The L'Anguille River Watershed Restoration 9 Element Restoration Plan

PROJECT 03-140

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In Partnership With

Audubon Arkansas

&

The Arkansas Soil & Water Conservation Commission

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The author wishes to recognize all those that participated in the efforts to form this plan. A great amount of energy and time was contributed to the foundation of this plan and the parcels of plans before this one. Citizens from the L'Anguille Watershed committed a great deal of time and resolve throughout the process of gathering data for this plan and the Watershed Restoration Action Strategy (WRAS). In particular Green Solutions wishes to thank Bill Layer for his work in establishing and allowing the sue of the WRAS, FTN for their work establishing the Total Maximum Daily Load for the watershed, Shirely Ball of the Cross County Conservation District and Patricia Perry of the St. Francis Conservation District. A special thanks to Tony Ramick of the Arkansas Soil and Water Conservation Commission, and the L'Anguille River Watershed Group.

It is the opinion of the Ecological Conservation Organization (ECO), that the L'Anguille Watershed is severely impaired and that the complete restoration of this watershed would require tens of millions of dollars and a vigorous and homogenous restoration effort. The headwaters of the watershed have been converted to straight-line ditches, creating an impairment from its' beginning. A truly meaningful restoration effort would include massive landowner agreements that allowed for natural stream conditions to reappear. The continual man made alterations to the watershed is the greatest problem and largest issue to be faced.

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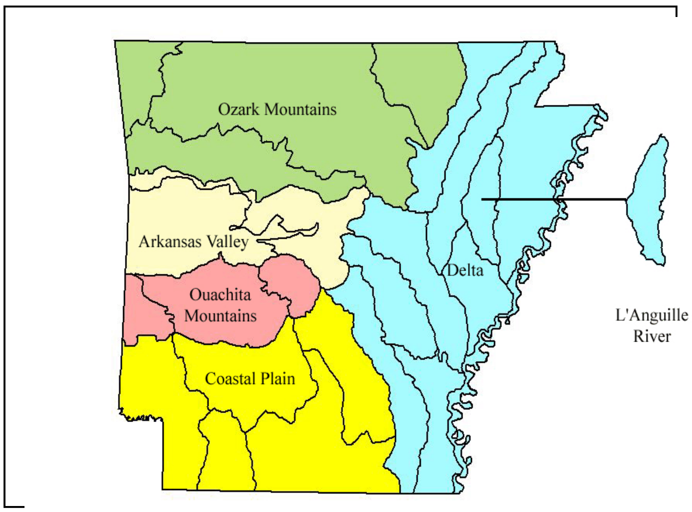
INTRODUCTION

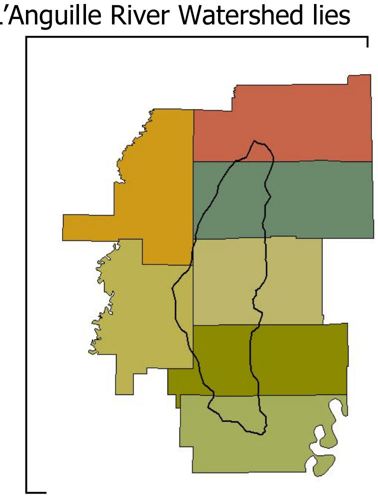
This plan is an attempt to gather and build off of resources that were developed to address the issues and problems with the L'Anguille River Watershed. In particular this plan aims to focus on the following;

1) Identification of pollution sources/causes in the watershed;
2) A description of the NPS management measures needed;
3) Estimated technical and financial assistance needed (Business Plan);
4) Information/education components needed to achieve success;
5) Reasonable timeline for implementation of plan;
6) Determined milestones for measurable success;
7) Performance criteria;
8) Monitoring component for determining success; and
9) Estimated load reductions expected from implementation of plan.

DESCRIPTIVE SUMMARY OF THE L'ANGUILLE RIVER WATERSHED



The L'Anguille River is located in northeast Arkansas and flows south, as a tributary to the St. Francis River. The watershed is represented by the Hydrologic Unit Area (HUA) 08020205, and encompasses approximately 623,219 acres. The watershed encompasses parts of seven counties: Craighead, Woodruff, Poinsett, Cross, St. Francis, Jackson, and Lee. Most of the L'Anguille River Watershed lies within the Mississippi Alluvial Plain Natural Division. Crowley's Ridge is a unique geographical formation and lines the eastern boundary of the upper watershed. Almost one-half or 300,000 acres of the watershed are managed in agricultural row crops and approximately 74 percent of the watershed is considered "prime farm land." Only a meir 40,000 acres of bottomland hardwoods remain in the LRW (Sutton 2002). The headwaters of the watershed begin at the outskirts of Jonesboro, AR, just off Crowley's Ridge. Most of the tributaries north of Forest City have been altered through channelization, but streams in the lowest portion of the watershed represent a more natural condition (FTN 2000). The major tributaries of the L'Anguille River include First Creek, Second Creek, Larkin Creek, and Brushy Creek. Prior to 1945, the L'Anguille River was channelized approximately 30miles, from just west of Whitehall, AR, to north of the Claypool Reservoir. The river's



appearance in this area resembles a muddy, straight ditch (Sutton, 2002). From its' confluence with the St. Francis River, the L'Anguille stems some 96 miles. A number of wildlife management areas (WMA's) frame the L'Anguille River. Brushy Creek WMA and The Pine Tree WMA encompass approximately 1,175 acres of the basin with 11,500 of those acres lying within the Pine Tree WMA.

While the L'Anguille River and its tributaries once represented a natural stream and wetland system, agriculture in the delta expanded and the upper watershed was cleared, channelized and exploited for irrigation. Wetlands were drained, clear cut, farmed, and dammed for irrigation issues. Of the remaining 40,000-forested acres of hardwood, some 4,000 acres have recently died from prolonged inundation (Suton, 2002). Floodwaters were removed as streams were drained to provide more acreage for farming purposes, widely encouraged by the federal government. "Approximately 91% of water used in the LRW is for agricultural purpose," (Layer, 2004). Like most delta watersheds the L'Anguille starts as a wide and shallow basin. Evidence suggests that the pumping of groundwater for agricultural purposes is a contributing factor to the watersheds decreasing water table issue. Predominant agriculture in the watershed includes cotton, rice, soybeans, and wheat.

The lowest seven-day period of flow in a ten-year period (7Q10 discharge data) was recorded at 2.5 cubic feet per second (cfs) near Colt, Arkansas (ASWCC 1988). Low flows indicate the stream approaches almost zero flow at low flow conditions, and it is expected that groundwater declines are due to agricultural practices. While flood events were once a historical norm for the watershed, drainage projects in the upper reaches have altered the flow conditions of the watershed.

The Arkansas Water Resource Center in partnership with the Arkansas Soil and Water Conservation Commission and Arkansas State University established a water quality monitoring station in 2002. A third year of data is being collected. Additionally the United States Geological Survey has established a flow gauge and automatic sampling unit in the watershed.

Unfortunately, the majority of the bottomland hardwood forests that represented the region in the watershed were cleared (Sutton 2002). Almost 75 percent of the watershed now lies in agricultural lands.

DETAILED DESCRIPTION OF THE L'ANGUILLE WATERSHED

(The following Sections were taken with author permission from the Watershed Restoration Action Strategy (WRAS) developed by Bill Layer in 2004: LANDSCAPE AND TOPOGRAPHY; GEOMORPHIC FEATURES; HYDROGRAPHY; HYDROLOGY; SOILS; LAND USE AND LAND COVER; WATER QUALITY; GROUNDWATER RESOURCES; VEGETATION; PUBLIC OUTREACH; and WATER QUALITY ISSUES.)

LANDSCAPE AND TOPOGRAPHY

Most of the LRW lies to the west of Crowley's Ridge, and comprises broad, level to nearly level areas. Loessal hills of Crowley's Ridge range from gently sloping to steep.

Crowley's Ridge rises to as much as 300 feet above the adjacent plain. The ridge extends in a north-south direction and is breached by the L'Anguille River in Lee County. Crowley's ridge separates the L'Anguille River Basin from the St. Francis basin on the east side of the ridge (ASWCC 1988). Slopes on Crowley's Ridge are between 10 to 40 percent with valley bottoms less than one percent.

Stream slopes and associated ridges vary from 3 to 12 percent across the upland plain, which itself has slopes of less than three per cent. Elevations on the plains west of

Crowley's Ridge in Cross County are between 200 to 280 feet, with elevations on the ridge ranging up to 453 feet (USDA 1968).

GEOMORPHIC FEATURES

During the Tertiary Period (66 to 1.65 million years ago), rises in seawater inundated southern and eastern Arkansas. Some rock formations from this period are buried in the Mississippi Embayment of eastern Arkansas. Such formations are buried now by deposits of the Mississippi River, except on Crowley's Ridge. These rock formations are actually soft materials. Lignite deposits accumulated in swampy areas. By the end of the Tertiary Period, the Gulf was south of Arkansas, as sea levels dropped. The Mississippi Embayment was a low area and the Mississippi River developed in the trough (Guiccione 1993).

The Quaternary Period lasted from the end of the Tertiary Period until present day. Periods of glaciation occurred as many as eleven times during this period. Most of these events occurred during the Pleistocene Epoch, which lasted until 11,000 years ago (Saucier 1994). The Mississippi River was an outwash from the ice sheets covering much of North America. A deep valley eroded west of Crowley's Ridge, the Mississippi River. The Ohio River similarly drained glaciers and cut east of the ridge. The confluence of the two rivers formed south of present day Arkansas.

Late in the Quaternary Period, the Mississippi River cut through Crowley's Ridge joining the Ohio River, increasing the flow through the channel east of Crowley's Ridge in Arkansas. Sand and gravel were deposited in the valleys. Windstorms blew across older river channels and deposited loess in many areas, including atop Crowley's Ridge. Sand dunes were formed by wind action in areas of northeast Arkansas.

The loessal materials on Crowley's Ridge exhibit a natural calcareous cementation. If disturbed, they erode easily and gulley's form (Krinitzsky and Turnball 1967). This has caused the formation of some rugged topography with 75 to 100 feet of local relief being common along Crowley's Ridge.

Relict braided channels were formed on each side of Crowley's Ridge during the waning of North American glaciers. The L'Anguille River follows one of these relict braided channels of the Mississippi River, and many tributaries have conformed to the linear trend of larger, relict streams. Some of these streams have formed small natural levees, which are discernable from larger levees formed by the relic channels they occupy. The Mississippi River switched from a braided to a meandering stream some 10,000 years ago. Continued erosion of banks resulted in oxbows, swamps, and other formations. New tributaries drained areas not now permanently inundated and as before mentioned, follow old braided river courses. The L'Anguille River follows such a channel and for most of its length is contained by old Mississippi River scars. The lower end of the channel passes through back swamp deposits formed by the meandering Mississippi River.

HYDROGRAPHY

The streams of the LRW form a network of tributaries beginning on Crowley's Ridge to the east. These eastern tributaries emanating from the ridge run primarily westerly forming confluences with the L'Anguille River. These streams are relatively short and many above Forest City and all the way up the watershed have been channelized where they leave the ridge and enter the relatively flat plain.

Main tributaries on the west side of the L'Anguille River run more southerly, somewhat paralleling the L'Anguille River. The majority of these streams in the upper two-thirds of the basin have been channelized and many have 90-degree confluences with receiving streams. Streams in the extreme lower portion of the LRW do not appear to have been as severely altered (FTN 2000).

Major tributaries to the L'Anguille River include Second Creek, First Creek, Brushy Creek and Larkin Creek. All of these streams enter the L'Anguille River on its west side.

The L'Anguille River itself was channelized prior to 1945 from west of Whitehall north to near Claypool Reservoir, a distance of nearly 30 miles. The river's appearance in this area resembles a muddy, straight ditch (Sutton 2002). The L'Anguille River extends some 96 miles from its confluence with the St. Francis River near Marianna to near Harrisburg. Brushy Creek, Second Creek, First Creek and Larkin Creek drain 115, 60, 91, and 43, square miles respectively.

Some wetland areas and lakes in the L'Anguille River Basin include Brushy Creek Wildlife Management Area, which is operated by the Arkansas Game and Fish Commission, and lies on either bank of the L'Anguille River, encompassing 215 acres. The Pine Tree Wildlife Management Area includes 11,500 acres and includes portions of First Creek, Second Creek, and Cypress Creek in St. Francis County. No large reservoirs exist in the LRW.

HYDROLOGY

The L'Anguille River and its tributaries were meandering streams when first settled by recent peoples. As more land was placed in agriculture, the stream channel in its upper end and many tributaries, especially in Poinsett and Cross Counties, were channelized to move floodwater, draining areas that were once wetlands. These drainage efforts made lands more favourable for farming through the removal of floodwater inundation.

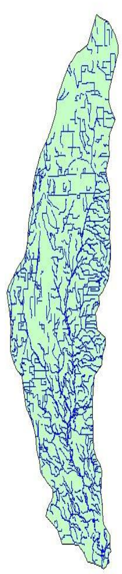


Figure 3

Streams draining Crowley's Ridge are typically more intermittent and exhibit high velocities during storm events. Little deposition of sediment occurs as the streams traverse the ridge, but deposition occurs near their mouths as they slow and enter the L'Anguille River.

Drainage canals not draining Crowley's Ridge in the LRW often have bare vertical banks. Sediment deposition has been a problem in these channelized tributaries and they require continual maintenance.

The L'Anguille River is relatively wide and marshy in Cross County. Below this area the channel is deeper and narrower but often braided. Gradient from headwaters to the mouth average 1.6 ft/mile (USGS 1979).

Stream flow in the L'Anguille River is extremely variable, fluctuating both seasonally and annually. Average annual flows reported by USGS (1979) range from 1.0 cfs to 11,400 cfs near Colt, Arkansas. Flows increase by 60% near Palestine. While flow records were not available for the lower river segment, ground-water contributions increase those flows substantially, except during summer. The stream flow characteristics of the L'Anguille River are closely related to the occurrence and development of water in the alluvial aquifer.

Mean annual discharge for the L'Anguille River is reported to be between 700 and 800 cfs at Colt, Arkansas. Discharges between May 1 and September 30 are typically much lower. For this time period, a flow of 260 cfs or higher occurs one-half of the time, while a flow of 40 cfs or higher occurs more than 90% of the time. Peak discharges for the L'Anguille River near Colt that recur at intervals of 2, 5, 10, 50, and 100 years have cfs values of 5,730; 8,800; 10,800; 15,200; and 16,900 respectively. Similar recurrence values downstream near Palestine are 3 – 5,000 cfs higher than those reported for Colt, Arkansas. Maximum peak annual discharges at Colt for the years 1971 – 1984 ranged from 1,730 cfs to 12,000 cfs.

The Arkansas State Water Plan did not compute instream flow requirements for the L'Anguille River. However, 7Q10 discharge data, which is the lowest seven day period of flow to occur in a ten year period, were reported as 2.5 cfs near Colt; 0 cfs at Palestine; and 0 cfs at the mouth. Interestingly, Colt is farther upstream than the other two points of computation (ASWCC 1988). Streams throughout the Mississippi Alluvial Plain are usually characterized as "gaining" streams, meaning the streams increase in size as they flow downstream due to groundwater seepage. This phenomenon is apparently not exhibited, at least during the growing season, for the L'Anguille River. Extensive groundwater pumping for agricultural purposes may be the cause. Approximately 91% of water used in the LRW is for agricultural purposes. The extremely low 7Q10 levels indicate the stream approaches near zero flow conditions frequently. The lower downstream values support the assumption that the stream is not "gaining" in flow from ground water contributions during summer as would be expected.

Groundwater declines in the basin probably have reduced base flows in the river. Extensive channelization moves water quickly from Crowley's Ridge and upper portions of the L'Anguille River watershed. The L'Anguille River itself has been straightened and deepened in Poinsett County. While moving floodwaters efficiently from these areas, beginning at the Poinsett – Cross County line, the river assumes its meandering channel. Undoubtedly, velocities slow, flood peaks are higher than naturally occurring peaks, and sediment from squarely shaped upstream channels is deposited in these areas, further augmenting over bank flooding. Upstream, kinetic energy of water deepens streambeds, which ultimately drain alluvial systems. In the mid-portion of the L'Anguille River, over bank flooding has contributed to bottomland hardwood mortality. Over 4,000 acres of dead timber currently exists with more being lost each year (Sutton 2002). These areas historically flooded seasonally, but due to extended flooding during the growing season, many tree species that cannot tolerate being inundated for long periods during the growing season are dying.

Large flood events have occurred historically in the L'Anguille Basin. Over 176,000 acres flooded in 1953. Drainage projects have drained wetlands and upper reaches of the

LRW, but at a cost to lower river segments, which can't handle the new higher peak flows.

SOILS

General soil units encompassing the LRW are of two types. The Loessial Plains lie west of Crowley's Ridge and make up most of the WPA area. These areas are characterized by the Calloway-Henry-Grenada-Calhoon general soil unit. Crowley's Ridge on the east side of the LRW is in the Loessal Hills region, and exhibits the Loring – Memphis general soil unit. Potential wetlands and existing wetlands occur in the Loessal Plains comprising the majority of the LRW area (ASWCC 1988).

Crowley's ridge is formed by outcropping beds of clay, silt, and sand of Tertiary age as well as gravel, silt, clay and loess of Pleistocene age (Haley 1976).

In the Loessal Plains along the floodplain, soils are slowly permeable and fine textured. In terraces away from the stream, soils are medium textured and more permeable. The lower end of the LRW, east of Marianna, exhibits deep, fine-textured, wet bottomland soils made up of dark clay. Those soils are described as very slowly permeable (USGS 1979).

Hydric soils contained in Poinsett, Cross, St. Francis, and Lee Counties comprise 296,892; 211,523; 235,504; and 191,543 acres, respectively. Together, nearly one million acres of hydric soils are found in the major counties of the LRW (NRCS 2003). Only portions of these counties are found in the LRW so all hydric soils for a given county are not within the LRW. However, major portions of these counties outside of Crowley's Ridge lying to the west were certainly once wetlands, presumably bottomland hardwood forests.

LAND USE AND LAND COVER

Most of the bottomland hardwood forests that were once a vast wilderness in the LRW have been cleared (Sutton 2002). Seventy-five percent of the land in the basin is in agricultural production.

Most of the upland loess plains west of Crowley's Ridge are suitable for farming. Though excess water is a hazard on flat slopes, drainage activities have converted those areas to agricultural production. Crops include cotton, rice, soybeans, and wheat. Tame grass pastures are present in some areas, though acreages as such are minimal compared to cultivated lands.

Crowley's Ridge on the eastern side of the LRW has severe slopes. Natural vegetation includes a variety of hardwood and herbaceous vegetation. Upland hardwoods dominate the northern portion of the ridge along with shortleaf pine. Extensive inhabitation of the area has drastically altered plant communities and resulted in even more severe erosion on slopes.

Little public land occurs in the LRW. Brushy Creek Wildlife Management Area and Whitehall Wildlife Management Area (WMA's) are the only two such areas in the WPA constituting a total of 317 acres. Pine Tree Experiment Station belongs to the University of Arkansas and encompasses 11,500 acres in St. Francis County on the western side of the L'Anguille River. Only about 40,000 acres of bottomland hardwoods occur in the LRW. Of these, some 4,000 acres have died due to prolonged inundation (see Hydrology).

WATER QUALITY

The L'Anguille River has been designated for beneficial uses of primary and secondary contact recreation; domestic, industrial, and agricultural water supply; and a perennial delta fishery (ADEQ 1998a). Water quality standards include a value of 45NTU for the L'Anguille River. NTU is a measurement for turbidity, in lay terms, how muddy the water is. Water quality data show this value is exceeded frequently along the entire length of the L'Anguille River. For this reason, the entire length of river was placed on the Arkansas 1998 303(d) list for not supporting aquatic life due to siltation and turbidity (ADEQ 1998b).

A report by USGS (1979) found low dissolved oxygen (DO) in the river. Many sites shared recorded values below 5 mg/l. The value of 5 mg/l is commonly accepted as the amount of oxygen needed in warm water streams to sustain fisheries. While many invertebrates found in the L'Anguille River can adapt to low DO, fish populations may be adversely impacted by values in this range.

The USGS (1979) concluded that more sediment enters the stream than leaves its mouth (the confluence with the St. Francis River). Low velocities in the stream allow sediment to be deposited on the streambed. Included with sediment besides silt, clay, sand, and gravel is organic detritus. Detritus is probably primarily plant material. As detritus decomposes, organisms such as fungi, bacteria and invertebrates utilize DO to accomplish the task. This results in lower DO values in the river system. Sources of sediment and detritus were not identified, however, further studies were proposed to examine erosion rates and sediment transport in the system. Specifically, a study examining tillage practices was mentioned.

Several contaminants were found in the 1979 study by USGS: high concentrations of DDD, DDE, toxaphene, PCB's, 2, 4-D and 2,4.5-T. DDD and DDE are derivatives of DDT, which has been banned from agricultural use, as has toxaphene. The source of PCBs is unknown in the watershed. 2,4-D and 2,4,5-T are commonly used with herbicides.

Fecal coliform has recently been found exceeding water quality standards (FTN 2000). These bacteria originate from mammalian waste. Sewage, runoff from livestock holding areas, and wildlife can all contribute to elevated levels. The report did not hypothesize a source. However, it is doubtful that wildlife is a major contributor because of lower densities and the lack of confinement. Livestock production appears low in the watershed. Contributions from septic tanks or fields could be a possible source. Only the upper two-fifths of the L'Anguille River exceed the water quality standard on occasion. Sutton (2002) reported fecal coliform may be coming from runoff from lands where livestock are kept; however, due to low numbers of livestock in the LRW, this is doubtful. FTN (2000) indicated most cattle operations were small, away from the main stem of the L'Anguille River, and comprised only 5.4% of the basin's land area. Second Creek had the highest fecal coliform values, but also was considered least disturbed due to its extensive riparian zone. The report (FTN 2000) considered wildlife as a possibility for the coliform levels. The area has not been assessed for possible septic tank leakage or other human origins.

GROUNDWATER RESOURCES

The State Water Plan includes the L'Anguille River WPA in the Eastern Arkansas Basin, which includes a 16-county area, essentially including the St. Francis, Big Creek, Cache River/Bayou DeView, L'Anguille, Bayou Meto, and Lower White River WPAs. This 7+ million-acre area uses 3,090 million gallons of water per day (MGD) in 1985. Of this amount, 91% was used for irrigation on agricultural crops. Some 88% of the total water used was from ground water sources. The quantity of water projected to be used in 2030 nearly doubles the values reported for 1985. The State Water Plan (ASWCC 1998) suggests possibly using surface water sources to meet the demand, as significant groundwater declines have been noted. There are two primary aquifers within the LRW: the alluvial aquifer and the deeper Sparta aquifer.

The alluvial aquifer that lies underneath the Mississippi Alluvial Plain has long been heavily utilized as a source of irrigation water for row crop agriculture. This aquifer typically yields 1,000 to 20,000 gallons per minute (GPM) (Broom and Reed 1973). Large withdrawals of water for rice production in the upper half of the L'Anguille watershed since rice was introduced as a crop resulted in the water table being dropped by nearly 50 feet by 1979 (USGS 1979). The L'Anguille River is a "losing" stream in the upper half, as its channel is no longer at a level providing base flow from alluvial aquifers. This results in water moving into the alluvial deposits from the stream channel when water is present (i.e. often runoff events). Bryant et al. (1979) describes the hydraulic connection between the aquifer and stream channel. The loss of stream channel length reduces the opportunity for groundwater recharge via streambeds and banks at high flows during runoff events, because of reduced surface area for exchange, as well as water moving faster through the system due to shorter channel lengths and higher runoff peaks.

Another significant aquifer in the region is the deeper Sparta sand aquifer, which normally yields 500 to 1,500 GPM. Within the L'Anguille River WPA, the Sparta Sand formation lies under Poinsett and Cross Counties. Water levels have declined over most areas underlain by this formation. This aquifer is utilized primarily by municipalities as a public water supply or by large industries in the manufacture of various products. The Memphis Sand Aquifer is described in some areas as including the Sparta Sand formation. With ground water declines, utilization of surface water has increased.

The daily water use in Arkansas in 1985 was 4,760 MGD, with 80 percent composed of groundwater. As of 1995, the daily groundwater use in the state had risen to 5,456 MGD, with 5,062 MGD originating from the alluvial aquifer (Holland 1999). The water requirements of the state by 2030 are projected to be over 11 MGD (ASWCC 1987). Most of the increase is expected to occur in the Delta area in the east and southeast regions of the state to supply additional irrigated croplands. Even at 1985 pumping rates, withdrawals from the alluvial aquifer were 17 percent greater than the rate of recharge.

Several critical ground water areas have been designated throughout the state of Arkansas (ASWCC 1990). These areas are defined as those where the quantity of ground water is rapidly becoming depleted or the quality is being degraded. One of these areas covers a portion Poinsett and Cross Counties.

Because of declining groundwater levels within the LRW, demand is shifting increasingly to surface waters. One of the greatest challenges facing the water managers in the L'Anguille River WPA will be to balance the use of ground and surface water in a way that will provide the drinking, industrial, and agricultural needs of people while restoring aquatic (stream and wetland) fish and wildlife habitat.

VEGETATION

The natural composition and distribution of vegetation in the LRW has changed drastically since intensive settlement began in the latter 19th century. Prior to that, bottomland hardwood forests covered much of the watershed from the stream bottoms to Crowley's Ridge, with some prairie occurring to the west of the L'Anguille River. Much of the L'Anguille River was swampland, the river probably being choked with fallen trees and bank overflow may have been common in much of the upper two-thirds of the basin. Examination of archeological sites and even clues from de Soto's travel seem to indicate that, except perhaps in its lower end near the confluence with the St. Francis River, the L'Anguille basin was virtually uninhabited due to the extensive swamps that occurred there. Virtually all of these original swamplands have been drained, the forests cut, and replaced with cropland.

Bottomland hardwood forests still do occur along the L'Anguille River, especially on its eastern bank. The lower portions of Second Creek and First Creek also contain some woodlands. Crowley's Ridge contains woodland

communities representative of upland sites. Many channelized drainages in the WPA contain little or no vegetation on their banks, and side slopes appear to erode during storm events (FTN 2000). The woodlands along Crowley's Ridge and those bottomland areas remaining in forest together comprise about 22 per cent of the LRW. The L'Anguille River, especially in its midsection, has been choked with silt and debris and currently floods bottomland forest areas during the growing season. This is resulting in the die-off of large acreages of remaining hardwood forests.

PUBLIC OUTREACH

In order to outline and implement a Watershed Restoration Action Strategy, significant participation from local stakeholders will be necessary. The formation of several groups will be required. The Cross County Conservation District along with other conservation districts in the watershed have already developed two groups whose mission is to facilitate watershed planning and implementation of measures to reduce sedimentation, siltation, and turbidity in receiving streams in the watershed. While these groups provide necessary functions, a third group should be developed.

Cross County Conservation District currently leads a Watershed Steering Committee (WRS) that reviews various projects for selection under technical guidelines for implementation as a part of various farm programs. As a part of the development of this WRAS plan, a L'Anguille River Technical Support Group (TSG) was formed. The TSG is composed of individuals who represent various agencies, state and federal, as well as local governmental organizations and nonprofit groups who have an interest in the watershed and/or represent entities that have either technical expertise or programs which may provide financial assistance to address specific problems. These planning and implementation groups are necessary to plan implement various strategies to reduce or correct problems that were identified through the various public meetings that were held throughout the basin.

A L'Anguille River Watershed Group should be formed which can capture the interest, energy, and resources which the public can provide. A major function of this group would be to promote the work and plans that need to be accomplished to correct the various problems encountered in the watershed.

The group should be composed of various stakeholders in the watershed and should include a make-up that is comprised of at least one-half local landowners. Without the support of landowners in the watershed, the best plans will not see fruition. While various problems have been identified throughout the watershed, and some problems in one portion of the watershed differ from those in another, the LRWG should include at least two representatives from each of the upper, middle, and lower reaches of the watershed. Forming one group (LRWG) will insure that programs developed and implemented in one area of the watershed, will also be coordinated with programs in other areas of the watershed. Corrective actions in one area of the watershed may have an effect in other areas, subsequently coordination is essential.

Interests that might be included in the formation of a LRWG include landowners, businessmen, industry, environmentalists, recreational interests/businesses, etc. The group should represent all of those who have an interest in the future of the natural resources within the watershed boundaries. Excluding any interest would create polarized views and reduce the probability of success.

The LRWG should incorporate itself and function as a nonprofit entity that can then take advantage of various funding programs for which only nonprofits can apply. The Arkansas Department of Environmental Quality has recently completed a "watershed planning guide" which includes information on how to form a watershed group. This group could also serve as a focal point for issues in the watershed and insure that the public and landowners were involved in decision making processes. The group may also lead discussions of the TSG to continue to refine and evaluate the implementation of the WRAS. As programs are implemented and results produced, the TSG and the LRWG should continually update where they are in their efforts and what new directions need to be taken. The restoration of a watershed and its streams should not be a static effort.

WATER QUALITY ISSUES

Various issues in the watershed have been defined through a series of public meetings held in the watershed. Table 1 outlines those issues that have been identified as concerns by local citizens. The TSG should address and prioritize which of these issues are most important and focus on those that are of immediate importance. Many of these issues are linked together and addressing on issue/problem may well affect another. For instance, controlling erosion of ditches will ultimately improve turbidity in receiving streams. As one reviews Table 1, it is apparent that ideas of problems change as one goes upstream from Marianna to Harrisburg. The latter being located high in the watershed while Marianna is in the lower watershed. It is also apparent that views differ even within the same area. An example would be the need cited for more drainage districts and the opposite view that no more are needed. An important function of the LRWG will be to become educated and through various outreach programs, educate the public and citizens in a manner that will bring resources together for the support needed to finally implement corrective actions required to address problems.

Many of the problems identified by local citizens result in the problems addressed in the TMDL document developed by FTN (2000). The L'Anguille River currently does not meet water quality standards for turbidity and fecal coliform bacteria.

The Restoration Plan

Through collaboration with Conservation Districts, a detailed Watershed Plan for the L'Anguille River has been developed. Multiple Conservation Districts in the L'Anguille River Watershed lead public meetings throughout the watershed to gather citizen input and information on issues relevant to the L'Anguille and the federal listing. The foundation of this plan established stakeholder identification and participation to ensure plan success. This plan takes considerable guidance from Soil and Water staff and input from appropriate agencies and parties. This plan develops scientific management plans according to the CTIC model and lays out the steps and resources needed to restore the L'Anguille River Watershed.

The L'Anguille River was listed as a "Federally Impaired Water Body," (303d) in 1998. The two specific dilemmas for the L'Anguille, which sparked the listing are the abundant amounts or readings for turbidity and an overabundant presence of fecal coliform bacteria in the upper two-thirds of the river, which didn't support primary contact for recreation. While these two subjects are not easily remedied or pinpointed, the watershed has been studied enough to determine the major contributing sources. These sources are identified and examined in this plan. This information was gathered and determined from a number of sources including FTN's study of the rivers' Total Maximum Daily Load (TMDL), Bill Layers Watershed Action Strategy (WRAS), and the additional information and concerns gathered from the established L'Anguille Watershed Coalition. It is the goal of the author that this plan provides a implementable solution that will restore the water quality and ecological health of the L'Anguille Watershed. Because of this goal, it was imperative that all stakeholders were identified and cultivated for their input and participation in establishing this plan. The goal of this plan is to establish a road map for implementing a restoration project that will improve water quality and ecological health in the watershed, resulting in the removal of the L'Anguille from the federal impairment listing.

Identification of pollution sources in the L'Anguille Watershed

As stated earlier, the two major contributors of the L'Anguille River's 303d Federal Impairment listing, are turbidity and fecal coliform bacteria. Of these two sources, turbidity is the most complex source of pollution and enters streams in multiple scenarios and multiple locations. Turbidity will be the first source of nonpoint source pollution identified in this plan, followed by fecal coliform. In addition to the two federal water quality violations, a number of other issues and concerns we determined from the L'Anguille Watershed Coalition. It is the aim of this plan to include all concerns and issues determined to be present in the watershed.

Pollutions Sources were identified by the L'Anguille Watershed Group as follows:

Turbidity
Channelization and channel enlargements
Sedimentation
Eroding Farmland
Gravel mining and construction
Fecal Coliform Bacteria
Irrigation

TURBIDITY

1.) Channelization and channel enlargements are a major contributor to sedimentation. The straightening and dredging of channels causes immediate impacts to water quality. Furthermore, these channel alterations are the catalyst for additional impacts downstream. As channel alterations are made and the natural channel meanders are removed, the velocity of the flow is increased. As the flow increases it builds power and continues until the flow collides with something. Most often, that something is the streambank, and most often, this impact creates erosion of soil and all materials within it. As sediment builds in the stream, it begins to take on a "sand paper affect," which has a domino affect down stream. The sediment rubs against other stabile particles and causes additional releases of sediment. This is a reciprocal effect that is increased by channelization.

Channelization and channel alterations have been historically accepted as beneficial techniques to manage water for a desired use. Whether it's the removal of water off a piece of property for an alternative land use, such as farming, or the transfer of water to a desired use or site, such as irrigation, this practice has been widely used and prescribed which moves water quickly from one location further downstream. The upper portion of the watershed has the most historical channelization. The upper region was straightened and deepened to slow the river. Sedimentation deposits altered the natural conditions of the river, changing flooding conditions. In spite of a greater knowledge, this practice continues today and is commonly used by such agencies as the U.S. Army Corps of Engineers.

Prescription

In order to address channelization and channel alterations, a number of steps have been identified and prescribed. These steps are listed in a prioritized and chronological order. They include:
1.) the identification of project stakeholders;
2.) the written agreement with state and federal agencies for their participation and assistance with the project.
2.) the inventory of banks and ditches to determine problem sites;
3.) the prioritization of the inventory addressing the most severe sites;
4.) the forming of partnerships and expertise to specifically address the channelization issue;
5.) the forming of a "Channel Committee" to address current and future related issues;
6.) the recruiting of participation from landowners; and
7.) the implementation of demonstration projects to correct channelization effects.

Goals

The long-term goal for addressing channelization and channel alterations in the watershed were to decrease channelization and stabilize streambanks with natural vegetation and allow for more natural stream meanders as the stream re-adapts. The short-term or immediate goal is to identify, prioritize and stabilize the most severe banks with vegetation to control erosion while providing an educational demonstration site to relate the issue to landowners.

Measures of Success

The measures of success should be further determined for both the short and long-term goals, as the work plan for this project is further developed. The *short-term measure of success* is to effectively establish ten demonstration sites that display the appropriate remedy and provide an educational opportunity for landowners and future participants.

The long-term measure of success is to effectively stabilize 30% of the eroding streambanks with natural vegetation and allow natural meandering conditions to return by project end.

Performance Criteria

The performance criteria will be evaluated on a quarterly basis each year (four times). It is expected that accomplishing the measures for success will be slower in the early stages, but progress should begin to be more evident by the second quarter. The *short-term performance criteria* should be determined by steady accomplishment for the measures of success. Three demonstration projects should begin within the first year of the project. Four demonstrations should be initiated within the second year and at least two of the three demonstrations from the first year should be completed within the second year. The remaining three demonstration projects should begin and be completed within the third and final year of this project. It should be noted that the performance criteria becomes more stringent as the project progresses due to the "learning curve" within this task.

The *long-term performance criteria* should be evaluated on a quarterly basis. Planning and site selection should begin in the first quarter of the project and implementation should start within the second quarter of the first year, or according to species planting/growing season. The criteria should also evaluate commitments from landowners to participate in allowing re-vegetation. By project end, 30% of eroding streambanks should be natural vegetated.

Monitoring Needs

Water quality monitoring will be a major component to determining project success and should be the overall determination for project success. Regular sampling should take place throughout the watershed and baseline data should be established immediately. Streambank restoration sites should be visited a minimum of one at least two visits per quarter. Washouts are likely to occur and should be recorded, monitored, and addressed appropriately. Photographs and a written summary of conditions should be used to document each site quarterly. The long-term goal of addressing 30% of the channelized stream sections should be met within an applicable timeframe of 10 years.

Funds Needed for Implementation

It is estimated that steps one through six would require approximately $50,000 to $150,000 for a complete inventory of the watershed, mapped and prioritized by problem site. An Additional $40,000 will be needed to implement the demonstration project, but partnerships and leverage of funding should play a vital role in the demonstration project. An estimated $200,000 to $500,000 a year will be needed to conduct water quality monitoring, depending on the number of sites and sampling frequency needed.

Timeline

Step one should begin upon the projects beginning. A year and a half should be allowed for the complete inventory and prioritization of sites. Partnership development should begin immediately to address channelization issues. Upon the projects initiation, the "Channel Committee", should be formed and making significant progress in recruiting landowners for participation in BMPs and a potential demonstration project. The demonstration project should begin within the third quarter of the project and should be completed by the fifth quarter.

2.) Sedimentation is one of the most significant sources of turbidity. Sedimentation is formed from particles of soil and bonding nutrients. As sedimentation builds, it begins to choke out vegetation and other aquatic life. The effects are reciprocating and lead to additional impacts within a water body. Untreated, sediment can build to a state that fills a section or entire body of water, depending on conditions.

Sedimentation is a result of many malpractices and mishaps in the L'Anguille Watershed. The L'Anguille Watershed Coalition identified ditches as one of the most predominant sources or causes of sedimentation in the watershed.

Prescription

A number of steps have been identified and prescribed by the coalition to address sedimentation. These steps are listed in a prioritized and chronological order. They include:

1.) the initiation of water quality monitoring throughout the entire watershed;

2.) the inventory of road ditches in the watershed;

3.) the prioritization of the inventory addressing the most severe sediment contributing ditches;

4.) the establishing of guidelines for road ditches and their maintenance and production of brochure or pamphlet for dissemination;

5.) the forming of a "Road Ditch Committee" to address current and future related issues;

6.) working with municipalities, landowners, and developers to address ditched property and;

7.) the implementation of demonstration projects to correct sedimentation from roadside ditches.

Goals

The *long-term* goal of this element is to reduce the level of sediment in the L'Anguille River so that the river once again meets the federal water quality standard. The *short-term* goal of this element is to set yearly achievable standards of reducing sediment.

Measures of Success

Both the short and long-term goals should have reasonable measures of success. Short-term measure of success should include a comprehensive and prioritized inventory of road ditches in the watershed, a working committee focused on ditches, the development of guidelines and best management practices for the creation and maintenance of ditches, and the establishment five demonstration sites that display the appropriate ditching applications and provide an educational opportunity for municipalities, landowners and developers. The long-term measure of success is to create a sustainable management practice for ditches in the watershed that reduces the affects of sedimentation.

Performance Criteria

The performance criteria should be ensured four times a year and progress should be evident by the second or third quarter. The *short-term goals* should be accomplished within the first or second quarter of the project. At any point the measures of success become unachievable or stalled for an extending amount of time, the short-term goals and measures for success should be reconsidered in order to achieve the long-term goal.

The *performance criteria for the long-term goal* of this task should also be determined quarterly, even though there will be a much less apparent change in improving water quality, at least for a number of years. The performance criteria should look at the signals of over-all improvement for reducing sediment. At project end, the improvement should begin to be more evident and continuation of this plan should be considered or adjusted thereafter.

Monitoring Needs

Water quality monitoring and sediment sampling will be a major component to determining project success. Basic sampling techniques and methods should be used, but it is recommended that the project use sampling as an education tool and incorporate this task into the project. Baseline data should be collected as one of the first priorities of the project. This data should help determine the number of sampling sites and frequency of sampling. A minimum of two site visits per quarter should be made to each area and demonstration project being conducted for this task. The best management practices prescribed at each ditch should examined quarterly to ensure that the practice is applicable and successful. Photographs and a written summary of conditions should be used to document each site quarterly. The long-term goal of reducing sediment to meet federal water quality standards should be met within a 10-year timeframe.

Funds Needed for Implementation

Approximately $50,000 to $150,000 will be needed to develop a full inventory and assessment of road ditches in the watershed. This element can be combined with the first step from the first element of inventorying channelization. Establishing the ditch committee and guidelines for ditches should be supported by approximately $10,000 for meetings, supplies, and the development of a simple brochure for ditch BMPs. Ditch demonstration techniques (5) should be accomplished for less than $30,000 through partnerships and funding leverages.

Timeline

The initiation of a ditch inventory and prioritization of most impaired should begin in the first quarter of the project and take no longer than six quarters. Establishing guidelines should begin within the first quarter of the project as well as the forming of a committee to address ditches. The demonstration project should be identified and initiated within the third quarter of the project.

3.) Eroding farmland is also one of the most significant sources of turbidity. This occurs from a number of issues and land use practices. Many of these practices can be addressed through alternative tilling and irrigation techniques. Additionally, a great deal of erosion comes from the farming of unsuitable agricultural lands. Stream Management Zones (SMZ's) should also play a vital role in preventing erosion. Vegetating streambanks should be a project priority.

Prescription

A number of steps have been identified and prescribed in order to achieve success. These steps are listed in a prioritized and chronological order according to the L'Anguille Watershed Group. They include:

1.) Identification of Conservation opportunities;
2.) Accelerate conservation planning on farms;
3.) An individual or group of individuals to coordinate conservation planning;
4.) Find financial assistance to implement or aid the implementation of conservation plans;
5.) Identify and implement reforestation/SMZ opportunities;
6.) Develop demonstration/education and cost share programs for farmers;
7.) Develop a strategic education committee and program;
8.) Inclusion of needs for each county and;
9.) Calculate load reduction

Goals

The long-term goal of this element is to meet federal water quality standards by reducing sediment loading from eroding farmland in the L'Anguille River Watershed. The short-term goal to develop and implement conservation plans on 50-60 farms in the watershed within 3 years.

Measures of Success

The short-term measure of success should show an incremental path of progress through the establishment of farms that have developed and implemented conservation plans. This measure is fairly simply to determine in that two levels of success can be established and monitored: 1.) how many conservation plans have been developed for farms and; 2.) how many farms are implementing the plans successfully. The long-term measure of success will take years or even decades to accomplish because of the size of the watershed and the number of farms that need to be reached with conservation planning. While the long-term goal may take years to accomplish, consideration should be given to any success of water quality improvement due to this task.

Performance Criteria

The performance criteria should be evaluated quarterly per year and progress should be evident by the second or third quarter. At any point the measures of success become unachievable or stalled for an extending amount of time, the short-term goals and measures for success should be reconsidered in order to achieve the long-term goal.
The *criteria for the short-term goal* will be the most feasible to show progress on and a project average of at least 5 conservation plans per quarter should be established with farmers. Within the 3 years of this project, 60 conservation plans should be established for farms. By the third quarter of the project, on-farm implementation of the conservation plans should start to take place. By project end, 50 farms should be implementing the conservation plans. While these performance criteria may sound like a "lofty" goal, it should be noted that some farms may only require one or two simple modifications.

The *performance criteria for the long-term goal* of this task should be also be determined quarterly, even though there will be a much less apparent change in improving water quality, at least for a number of years. The criteria should look at the patterns or trends of improvement. At project end, the improvement should begin to be more evident and continuation of this plan should be considered or adjusted thereafter.

Monitoring Needs

Water quality monitoring and sediment sampling are needed to determine project and task success. Water sampling should take place on a regular schedule and sampling specifics and techniques should be determined as the work plan for this project is further developed. Each quarter a project employee should make site visits to the farms that are implementing conservation plans. Digital photographs should be made with each visit to document progress and modifications to existing plans should be made or determined from these site visits depending on success.

Funds Needed for Implementation

This project will certainly require at least one full time position for the life of the project. This individual should coordinate with the L'Anguille Watershed Coalition and sub-committees to accomplish the goals laid out in this plan, as well as new or unforeseeable items not presented in this plan. The position should be supported with approximately $40,000 per year to cover a salary and benefits. The funding of this position should cover the completion of conservation planning and coordination with landowners, laid out in this task. The on-farm conservation cost share component should be supported with as much available funding as possible. This number can be most closely estimated to be in the millions of dollars to incorporate such on-farm conservation as tail water recovery, multiple inlet irrigation valves, and flash board risers, to name a few. Reforestation/vegetation should be identified and implemented where applicable and the project staff should work with agencies such as the Natural Resource Conservation Service (NRCS), to enroll land in federal conservation programs that provide financial incentives for farmers. Approximately, $50,000 should be included to pay for trees and tree planting on farms as a separate cost share for reforestation. Native vegetation should be allowed to regenerate on streambanks naturally. Some seeding may be necessary, but serious consideration should be given to the type of species used. Native prairie grasses should be used as much as possible. The Arkansas Natural Heritage Commission should be the vegetative consultant for this effort. The education component of this project should be incorporated into every step. No opportunity to educate should be wasted nor neglected. Approximately $70,000 should be devoted to education and the production and distribution of educational materials. Approximately $100,000 should be devoted to demonstration projects, with the emphasis of funding gearing towards cost share projects. Calculating load reductions for the entire project should be supported with approximately $20,000.

Timeline

The hiring of at least one full time position should take place as soon as the project begins and continue as long as funding supports. The position should initiate contact and develop relationships with landowners as soon as possible in order to achieve the goal of establishing 50 conservation plans for farms. At least 10 farms should be implementing the established conservation plans by the end of the first year. Keep in perspective that conservation plans might include just one or two simple BMPs to be implemented. Cost share programs should be on the ground within the first three quarters of this project. Reforestation should be implemented by the end of the second year of the project. Program education should begin as soon as the project receives funding and should continue indefinitely. Loading calculations should be determined within the first two years of the project.

4.) Construction/Gravel Pits – Road construction and gravel mining contribute an undetermined amount of sediment to the L'Anguille Watershed. While the exact contribution has not been determined, it is expected that such disturbances contribute significantly. Road construction and maintenance is never ending and Best Management Practices could make a significant change in decreasing in-stream sedimentation.

Prescription

Three steps have been identified and prescribed for addressing nonpoint source pollution from construction and gravel pits. They include:

1.) the inventory of existing and abandoned mines in the watershed;
2.) the development and implementation of a Best Management Practices (BMP) demonstration project with at least one gravel mine and one construction site to be used for educational training. The audience for the demonstration projects should target gravel mine owners/operators and construction contractors with the goal of changing management practices at their operations, and;
3.) Water quality monitoring at or near sites to determine impacts on watershed.

Goals

The long-term goal of this element is to reduce run off from gravel mines and construction sites in the L'Anguille River Watershed so that the river once again meets the federal water quality standard. The short-term goal of this task is to establish BMP demonstration projects for at least one gravel mine and one construction site. These demonstrations should be used as an educational outreach tool.

Measures of Success

Both the short and long-term goals should have reasonable measures of success. The long-term measure of success should include a comprehensive inventory of gravel mines in the watershed. The short-term measure of success is to create a BMP demonstration project at a gravel mine and a construction site. A minimum of 20 total site visits should be made to the demonstration sites with gravel mine owner/operators and construction developers.

Performance Criteria

The performance criteria should be ensured four times a year and progress should be evident by the second or third quarter. Progress on each goal should begin in the first quarter. The gravel mine inventory should be completed by the fourth quarter. The short-term goals should be accomplished within the fourth quarter and site visits should be planned and facilitated by the fifth quarter. At any point the measures of success become unachievable or stalled for an extending amount of time, the short-term goals and measures for success should be reconsidered in order to achieve the long-term goal.

Monitoring Needs

Water quality monitoring is not applicable for this component. The best management practices prescribed at each project site should examined quarterly to ensure that the practice is applicable and successful. Photographs and a written summary of conditions should be used to document each site quarterly, as well as visitors to each site.

Funds Needed for Implementation

Approximately $10,000 is needed to develop an inventory of gravel mining and road construction projects. An estimated $30,000 is needed to implement BMP projects and the educational component.

Timeline

The inventory of existing and abandoned mines in the watershed should begin within the second quarter of the project and be completed by the end of the first year. The partnership for developing a BMP project at both a gravel mine and road construction site should be identified within the first year. The implementation of a Best Management Practices (BMP) demonstration project with at least one gravel mine and one construction site should be completed by the second year of the project. Educational training, through the sites, should begin no later than the third year of the project and continue as long as funding allows.

5.) Irrigation practices contribute to both soil and water loss within the L'Anguille Watershed. Ground and surface water are pumped from the area to irrigate fields and while some advanced techniques are being utilized, the majority of farmers do not have the knowledge or finances to participate or adopt such practices. As irrigated water runs off its' targeted use, soil and nutrients such as fertilizers and pesticides are carried away with the water. The resource lost from the land, as well as the financial loss to farmers, is immense and unnecessary. More practical, financial and conservative practices are now present and should be used.

Prescription

A number of steps have been identified and prescribed in order to help farmers implement irrigation conservation techniques. They include:

1.) the development of education materials;
2.) staff outreach to farmers for program participation;
3.) farmer sign-up period for participating in program;
4.) resource cost share to help implement irrigation conservation;
5.) the implementation of on farm water conservation projects, and;
6.) the calculations of load reductions from task efforts.

Goals

The long-term goal is to reduce non-point source pollution from irrigation. The short-term goal of this component is to increase irrigation conservation in the L'Anguille Watershed. Any and all allocated federal cost share funds created for this task should be exhausted by project end. At least 30 farms should be affected and assisted with irrigation conservation through this element.

Measures of Success

Measures of success should show consistent progress through the establishment of farms that participate in a cost share for irrigation conservation. This measure of success is simple to determine in that all available cost share funds should be used for irrigation conservation by project end. Steady progress should be achieved and recorded each quarter.

Performance Criteria

The performance criteria should be evaluated quarterly per year. On-farm progress with cost share should be evident by the third quarter and an average of at least 5 farms per quarter should be implementing irrigation conservation measures. Within the 3 years of this project, 30 farms should have received federal cost share, technical assistance, and on-farm irrigation conservation. The *performance criteria* for both the short and long term goal of this task should be monitored and determined quarterly.

Monitoring Needs

Monitoring should include on site visits to farms implementing irrigation conservation. Basic before and after samples should be taken and recorded on a sample of the farms to represent water quality and quantity improvements. This should be a statistically viable sample that gives validity to task cost.

Funds Needed for Implementation

The funds needed to implement irrigation conservation cost share are estimated at $300,000. Flashboard risers, multiple inlet valves, and other progressive irrigation techniques are needed to make a significant effort at reducing soil, water, and nutrient loss on farms.

Timeline

Cost share funding should begin by the second quarter of the project. After the second quarter, available cost share funds should flow at a steady level that leads to the exhaustion of available funds before project end.

FECAL COLIFORM BACTERIA

6.) Fecal coliform bacteria is the second reason for the federal 303 d listing of the L'Anguille River. Algal Blooms were listed in the TMDL for two reaches of the watershed, but additional Algal Bloom threats are present throughout other portions of the watershed and are a result from over abundant fecal coliform bacteria and sediment, producing eutrophic conditions.

Prescription

A number of steps have been identified and prescribed in order to achieve success. These steps are listed in a prioritized and chronological order according to the L'Anguille Watershed Group. They include:

1.) the development of education materials;
2.) nutrient management workshops for farmers;
3.) updates conservation farm plans with nutrient management;
4.) septic tank contribution inventory;
5.) establishing a septic tank cost share program;
6.) working with livestock producers to establish BMP's;
7.) conducting technology tours of animal waste management sites;
8.) developing irrigation conservation measures for farmers;
9.) calculation of load reductions from efforts and;
10.) an inventory of point-sources in the watershed.

Goals

The long-term goal to reduce fecal coliform bacteria in the L'Anguille River and meet the standards of the Clean Water Act. The short-term goal of this component is to identify and reduce fecal coliform bacteria.

Measures of Success

The short-term measure of success should show an incremental path of progress through the establishment of farms that have developed and implemented conservation plans. This measure is fairly simple to determine in that two levels of success can be established and monitored by determining the number of conservation plans successfully developed for farms and the number of farms implementing the plans successfully. The long-term measure of success will take years or even decades to accomplish because of the size of the watershed and the number of farms that need to be reached with conservation planning. While the long-term goal may take years to accomplish, consideration should be given to any success of water quality improvement due to this task.

Performance Criteria

The performance criteria should be evaluated quarterly per year and progress should be evident by the second or third quarter. At any point the measures of success become unachievable or stalled for an

extending amount of time, the short-term goals and measures for success should be reconsidered in order to achieve the long-term goal.
The *criteria for the short-term goal* will be the most feasible to show progress on and a project average of at least 5 conservation plans per quarter should be established with farmers. Within the 3 years of this project, 60 conservation plans should be established for farms. By the third quarter of the project, on-farm implementation of the conservation plans should start to take place. By project end, 50 farms should implementing the conservation plans. While this performance criteria may sound like a "lofty" goal, it should be noted that some farms may only require one or two simple modifications.

The *performance criteria for the long-term goal* of this task should be also be determined quarterly, even though there will be a much less apparent change in improving water quality, at least for a number of years. The criteria should look at the patterns or trends of improvement. At project end, the improvement should begin to be more evident and continuation of this plan should be considered or adjusted thereafter.

Monitoring Needs

Water quality monitoring and sediment sampling are needed to determining project and task success. Water sampling should take place on a regular schedule and sampling specifics and techniques should be determined as the work plan for this project is further developed. Each quarter a project employee should make site visits to the farms that are implementing conservation plans. Digital photographs should be made with each visit to document progress and modifications to existing plans should be made or determined from these site visits depending on success.

Funds Needed for Implementation

Approximately $20,000 of funding is needed for the development and dissemination of education materials. Some $5,000 should support nutrient management workshops for farmers and an estimated $10,000 is needed to support staff efforts to establish and/or update conservation farm plans, focusing on soil, water, and nutrient management. The surveying of septic tanks should be combined with other field surveys and data should be compiled and pulled from existing data. An estimated $10,000 should be granted to support time and expenses of a watershed septic tank inventory. An additional $10,000 should be reserved to support a staffed position to work with livestock producers to establish BMPs. At least $5,000 should be established to conduct technology tours of animal waste management sites. Cost share for developing irrigation conservation measures for farmers should be supported with significant funding. An estimated $250,000 is needed to support such efforts. That last component of this task requires approximately $5,000 for the inventory of point sources in the watershed.

Timeline

The development of education materials should begin within the first quarter and continue through conclusion of project. By the fourth quarter the first form or round of educational materials should begin dissemination. Nutrient management workshops for farmers should begin after the second quarter. Three workshops per quarter should occur by the third quarter until a minimum of 12 workshops have been completed. Updates to conservation farm plans focusing on nutrient management should begin within the second quarter and continue through the life of the project. At least five plans per quarter should be established or updated for a goal of 50 to 60 plans for the project. An inventory of septic tanks in the watershed should begin within the second quarter until completed. In the third quarter, staff should begin work with livestock producers to establish BMPs and conduct technology tours of animal waste management sites. This should continue through the end of project. Staff should begin developing irrigation conservation measures for farmers in the second quarter and continue through project end. The inventory of point sources in the watershed should begin and end within the first year of the project.

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