanical – into a custom-made pest control system

**Irrigation** — The controlled application of water for agricultural purposes through man-made systems to supply water requirements not satisfied by rainfall.

**Loess (soil)** — A fine-grained, yellowish-brown, extremely fertile loam deposited mainly by the wind and found widely in North America, Asia, and Europe. Such soils are highly susceptible to water erosion

**Macroinvertebrate** — Invertebrates visible to the naked eye, such as insect larvae and crayfish

**MAP** — Missouri Academic Performance

**Microbial load** — The total number of bacteria and fungi in a given quantity of water or soil or on the surface of food. The presence of the bacteria and fungi may not be related to the presence of disease-causing organisms

**Missouri Conservation Assistance Guide** — A compilation of natural resource conservation programs and practices, technical, financial, informational and educational assistance, available agency resources and contact information. The guide is a joint effort by Missouri Department of Agriculture, Missouri Department of Conservation, Department of Natural Resources, University Outreach & Extension, United States department of Agriculture and the Missouri Association of Soil and Water Conservation Districts under the leadership of The Missouri Watershed Information Network

**Nonpoint source (NPS)** — Pollution sources which are diffuse and do not have a single point of origin or are not introduced into a receiving stream from a specific outlet. The pollutants are generally carried off the land by stormwater runoff. The commonly used categories for non-point sources are: agriculture, forestry, urban, mining, construction, dams and channels, land disposal, and saltwater intrusion.

**Outreach** — an organized effort to extend services beyond the usual limits – to particular segments of a community

**Permeability** — For a rock or an earth material, the ability to transmit fluids; the rate at which liquids pass through soil or other materials in a specified direction. It is measured by the rate at which a fluid of standard viscosity can move through a material in a given interval of time under a given Hydraulic Gradient. Permeability for underground water is sometimes expressed numerically as the number of gallons per day that will flow through a cross section of 1 square foot, at 60°F, under a hydraulic gradient of 100 percent. Permeability is equal to velocity of flow divided by hydraulic gradient

**Pollution** — Generally, the presence of matter or energy whose nature, location or quantity produces undesired environmental effects. Under the Clean Water Act, for example, the term is defined as the man-made or man-induced alteration of the physical, biological, and radiological integrity of water.

**Potable water** — Water that is drinkable. Specifically, freshwater that generally meets the standards in quality as established in the U.S. Environmental Protection Agency (EPA) Drinking Water Standards for drinking water throughout the United States. Potable water is considered safe for human consumption and is often referred to as Drinking Water.

**Precipitation** — As used in hydrology, precipitation is the discharge of water, in liquid or solid state, from the atmosphere, generally onto a land or water surface. It is the common process by which atmospheric water becomes surface or subsurface water. The term “precipitation” is also commonly used to designate the quantity of water that is precipitated. Forms of precipitation include drizzle, rainfall, glaze, sleet, snow, small hail, and hail.

**Public Water System (PWS)** - Any water system which provides water to at least 25 people for at least 60 days annually. There are more than 170,000 PWSs providing water from wells, rivers and other sources to about 250 million Americans. The others drink water from private wells. There are differing standards for PWSs of different sizes and types.

**Reforestation** — The restocking of an area with forest trees

**Riparian** — Pertaining to the banks of a river, stream, waterway, or other, typically, flowing body of water as well as to plant and animal communities along such bodies of water. This term is also commonly used for other bodies of water, e.g., ponds, lakes, etc. Littoral is the more precise term for such stationary bodies of water. Also refers to the legal doctrine (Riparian Doctrine and Riparian Water Rights) that says a property owner along the banks of a surface water body has the primary right to withdraw water for reasonable use

**Runoff** — (1) That part of the precipitation, snow melt, or irrigation water that appears in uncontrolled surface streams, rivers, drains or sewers. It is the same as stream-flow unaffected by artificial diversions, imports, storage, or other works of man in or on the stream channels. Runoff may be classified according to speed of appearance after rainfall or melting snow as direct runoff or base runoff, and according to source as surface runoff, storm interflow, or ground-water runoff.

**Sedimentation** — (1) Strictly, the act or process of depositing sediment from suspension in water. Broadly, all the processes whereby particles of rock material are accumulated to form sedimentary deposits. Sedimentation, as commonly used, involves not only aqueous but also glacial, aeolian, and organic agents. (2) (Water Quality) Letting solids settle out of wastewater by gravity during treatment.

**Soil conservation** — The use of land, within the limits of economic practicability, according to its capabilities and its needs to keep it permanently productive

**Source water protection** — The prevention of pollution of the lakes, reservoirs, rivers, streams, and groundwater that serve as sources of drinking water. Wellhead protection would be an example of a source water protection approach that protects groundwater sources, whereas management of land around a lake or reservoir used for drinking water would be an example for surface water supplies. Source water protection programs typically include: delineating source water protection areas; identifying sources of contamination; implementing measures to manage these changes; and planning for the future.

**Siltation** — The deposition of finely divided soil and rock particles upon the bottom of stream and river beds and in reservoirs.

**Silt Loam** — Soil material that contains 50% or more silt and 12 to 27% clay, or 50 to 80% silt and less than 12% clay.

**Solid waste** — (Water Quality) Any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semisolid, or contained gaseous materials resulting from industrial, municipal, commercial, mining, and agricultural operations, and from community and institutional activities.

**Stakeholders** — individuals affected by the outcome—negatively or positively—or those who can affect the outcome of a proposed intervention, project, activity etc.

**Stormwater** — water draining into streams. Lakes or sewers as a result of a storm

**Streambanks** — The usual boundaries, not the flood boundaries, of a stream channel. Right and left banks are named facing downstream (in the direction of flow).

**Streambank stabilization** — Natural geological tendency for a stream to mold its banks to conform with the channel of least resistance to flow. Also the lining of streambanks with riprap, matting, etc., to control erosion.

**Streambed** — The channel through which a natural stream of water runs or used to run, as a dry streambed.

**Surface runoff** — Precipitation, snow melt, or irrigation in excess of what can infiltrate the soil surface and be stored in small surface depressions; runoff is a major transporter of non-point source pollutants

**The Missouri Watershed Information Network (MoWIN)** — A University of Missouri Outreach and Extension Project designed to assist in locating and accessing of information relative to Missouri watersheds

**Timber stand improvement (TSI)** — A loose term comprising all intermediate cuttings made to improve the composition, condition, and growth of a timber stand; it may also include practices such as girdling and poisoning

**Total maximum daily load (TMDL)** — (Water Quality) The maximum quantity of a particular water pollutant that can be discharged into a body of water without violating a water quality standard. The amount of pollutant is set by the U.S. Environmental Protection Agency (EPA) when it determines that existing, technology-based effluent standards on the water pollution sources in the area will not achieve one or more Ambient Water Quality Standards. The process results in the allocation of the TMDL to the various Point Sources (PS) of pollutants in the area.

**Total organic carbon (TOC)** — (Water Quality) A measure of the amount of organic materials suspended or dissolved in water. The measure is very similar to the assay of the total carbon content; however, samples are acidified prior to analysis to remove the inorganic salts of carbonates and bicarbonates. The assay of total organic carbon represents an estimation of the strength of wastewater and the potential damage that an effluent can cause in a receiving body of water as a result of the removal of dissolved oxygen from the water. The measurement of total organic carbon requires less sample, is more rapid, and yields more reproducible results than the measurement of either the Chemical Oxygen Demand (COD) or the Biochemical Oxygen Demand (BOD). As a pollution indicator, this method is more reliable than the assay of Total Carbon (TC) when the wastewater contains high amounts of total inorganic carbon as well.

**Turbidity** — The term “turbid” is applied to waters containing suspended matter that interferes with the passage of light through the water or in which visual depth is restricted. The turbidity may be caused by a wide variety of suspended materials, such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, plankton and other microscopic organisms and similar substances. Turbidity in water has public health implications due to the possibilities of pathogenic bacteria encased in the particles and thus escaping disinfection processes. Turbidity interferes with water treatment (filtration), and affects aquatic life. Excessive amounts of turbidity also make water aesthetically objectionable. The degree of the turbidity of water is measured by a turbid meter.

**Watershed** - the land area that water moves across or under while flowing to a stream, spring, pond, lake or river

**Watershed management** —The analysis, protection, development, operation or maintenance of the land, vegetation and water resources of a drainage basin for the conservation of all its resources for the benefit of its residents. Watershed management for water production is concerned with the quality and timing of the water which is produced.

**Water quality management** — Planning for the protection of a water's quality for various Beneficial Uses, for the provision of adequate wastewater collection, treatment, and disposal for municipalities and industries, and for activities that might create water quality problems, and regulating and enforcing programs to accomplish the planning goals and laws and regulations dealing with water pollution control.

**Watershed Restoration Action Strategies** — plans to restore the health of water-bodies that do not meet clean water or other natural resource goals and will be supported by more specific grant work-plans. In many cases, development of Total Maximum Daily Loads (TMDLs) for impaired waters within a watershed will form the core of each strategy.

**Wetlands** — areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

## **References**

Webster's II New College Dictionary. 1995 Houghton Mifflin Company. Boston, New York  
A Glossary of Selected Terms of Conservation, Ecology and Resource Use

## **URLs as indicated below:**

<http://outreach.missouri.edu/mowin/Resources/glossary/glossary.html>

<http://www.mo.nrcs.usda.gov/WRASGUID.html>

<http://www.worldbank.org/wbi/sourcebook/sb0302t.htm#B1>

[http://sis.agr.gc.ca/cansis/glossary/texture,\\_soil.html](http://sis.agr.gc.ca/cansis/glossary/texture,_soil.html)

<http://www.epa.gov/owow/nps/cwact.html>

<http://www.epa.gov/OGWDW/glossary.htm#ilink>

<http://www.epa.gov/owmitnet/afos/rule.htm>

**This glossary was developed for the North Fork Salt River WRAS by Tabitha Madzura, PhD, Interim Director of MoWIN, 205 Ag Engineering, UMC, Columbia, MO 65211. Her contribution is a valuable addition to this document.**

## ***Watershed Restoration Action Strategies in Missouri***

The President's Clean Water Action Plan provides that a significant part of any new funding be targeted at *restoration* of those watersheds identified as not meeting clean water and other resource goals. The plan calls for states to develop Watershed Restoration Action Strategies (WRAS) for those watersheds.

The North Fork Project has included the following recommended elements in the preparation of the WRAS for the North Fork Salt River Watershed:

1. ***The public outreach method(s) and structures used to engage and maintain public and governmental involvement.*** This describes local involvement/leadership, cross-agency coordination, and a process for continuous public involvement.

The reader will find a description of these processes in Section IV. Public Outreach. See also Appendix 1 for detailed information on membership of the North Fork Steering Committee and Technical Resource Panel. Appendices 2 - 5 provide details of the information gathering process.

2. ***Identification of a watershed coordinator/evaluator.*** This person or persons would be able to make recommendations concerning practices or activities needed to address the problems.

This information is included in Section I. Introduction

3. ***Any monitoring and evaluation activities based on water quality goals and outcomes needed to refine the problems or assess progress towards achieving water quality goals.***

See Section V. Water Quality Monitoring and Evaluation Activities for details on this element.

4. ***The specific water quality problems to be addressed, the sources of pollution and the relative contribution of sources.*** The WRAS should support a comprehensive approach to addressing identified nonpoint sources in the target watershed. The WRAS should assure that water quality benefits are demonstrated in the short term.

NPS Watershed Issues, Proposed Actions and Desired Outcomes are covered in detail in Section VI. These are categorized as follows:

- Agriculture/Natural Resource Management
- Community/Watershed
- Water/Wastewater

Each NPS issue is broken down into the following segments:

- Proposed Actions/Programs of Work
- Identified Watershed Problems (identifies responsibility and proposed action)
- Outcomes and Impacts
- Evaluation/Monitoring
- Summary/Recommended Strategies
- Resource Needs

Section VI also addresses the following WRAS components.

5. ***A blueprint of actions to be taken and desired water quality goals and outcomes.***
6. ***A schedule for implementation of needed restoration measure and identification of appropriate lead agencies.***
7. ***Funding needs to support the implementation and maintenance of restoration measures.***

***Watershed Restoration Action Strategies (WRAS) – North Fork Salt River***

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