Date of Report: October 24, 1995

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I. Project Title: Minnesota River Implementation-Continuation.

Program Manager: Wayne P. Anderson, P.E.
Agency Affiliation: Minnesota Pollution Control Agency
Address: 520 Lafayette Road; St. Paul, Minnesota 55155
Phone: (612) 296-7323 (TDD: 297-5353)

A. Legal Citation: M.L. 93 Chpt. 172, Sect. 14, Subd. 11(a).

Total: $1,100,000
Balance Remaining: $- 0 -

Appropriation Language as drafted 7/27/92: 11(a) This appropriation is from the trust fund to the commissioner of the Pollution Control Agency. To accelerate the adoption of best management practices (BMPs) and to accelerate related state and local implementation activities for the Minnesota River Basin.

B. LMIC Compatible Data Language: N/A

C. Status of Match Requirement: N/A

II. NARRATIVE:

Conclusions & Recommendations:

Lessons learned from the wide variety of activities funded by this LCMR project can be summarized into the following conclusions and recommendations:

1. BMPs that involve farm management changes were often readily adopted by farmers provided with modest financial incentives and technical assistance. These BMPs include nutrient management, manure management, and crop residue management. These types of BMPs have a sound research base, appear to be economically attractive to farmers, and should be vigorously promoted across the basin.

2. BMPs that remove land from farm production, or transfer land from a higher to a lesser economic use, are resisted by farmers. Where they are adopted, large financial incentives are required to compensate for economic losses. These types of BMPs should be considered for targeted implementation in watershed projects. They may require substantial financial incentives to stimulate adoption.

3. Adoption rates of either type of BMP is strongly influenced by two key factors in addition to economic implications to the landowner:
   - The presence of a local "rallying resource" such as a lake or stream with significant development potential generates community support, which positively affects the receptivity of landowners to BMP adoption. To capitalize on these stimulants to adoption, major watershed projects organized under basin management should involve local citizens in setting goals for water quality improvements that matter to their communities, such as development of streams for fishing and other kinds of recreation. The MPCA's role will be to ensure that the sum total of all such efforts in the basin add up to a clean Minnesota River main stem.

   - The presence of local resource managers or project staff who are highly committed to the project, aggressively "sell" BMPs to landowners, and have good community rapport, also increases the receptivity of landowners to land use changes. Resource management technicians and others involved in watershed project should emphasize customer service in working with landowners to promote BMPs. Training in customer service may help them to be more effective.

4. There are exceptions to all of the above generalizations about BMP adoption. It is difficult to anticipate which BMPs will be most readily adopted in a particular location. Watershed projects should take a flexible approach to BMP promotion, allowing landowners to choose from a menu of alternatives. Those that are most readily adopted should be vigorously promoted early in the project, with remaining BMPs promoted after progress has been demonstrated in this initial phase.

III. STATEMENT OF OBJECTIVES:

A. Establishment of Demonstration Watersheds. These watersheds will accomplish the following:

1. Demon_ _e the effectiveness of applying total watershed B_. _reatment for water quality improvement.
2. Showcase BMPs in small geographic areas.
3. Demonstrate the process involved in achieving total watershed BMP treatment.

B. Accelerated implementation of existing state programs.

C. Development of new and innovative BMPs. Tile system evaluation and BMP work will have the following three main objectives.
1. Gather and analyze data on flow rates and transport of contaminants from drainage tile systems with different types of surface inlets,
2. Develop a tile drainage model for the Minnesota River Basin, and
3. Calibrate and apply the drainage model to evaluate long-term average and alternative BMPs for tile systems.

D. Educational development through Extension.

F. Educational development through schools.

F. Trend monitoring in the Minnesota River Basin.

IV. OBJECTIVES:

A. Title of Objective: Establishment of Demonstration Watersheds.

A1. Narrative: Two subwatersheds will be chosen as demonstration sites. Within the land use assessment portion of MRAP 10 of the 37 evaluated subwatersheds were further analyzed for the predicted benefit of applying BMPs. Two subwatersheds will be selected to demonstrate whether these predicted outcomes are achievable.

A2. Procedures: In the demonstration watersheds the installation and technical assistance for the needed BMPs would be directed by the findings of the current LCMR project studying the Minnesota River.
1. Watersheds will be selected based on the likelihood of success, manageability, and location based on the findings of MRAP.
2. A local project coordinator will be established through a local unit of government.
3. Establish monitoring design and implement monitoring system.
4. Working through local coordinator establish land owner intent to participate.
5. Develop BMP plans and landowner contracts through the local unit of government.
6. Imple_ _nt BMPs.

A3: Budget:
Amount Budgeted: $480,000
Amount Remaining: $-0-

A4. Timeline:

	July 93	Jan 94	July 94	Jan 95	July 95
Watershed Selection	******				
Substate contracts to local unit of government	****				
Establish monitoring	******				
Contracts with landowners	**********				
BMP Installation	**********	**********	**********	**********	**********
Final Report					**********

A5. Status:

Progress: Four demonstration watersheds were selected throughout the basin. Local units of government were solicited to find first-order watersheds where landowner cooperation would likely be high. The Beauford watershed in central Blue Earth County was the top selection. The Gode-Graff watershed in southwestern Brown County was the second watershed selected. This watershed is part of the Mound Creek watershed which drains into the newly created Wellner-Hageman Lake. A third watershed was selected in Lincoln County - the Lake Shaokatan watershed. This project is currently funded through Clean Water Partnership. However, we will provide additional monitoring assistance to document water quality changes from their implementation effort. The fourth site is the Meadowbrook Creek site in Big Stone County.

Beauford

After multi-agency comments and review, the overall project focus was to promote the following:
1. Conservation tillage.
2. BMPs for fertilizer and manure applications.

3. Upgrading home septic systems.
4. Buffering of ditches, streams, and tile intakes.
5. Building typical NRCS conservation structures.
6. Use of wetlands to clean or slow water runoff.
7. Changing or removing tile intakes.

1. **Conservation tillage**

This part of the program offered subsidies per acre for farmers implementing conservation tillage or purchasing conservation tillage equipment. An operation had to have 30% residue cover after planting in order to receive this subsidy. The rates used for this BMP was $6.00 per acre with a maximum of $1,200.00 or $1,200.00 toward the purchase of equipment.

Results: Ten of Fifteen - 66% of farmers in the project area participated in this part of the project

Conclusions: There appears to be a degree of acceptance of conservation tillage. Possible reasons are the following:

a. Economics. Disk chiseling is about 50% faster than plowing and there is a fuel savings.
b. Long term benefit of educational programs from a multitude of traditional agriculture agencies.
c. It is beginning to be accepted by farmers as "good management".

2. **BMP Fertilizer and Manure Applications.**

This part of the program offered subsidies for grid soil sampling and manure testing. The subsidy was $4.00 per acre for soil testing and $40.00 per manure pit test.

Results: Five of the farmers made use of this part of the program while one did not.

Conclusions: There appears to be a degree of acceptance of manure and grid soil testing. Possible reasons are:

a. Economics. Farmers can see an economic benefit to not over applying fertilizers and other chemicals.
b. Long term benefit of educational programs from a multitude of traditional agriculture agencies.
c. It is beginning to be accepted by farmers as "good management".

3. **Upgrading Home Septic Systems.**

This component of the project offered cost share of $2,500 per home, not to exceed 50% of the cost to upgrade the home septic system. Additionally there were some experimental septics funded under a separate funding source that were installed in this watershed at a 100% cost share level.

Results: Five experimental septic systems were installed by local contractors under the direction of the University of Minnesota. These systems are being monitored for their effectiveness in treating the sewage. The purpose of this work is the development and evaluation of lower cost alternatives to mounds or at-grade systems.

There were a total of twenty-five homeowners eligible for the $2,500.00 cost-share assistance to upgrade their septic systems. Of these seventeen participated and upgraded their systems.

There were considerable comments inside the watershed as to why certain people were chosen for the experimental septics. There were also many comments from the immediate area outside the Beauford Watershed as to why the Beauford residents were getting cost-share money.

Conclusions:

a. In the future, it is best not to mix experimental septics with a subsidy program, because of jealousy.
b. There is not an overwhelming commitment in the rural areas to upgrade home septics. These systems are viewed as too costly, and not necessary as long as the current system of disposal doesn't cause any back-up of water into the house. There seemed to be little regard that the effluent went to surface water untreated.

c. Des penly admitting to having their septic system ef going directly to surface water, a large percentage of the people did not seem concerned about enforcement or being required to upgrade their system in the future. There seemed to be an expectation that the "government" would provide even greater subsidies in the future.
d. The cost of the septic systems, even with the subsidy, seemed quite high - $7,500.00.
e. Subsidy programs are almost as controversial as enforcement. Those who upgraded their system on their own prior to this program did not feel that is was fair that others received subsidy.
f. It appears that a percentage of the rural population will not upgrade their systems even with a subsidy.
g. There did not appear to be any specific characteristics of the population that would be willing to upgrade their systems with a subsidy program.
h. There has not been a concerted long term effort of traditional agriculture agencies stressing the health and pollution problems associated with improper home septic systems.

4. Buffering of Ditches, Streams, and Tile Intakes:

This part of the project offered a rental subsidy of $85.00 per acre for a buffer. The landowners would be allowed to hay this ground.

Results: Not a single landowner participated in this part of the project.

Conclusions:

a. Landowners are less willing to have buffers around tile intakes and along ditches and streams than they are to use conservation tillage or BMPs for fertilizer and manure management. Possible reasons for this are as follows:

    1) Some perceive this as unnecessary.
    2) Landowners tend to view buffers as uneconomical and difficult to farm around.
    3) There has been no long term educational programs stressing the need for buffers.

b. Available r ch has not been made available out-state to just ich buffers.

5. Typical NRCS Conservation Structures.

The traditional structures such as terraces, waterways, and manure holding pits were also available for subsidy.

Results: One such project was funded. In involves a rock chute and a grassed waterway.

Conclusion:

a. There is a definite need for such programs and for such structures
b. They are now accepted by the farming community.

6. Wetlands

Extra effort was made by the SWCD and DNR staff to convince the landowners in the Beauford watershed that wetland restorations would provide water quality and quantity benefits. The watershed historically had a large wetland/lake which if reestablished could provide multiple benefits, but because of its value as prime farmland the landowners where not interested. Areas where the landowners were having problems with excess water destroying crops were suggested as potential restorations, but the landowners wanted to drain these areas further. There was a prime candidate for RIM funding which the landowners started to enroll but decided against because an adjoining field would be affected by some shortened rows. A good inventory of all the potential sites was made with the help of Blue Earth County Environmental Services.

Results: No areas were enrolled.

Conclusions: Many factors stand in the way of getting land enrolled in a RIM type program.

a. Many landowners are unconvinced as to the need or desirability of having wetlands on their property. Many have literally spent a lifetime getting rid of the water as fast

as possible through ditching and tiling and so to restore wetlands goes against tradition.

b. The land where enrollments can have the most benefit are often the most prime farmland.
c. Wetland restorations will take a cooperative effort between a multitude of people.
d. Traditional agriculture agencies have not promoted the benefits of restoring wetlands.

7. Changing Tile Intakes:

With the cooperation of local drainage contractors, an effort was made to design and put into place tile intakes that would prevent sediment from entering tile systems. Several have been installed and will be evaluated over time.

Results: It will take several years for the results to come in.

Conclusions: None.

Project Summary: The Beauford Watershed Project was the first attempt by the agencies to initiate a total watershed cleanup without a nearby potentially valuable waterbody such as a lake to center the clean-up around. Parts of the project were successful while others were not. It is important to learn to work in watersheds like this because much of the Minnesota River Basin is similar to the Beauford watershed.

Water quality monitoring was started and will continue after this project. However, within the short time of this project, it was not possible to detect any water quality trends.

Keys to success include:

1. Enough time has to be available for programs to be effective.
2. Educational efforts in the areas of home septics, stream and tile intake buffers, and wetland restoration need to be in place and accepted both by the landowners and by the traditional agricultural agencies.
3. Traditional agriculture agencies and political leaders must be willing to give open and continual support to landowners working on helping to protect the environment. Long term acceptance by the agencies of conservation tillage and fertilizer BMPs appears to be having a positive impact.
4. With so many watersheds to clean-up in the Minnesota River Basin it will be most effective to first work on those that have local concerned leadership and a "rallying" physical feature, such as river or stream.
5. It will take a good combination of education, incentives and enforcement to clean-up the Minnesota River. Operating separately each will have limited effectiveness.
6. Economics will play a role in what practices each farmer is willing to implement.

Wellner-Hageman Watershed of Mound Creek

Historical Background: The Wellner-Hageman Watershed is located on 8,000 acres in southwest Brown County and northeast Cottonwood County. It consists of the Mound Creek and three unnamed tributary streams, all first order. At the outlet of the watershed is a reservoir produced by the construction of an earthen dam in 1992. The streams rise off part of the Coteau des Prairies, called the Red Rock Ridge, where Sioux Quartzite outcrops or underlies thin layers of glacial till.

The predominant soils in this area are Germantown, Everly-Letri, and Ves-Canisteo. Geologic sensitivity has been characterized as high, due to the shallow depth to bedrock. The streams are flashy — rising quickly in response to precipitation and also falling quickly.

All land in the watershed is agricultural with row crops (corn and soybeans) and livestock production, primarily beef. There are about 33 households; 24 been identified as having noncomplying individual sewage treatment systems outletting to tiles or surface waterbodies.

The area has been monitored for ground water and surface water quality since 1989. All four streams have been sampled by automated sampling stations and regularly scheduled grab sampling from 1992 through 1994.

Project Description: A number of projects are being implemented in the watershed:

A. Work began on a pasture management project on the easternmost tributary stream in the spring of 1994. This rotational grazing demonstration was established to control

sedimen and attached phosphorus. The project has enco ed some difficulties: lightning struck the electric fences, some cattle broke out of the paddock, and this year the cattle won't be moved into the paddocks until July due to late calving. Despite these problems, the project could be considered a conditional success, because publicity surrounding its establishment has led to a great deal of interest in the pasture management concept, with other producers beginning plans to change their pasturing, and the development of a Pasture Management Association of 19 members in Cottonwood County.

B. Using a combination of MPCA Onsite Sewage Treatment Systems Grant dollars and State Revolving Fund Best Management Practices Implementation Loan dollars (applied for under the Clean Water Partnership), all septic systems in the watershed will be upgraded by fall of 1995. The 24 new systems will include some at-grade systems, new to the area, and two experimental systems which will be monitored for effectiveness by the University of Minnesota Ag Engineering Department.

C. Erosion controls such as grassed waterways and hillside vegetated filter strips have been installed at three farms in the watershed; funds from the BWSR cost-share program are encumbered for three more.

D. Three new agricultural waste systems have been installed in the watershed, and three more have requested funding for 1995 through the BWSR cost-share program.

E. Through the Clean Water Partnership and Cottonwood County Environmental Office funding, 46 abandoned wells in the watershed area have been sealed, totaling $12,900.

F. A manure management demonstration project was established in the watershed in 1994. This field, planted in soybeans in 1995, will be monitored for yields this year, and will be reestablished in corn in 1996.

G. Three field days have been held for area ag producers; two on the rotational grazing project, and one showing the manure management field and a new ag waste system. Monitoring of area streams was also highlighted to the producers, further emphasizing the land-management/water quality connection.

H. Other educa as taken place: three editions of a BMP newsl have been distributed to all landowners, three public meetings on the project goals and sewage treatment systems programs have been held, two display booths have been produced with project results and shown at area events.

I. In the discussion/planning phase are: one alternative ag waste system installation, using alternative crops for filter strips, a second rotational grazing project, another grassed waterway, a second manure management test plot site, a project to monitor the effectiveness of an animal waste storage system, and a project to monitor the effectiveness of the experimental septic systems.

Monitoring of the surface water quality as these innovations are installed is a very important component of any future programming.

Water Quality Response: This project expanded on Area II-sponsored monitoring which took place on the four streams in 1992 and 1993, and continued under local sponsorship in 1994. Three sampling sites were established with flow meters, automated samplers and one automated rain gauge. Two of these sites are situated on "Gode Creek," the easternmost tributary stream; they are located upstream and downstream from the pasture management demonstration. The other site, which can be considered a "control" because it is outside the watershed implementation area, is located on a tributary of the Highwater Creek.

In addition to storm event and grab sampling at these three automated sites, grab samples are taken at least monthly at six other sites in the watershed. For the stream samples, the following parameters were analyzed monthly: dissolved oxygen, total phosphorus, dissolved phosphorus, nitrate, nitrite, pH, oxidation-reduction potential, conductivity, total suspended solids, total coliform, fecal coliform, fecal streptococcus. Reservoir samples were also analyzed for chemical oxygen demand and chlorophyll A. Annually, samples from all sites were analyzed for all anions, cations, and alkalinity. Storm samples were analyzed for nitrate, nitrite, dissolved phosphorus, total phosphorus, total suspended solids and conductivity.

Casual analysis of monitoring results over the 1992 and 1995 sampling period shows no appreciable decrease in contaminants; however, climatic variations may be involved. We expect the bacteria levels to decrease with better management of human sewage and

animal manure. We also hope that, as sedimentation decreases, total suspended solids, conductivity, and total phosphorus levels will decrease. Over time, nitrate levels may also decline.

Probably 50% of the BMPs proposed for this area have already been achieved. The rest are scheduled for implementation over the next two years.

Landowners Response: Approximately 90% of the landowners in the entire watershed have been favorably disposed toward the project, and have indicated some degree of willingness to participate in trying some BMPs. We have seen a noticeable change in perception about the "why" of environmental upgrades.

The residents of the area are concerned about the water quality of the new reservoir: Is the lake polluted? Will fish survive? Is the lake swimmable? This concern extends to the streams which supply the reservoir. About half the residents utilize a community water system, Red Rock Rural Water. Despite having access to safe drinking water, most are also concerned about the ground water, which in two of the four local aquifers, shows contamination by human activities.

This LCMR project, in conjunction with the other projects occurring in the watershed, had a tremendous effect on awareness of the land-use/water quality connection. Biannual newsletters, demonstration field days, public meetings, and general neighborly visits during monitoring activities have helped raise local awareness. Recent publicity about the water quality of the Minnesota River and its tributaries, and about enforcement actions taken by the DNR against water pollution violations, have also contributed to land use decision changes.

Community Response: The community of this area is difficult to define. There is no town; the area includes parts of four townships in two counties. There is no association of water users such as might be found around a more traditional surface water system. However, the "community" is above average in awareness of water quality impacts and improvements. We have seen some evidence of long-term support, such as the establishment of the pasture group, and the large turnout for demonstration field days and public seminars.

Transferability: The actions taking place within this watershed should be considered very transferable. The land uses are representative of the agricultural segment of the Minnesota River Basin. All the BMPs proposed and implemented in this area are being promoted throughout the basin.

Because of the responsiveness of the watershed, land use changes may lead to more rapid water quality improvements than might be true in a less sensitive stream system. This situation lends itself well to demonstrations and other public relations efforts.

Suggestions for Improvement: Develop and distribute a watershed newsletter as a way of communicating watershed activities .

Lake Shaokatan

Historical Background: Lake Shaokatan is a shallow prairie lake located in west central Lincoln County, Minnesota. The lake water quality has severely deteriorated in the recent past due to excessive nutrient loading associated with watershed land use practices. Nuisance algal blooms dominated the open water season and have occasionally produced algal toxins resulting in the death of cattle and dogs.

Lake Shaokatan has a surface area of 1,018 acres, a mean depth of 7.3 ft. and receives water from an 8,054 acre watershed. The major water inlet to the lake originates in the steep southern portion of the watershed and flows north to flatter topography where it turns northeast prior to entering the lake. Tributaries join the flow draining steep watersheds northwest and southeast of the creek. The remaining watershed consists of smaller drainage adjacent to the lake shore.

The farthest watershed to the southwest of the lake consists primarily of land under the Conservation Reserve Program (CRP). The western watersheds are a mixture of CRP, pasture, and cropland, and the watersheds closer to the lake are primarily cropland. Six drain tiles outlet directly to the lake; three flow from southern watersheds, two from eastern portions, and one from the north. Two southern drain tiles are much larger in both drainage area and tile diameter than the remaining tiles.

Project Description: The Yellow Medicine River Watershed District (YMRWD), with the assistance of the Lincoln County Soil and Water Conservation District (LCSWCD),

and the Sha[illegible]n Lake Shore Association. The project steering [illegible]ittee consists of the five YMRWD board members and the project representative is board member Terry Renken. A flexible sampling design was created using information from local residents, land use information, and an initial watershed tour. The project representative, the SWCD personnel, and several lake association members were heavily involved in the diagnostic phase of the project, including: the setup and operation of the automated sampling stations, collection of samples, data management, funding applications, and the design of an implementation plan. Specific objectives of the monitoring program include:

- to quantify runoff and nutrient loadings from the local watersheds;
- to characterize the basic limnology of the lake;
- to assess cause-effect relationships relating watershed land use practices and lake water quality conditions;
- to demonstrate the design and operation of implementation control measures.

Water Quality Response: There is a large reduction in the loading to the lake as a result of the stream diversion bypassing the swine operation (fall of 1993) and the partial impact of constructing the containment system at the dairy farm (August 1994). The major water quality parameters shown in Figure 2 indicate the reduction in loading to the lake has translated into lower in-lake phosphorus concentrations (270 ppb to 80 ppb), higher clarity, and reduced algal growth.

Landowner Response: Negotiations were completed with a landowner to buy out an uncontained portion of a feedlot and a twenty acre parcel that included the wetland site and a buffer on either side of the stream flowing throughout the property.

The design and construction of a sealed containment pit for the dairy operation above site 3 was completed in the fall of 1994. The containment pit is designed for up to one year's storage to enable the operator to apply the stored manure as fertilizer during non-sensitive times of the year. Additionally, the design allows the operator to expand his herd with no adverse impacts on downstream water quality and essentially creates a win win situation for both the land owner and the lake shore residents. Negotiations with other landowners have began to purchase both buffer strips and wetlands along the "public water" portion of the inlet stream, and the feasibility of restoring additional wetlands and establishing buffer strips are presently being pursued.

Community Response: The lake shore residents have responded quite favorably to the marked change in the lake quality and have fully endorsed the effort. The improvement has become the most effective public relations program thus far in the project, and has vastly surpassed the previous promotions of the lake restoration.

Transferability: The actions taking place within this watershed should be considered very transferable. The land uses are representative of the agricultural segment of the Minnesota River Basin. All the BMPs proposed and implemented in this area are being promoted throughout the basin. However, geographic-climatic conditions perhaps limit transferability primarily to the region.

Suggestions for Improvement: None.

Meadowbrook Creek

Historical Background: Meadowbrook Creek is located in western Minnesota in Big Stone County, ten miles north of Ortonville, MN. Meadowbrook Creek drains over 11,000 acres into Big Stone Lake, which is at the headwaters of the Minnesota River. The landscape is rolling with clay loam soils derived from calcareous clayey till. The land has been used primarily for small grain production and row crops to a lesser degree. Tillage has resulted in adverse impacts to Big Stone Lake. In the 1980s, data was collected for nutrients and suspended solids. The data indicated that excessive loads and concentrations of nutrients and suspended solids were being transported to the lake. As a result of the Clean Lakes study, implementations of best management practices (BMPs) began throughout the larger Big Stone Lake watershed. This project focused on the BMP implementation in the upper 3,200 acres of Meadowbrook Creek.

Project Description: The Upper Minnesota River Watershed District (UMRWD) has been leading an effort to clean up Big Stone Lake; as such they have been identifying problem areas and recommending land use changes. Two important BMPs were implemented: long-term set aside in the form of the Conservation Reserve Program (CRFP) and strategic wetland restoration. Approximately 25% of the Meadowbrook Creek watershed was planted to various grasses, in particular the highly erodible lands. Several wetland restorations occurred in the watershed. A 45 acre wetland (Steen) was restored near the middle of the watershed which was more closely examined to evaluate

the water quality benefit. The expected benefit from this watershed was to limit loads by sediment reduction and thereby limit the associated phosphorus transport to Big Stone Lake.

Water Quality Response: The above combination of BMPs resulted in lower average annual loads and concentrations of suspended solids and nutrients delivered to Big Stone Lake. The CRP had a significant effect on sediment transport. However, the Steen wetland provided even more sediment reduction, 86% over a two year period of wet weather. Nevertheless, the sediment reductions did not directly translate into lower phosphorus loads in all runoff conditions. A higher percentage of the total phosphorus coming from the cropland was bio-available. Further, during spring runoff, the Steen wetland exported phosphorus. Yet, on an annual average, there was a 27% reduction in phosphorus loads from the upper 3,200 acres of Meadowbrook Creek. The long-term effect of these BMPs will likely result in the water quality improvement of Big Stone Lake.

Landowner Response: The sign up for the CRP was effective in that 90% of the farmers enrolled in the program during the first two years of availability. Wetland restoration was a more difficult sell, yet several farmers were able to agree that their land was marginal for crop production and that greater environmental benefit would be derived from a wetland restoration. There was one farmer that was admittedly opposed to the government buying cropland for wetland restoration. This farmer outbid the UMRWD offer for a proposed restoration and subsequently plans to manage (plow and fertilize) the land more intensively than the previous owner. Clearly, not every landowner in the watershed could be convinced to change behavior by the water quality benefits of the project.

Community Response: The community understands the value of Big Stone Lake, in part because of the educational efforts of the UMRWD working with Citizens for Big Stone Lake. Good marketing of the technical support of the Soil and Water Conservation District and the various cost sharing programs available to farmers, has created a sound land stewardship ethic amongst many of the landowners throughout the county. These were vital keys to the success of this project.

Transferability: The transferability of this project may be somewhat limited because of the clear goal of restoring a vital economic resource for the region - Big Stone Lake. People in other areas of the Minnesota River may not see the same economic connection and respond the same as the greater Ortonville community. The economic value of the land placed in CRP is not directly comparable to more productive cropland found in the eastern portions of the Minnesota River Basin. Lastly, because of climatic differences, similar pollutant load reductions would not be expected from wetland restorations in the eastern portion of the Minnesota River Basin, e.g. the Blue Earth Basin.

Suggestions for Improvement: Concentrate BMPs on the most vulnerable land and make more concerted efforts to educate those landowners who may be causing the relatively higher percentage of nonpoint source pollution. Hydrologic pathways of pollutant transport must be targeted, especially those land uses within the pathway's relative zones of influence.

A6. Benefits: Implementation on subwatersheds provides the best opportunity to demonstrate water quality improvement from land treatment. Additional benefits were to:
- Showcase BMPs in small geographic areas and demonstrate their connection to water quality.
- Demonstrate to policy makers at the local and state levels the benefits of the watershed approach.
- Provide validation of management tools within the Minnesota River Basin.

B. Title: Accelerated implementation of existing state programs in the Minnesota River Basin.

B1. Narrative: Inadequate pollution control from nonpoint sources is recognized as a priority issue in the Minnesota River Basin. The preferred approach for establishing effective pollution control programs is for integrated nonpoint source administration, cost share and technical assistance. The objective is to provide additional resources to support such an integrated approach.

B2. Procedures: Working in cooperation with BWSR, projects will be solicited from local units of government to utilize existing authorities to accelerate adoption of BMPs. Priority will be given to selection of projects which are in high priority watersheds as determined by MRAP, further local capabilities to administer programs such as the

county feed ogram, implement an innovative approach to m landowner adoption, and describe an effective means to evaluate water quality benefits, and include a local contribution to project implementation. Eligible activities under this funding will include administration, cost share assistance, and technical assistance for BMP and resource management system needs evaluation and design, and implementation.

B3. Amount Budgeted: $210,000
Amount Remaining: $-0-

B4. Timeline:

	July 93	Jan 94	July 94	Jan 95	July 95
Detailed Design	**********				
Technical Assistance	**********	**********	**********	**********	
BMP Installation	**********	**********	**********	**********	
Final Report				**********	**********
Project Selection	******				

B5. Final Status:

BLUE EARTH RIVER BASIN INITIATIVE - BERBI

This part of the project was conducted by the Blue Earth River Basin Initiative (BERBI), which formed in June of 1993 following about 18 months of planning. BERBI is a Joint Powers Board between the SWCDs in Blue Earth, Faribault, Martin, Waseca, and Watonwan Counties. BERBI cooperates with the counties through a Memorandum of Understanding, and a Waseca County commissioner serves as liaison to the counties. BERBI has a technical committee consisting of county water plan coordinators and SWCD managers and a policy committee of SWCD supervisors. The mission statement of BERBI is "to improve the water quality of the Blue Earth River basin through planning, coordination, and implementation of conservation practices and to share water quality benefits with others". BERBI developed an overall strategy on how to work through existing programs and offer assistance to landowners willing to experiment with innovative approaches to reduce nonpoint source pollution in surface waters. Four projects were chosen to demonstrate: manure management planning, riparian buffers, tile intake buffers, and septic system upgrades. Each county chose one area ich to concentrate. The counties developed det work plans which were reviewed and approved by the MPCA. Each project was designed to be implemented by the SWCDs. MPCA and BWSR reviewed the process to assure that if the projects proved successful and provided water quality benefits, they could be utilized as a tool toward achieving improved water quality throughout Minnesota.

BLUE EARTH COUNTY - Manure nutrient testing and management.

Blue Earth County SWCD decided the most effective way of helping to control pollution caused by manure was to encourage operators to develop manure management plans. The initial cost of both the manure testing and the soil testing is perceived to be the primary deterrent preventing operators from developing manure management plans. Subsidy was provided for manure testing necessary for the development of a manure management plan. The full cost of manure testing and 75% of grid soil testing up to a maximum of three dollars per acre were reimbursed. A maximum grid of 8.8 acres was required for the grid soil testing . Operators were required to have an approved manure management plan before reimbursement was made. Operators were also required to have a current feedlot certificate of compliance or be in the process of obtaining one.

Effectiveness: Blue Earth County SWCD was able to assist 32 landowners with manure testing and management at a cost of $27,200. Applications were received for 126 manure tests and 12,249 acres of land for grid testing. Upon completion of this project 30 livestock producers completed grid sampling on 6,985 acres and a total of 59 manure samples were analyzed to determine spreading rates.

Landowner Response: Originally the maximum allowable payment per operator was set at $400.00. After extensive publicity, only three operators signed-up for the program at this rate. The decision was then made to change the maximum to $1,000.00 per operator. After the increase interest in the program elevated significantly. Over 30 people applied for assistance. One difficulty for landowners has been the variability in cost per acre for the grid soil testing between agronomists.

Recommendations: BERBI would recommend keeping the maximum at $1,000.00 per operator and limit the number of times they may receive the assistance or place a $400.00 or $500.00 limit for additional years of testing. Typically, most operators have considerably more acres needing the grid soil testing than were tested. It would be

further recommended not to pay for 100% of the manure testing; this should be limited to 75% of the cost.

Standards should be set for what must be included in the soil tests and the manure management plans. The Blue Earth SWCD had the county feedlot specialist review and approve the manure management plans before reimbursements were made. The feedlot specialist followed the guidelines of the University of Minnesota Extension Service.

MARTIN COUNTY - Tile Intake Buffer Program

Landowners within the Blue Earth River basin in Martin County were offered a one time payment of $1000.00 per acre to establish grassed buffers around tile intakes. The buffers had to be a minimum of 30 foot radius from the intake and encompass a maximum of 2.5 acres per intake. Participating landowners signed a contract and Operation and Maintenance Plan to maintain the buffer for ten years. The landowner had a choice of two different seeding mixtures that could withstand standing water for up to three days. One of these mixtures was more suitable for wildlife habitat and the other was a more traditional mix. The landowner was provided with the seed for the initial seeding. The sites will be inspected annually by a county staff person to ensure they are properly maintained. The landowner is held responsible for the cost of maintaining the site after the initial seeding. If the buffer is wholly or partially removed, the landowner will have to repay the original amount plus interest.
A small amount of the grant was used for education efforts. These funds were used for a county fair booth and to assist in a county conservation tour, both of which featured the buffers.

Effectiveness: The effort was effective in getting some tile intake buffers established within the Blue Earth River basin. BERBI is hopeful that these buffers will help to reduce the amount of sediment and attached nutrients reaching the Blue Earth River. With the limited funding, monitoring was not established, however the work being conducted by the U of M in Parts C1, C2, and C3 of this LCMR project directly relate to this application of buffers.

Landowner Response: There was enough funding for a maximum of 25 acres to be enrolled in this program. The 25 acres were enrolled with a few landowners being turned away because of the lack of funding. Contracts were entered into with eight landowners to establish 14 tile intake buffers totaling 25 acres. Most of the landowners showed interest in enrolling the maximum of 2.5 acres per intake. If they were going to establish a buffer area, they generally wanted to enroll the maximum allowed. The type of seed they planted usually depended upon the accessibility of the buffer area and if they planned to hay the area. The landowners also showed some concern over the possibility of monitoring. They were concerned that with the present trend in enforcement of environmental laws, the information gathered by the MPCA might be used against them in the future.

Recommendation for Administrating a Future Program:

Establishing a contract and Operation and Maintenance Plan that clearly states landowner responsibilities should be completed at the beginning of the program. BERBI would recommend some monitoring on the contract. Martin County used the State Cost-Share Program contract and developed their own Operation and Maintenance Plan.

The results of Parts C of this LCMR project will assist in fully evaluating this effort and determine if public funds are well spent in this manner.

FARIBAULT COUNTY - Riparian Buffer Program

Faribault county offered landowners incentives to establish and maintain riparian buffers strips. Landowners were offered $50.00 per acre per year for a period of ten years to offset the loss of production on streamside farmland. The program was targeted to riparian acres with surface runoff that flows directly into tributaries of the Blue Earth River. It was theorized by BERBI that these buffer strips play a large role in decreasing sediment and nutrient loadings in the river system. BERBI's hope was that this relatively low-cost alternative will stave off more costly measures that could cripple an operator's business income.

Fifteen cooperators signed up a total of 54.4 acres. These areas include over 10 miles of buffer strip ranging from 16.5 to 40 feet wide and approximately 9.0 acres of critical area seedings. The critical area seedings are placed where the slope of the land or soil type warrant extra protection to accomplish the goal of sediment filtration. Most cooperators planted a mix of grasses. including alfalfa, and one site established an acre

of native pra rasses. The cooperators will be vigorously hayii se sites to remove excess nutrients. The exception will be the prairie grass which will be managed accordingly to maintain a good stand.

Discussion of Effectiveness:

The strength of this effort is the economic benefit to those farmers who have land next to a stream and have livestock. These operators saw a benefit to the environment and a site where the cost of forage could be reduced. In the future it should be noted that persistence, along with constant communication, eventually sells the program. It is encouraged that counties be persuaded to help provide incentives.

The buffer strip program has not only created awareness about buffer strips but has also created interest in other conservation practices which protect surface and ground water.

Landowner Response:

The cooperators have maintained a high level of enthusiasm which we hope to carry throughout the ten-year term of their contracts. More than one of the cooperators have expressed the desire to take their buffer strips permanently out of production. This positive attitude is a turn-around for producers in an area where corn is king. As these sites are seen during the coming years, we hope that more and more buffers will be established by farmers voluntarily without a cash incentive. The Faribault County SWCD will continue to look for other incentives to get buffer strips established in Faribault county. Tax breaks or some other type of program from our local government would strengthen the buffer strips' popularity.

Recommendations for Administering a Future Program:

In the future buffer strips could be expanded to different cropping systems or wildlife plantings. Some current research indicates that wildlife habitat could improve water quality without removing the material (haying); this may entice retired farmers, absentee landowners, and those with no demand for hay. No-till small grain cropping incentives may move production from corn/beans to small grain/grass hay production which may provide benefit without loss of cropland to operators and owners. Research should also continue into providing local incentives, such as tax breaks, for eliminating

crop productio /e streambanks. The program that Faribault SW leveloped was easy to handle and had no unexpected difficulties. This may be because we have very enthusiastic cooperators.

WASECA COUNTY - Riparian Buffer Program

The main goal for Waseca County was to establish vegetative buffers along an open drainage ditch system. The county ditch inspector's recommendation was to establish the buffers along County Ditch # 30 because of the high cost of maintenance incurred each year due to erosion within this system.

A program was developed to include compensation of $110.00 per acre per year for a contracted period of eight years. (Each participant received the entire payment after establishment of seeding, which was in the spring of 1994.) To complement the project, the CFSA provided a cost-shared permanent seeding practice which included seed bed preparation, seed, and seeding.

Discussion of Effectiveness:

A vegetative buffer strip is nature's way of stopping cropland soil from entering directly into the ditch and improving water quality by filtering out suspended material from up-slope cultivated land. Data has been gathered from water samples taken weekly from the outlet by the CLWP coordinators.

Landowners Response:

Landowners response was very favorable. Because the project was a combined effort between the Waseca SWCD and Waseca County, the county ditch inspector participated in the landowner contacts. There was a total of nine landowners along the open ditch system, and a total of 33.3 acres were enrolled into the ditch program. Buffer width varied from 30 to 100 feet; a majority of the buffers were installed at the 30 foot width. The entire ditch, with the exception of 950 linear feet, was buffered through this program. The area was seeded down with a recommended seed mixture and rate that allowed the participant to hay the area, which was a definite advantage to the program. There were two participants that did not feel the incentive payment of $110.00 per acre was sufficient to enroll in the program.

The participants and the ditch inspector have inquired about the availability of funding for other ditches. They have indicated the project was very worthwhile.

Recommendations for Administering a Future Program:

Funding allowed the buffer areas to be established only along the open ditch. To be most effective, vegetative cover should be established on waterways entering the ditch system, as well as around open tile intakes in order to eliminate additional sediment from entering the ditch.

Each county should evaluate county ditches to see if the mandated buffer area is maintained.

WATONWAN COUNTY - Septic Demonstrations

Originally the proposal was to upgrade as many septic systems as possible within a chosen watershed, in order to demonstrate improved water quality benefits. Since all failing septic systems are potential sources of disease causing organisms, it is difficult to prioritize them. They are all high priority. Coliform bacteria testing of surface waters and tile outlets has begun in Watonwan County as an educational tool to make residents more aware of the dangers associated with failing septics.

It was decided that education needed to be provided county-wide and that the watershed approach would not provide easy access to the demonstrations for residents across the county. The decision was made to do at least one septic system upgrade demonstration in each of the twelve townships. The goal was to do as many different types of systems as possible, with at least one mound system and at least one at-grade system.

Demonstrations were intended to be the main educational tool. To accomplish this, demonstrations have been located within just a few miles of every resident in the county. A total of 21 demonstration sites were done in eleven of the twelve townships.

Workshops and distribution of printed materials were also part of the ongoing education program. "Care and Maintenance of Your Septic System" workshops were held in St. James, Butterfield, and Madelia. A slide set prepared by the Minnesota Extension Service was the main component of these workshops. Over 100 people attended these three sessions which was more than expected. Although most comments about the program were positive, there were some negative comments at each session. The need for financial assistance in the form grants or cost-share was brought up at each session. In some people's opinion, the SWCD is responsible for the threat of enforcement aimed at failing septics.

Six brochures were used to provide individualized education on septic systems. Radio and newspaper reports were also done on this project. Additional educational materials have been reproduced and supplied to all private septic system owners.

A three piece septic system demonstration model, including a regular drain field and a mound system, was purchased and used at the demos, county fair, and other local events. A plastic model of a septic tank was also used.

Discussion of Effectiveness:

The demonstrations provided the necessary incentive for many septic owners to take the step to upgrade their system. The financial assistance of up to $1,000.00 was needed by many who hosted the demonstrations. Many interested individuals were unable to come up with the additional $2,000.00 or more necessary for upgrading their system. Other septic owners, who were financially capable, went ahead and upgraded their systems after seeing a demonstration. Approximately 88 septic system permits were issued in Watonwan County in 1994, and most of these were upgrades of existing systems. Contractors reported doing ten times more systems in 1994 than in 1993. There are 182 septic system owners on Watonwan County SWCD's list for assistance and the list continues to grow. If the trend of septic system upgrades remains at the 1994 level, Watonwan County's septic systems could be in compliance within ten years.

Landowner Response:

Landowner response varied from complete understanding of the problem to absolute disbelief that any problem exists. Most of the private septic system owners that attended the demonstrations became more aware of the need to upgrade failing systems. The difference between a septic system that disposes of the effluent and a system that treats the effluent before disposal is a difficult concept for many people to understand. Many

people belie ıt the septic tank itself completely treats the effl "I checked the end of the tile ıne and it was as clear as could be" is the typical comment.

Recommendations for Administering a Future Program: The hardest part of this effort was convincing someone to install a mound system, even at the 50% cost-shared level up to $5,000.00. In Watonwan County there were no contractors who were willing to install a mound system, and they are still reluctant to do so. Contractors and landowners fear the consequences that freezing may cause in the maintenance of a mound system as well as the initial cost of the mound. Contractors indicate that the availability of the right grade of sand is the main reason the mound is much more expensive in Watonwan County.

Education was stressed throughout the program. Attitudes must be changed and the only way to do this is through education. Explaining the message several times in several different ways is necessary before it is understood. One-to-one education was the most effective, but even then several contacts were necessary.

B6. Benefits: This component of the project will take advantage of current public interest in cleaning up the Minnesota River. It will demonstrate the effectiveness and efficiency of adequately funded and integrated programs for implementation of water quality BMPs.

C. Title of Objective: Development of new and innovative BMPs. Tile system evaluation and BMP work will have the following three main objectives.

Narrative: For the BMP development portion of this project, MRAP has successfully documented the extensive nature of tile drainage networks within the Minnesota River Basin. Many of these tile systems have surface inlets. Little is currently known about the impacts of tile systems, especially those systems using surface inlets, on the quantity and quality of flows in the Minnesota River Basin. These impacts will be evaluated using both experimental and simulation methods. Eighteen months of observed flows will be obtained to provide a data base to assess differences in surface and no-surface inlets, as well as an estimate of the relative importance of tile systems to the overall pollutant load of the Minnesota River Basin. A simulation model will be used to extend these experimental results to a longer weather record and to evaluate a wider range of potential management practices. Future implementation of best

management pr :s should clearly be targeted on those sources tl e the largest contaminant contributors. The importance of the load from tile systems is still unknown. The study will provide valuable information on this load, as well as an assessment of the impact of different types of surface inlets.

C1. Title: Gather and analyze data of flow rates and transport of contaminants from drainage tile systems with different types of surface inlets.

C1a. Activity: Data collection and analysis.

C1a1. Context within the project: This objective will provide a data base (1) to assess differences in responses between surface and non-surface inlets and (2) to estimate the relative importance of tile systems on the overall contaminant load of the Minnesota River Basin. The eighteen months of data will also be used to calibrate and evaluate a simulation model.

C1a2. Methods: Two tile systems will be instrumented with state-of-the-art equipment to measure flow rates and to obtain water quality samples at fine time scales. The tile systems will be selected such that different surface inlet practices can be investigated. Emphasis will be placed on the differences in response among standard surface inlets and no surface inlets. Valves or other mechanical devices will be installed on existing surface inlets to facilitate the study of the no-surface-inlet condition.

C1a3. Materials: In comparison to tile drains monitored for agronomic studies, much smaller time scales, of magnitude of 5 minutes, are needed to capture important water quality information. Instrumentation and data acquisition equipment will be selected to obtain information at these small time scales. Flow measuring devices and water collection equipment will be installed in the tile drains following the general procedures currently being used by a member of the research team for a site located near St. James, MN. Here the flow is routed through mall flumes. Water depth is recorded and converted to flow rates using standard techniques. Water samples are taken using automatic water quality samplers.

C1a4. Budget:

Item	Amount
Graduate students (2 yrs + fringe)	$ 40,000
Salary faculty (2 summer months + fringe)	$ 16, 000
Undergraduate student labor	$ 10,000
Travel and expenses	$ 10,000
Data acquisition equipment and installation costs (2 systems)	$ 39,000
Soil characterization (2 sites)	$ 20,000
Water quality analysis	$ 25,000
Total	$160,000

Amount Budgeted: $160,000
Amount Remaining: $-0-

C1a5. Timeline

	July 93	Jan 94	July 94	Jan 95	July 95
Site selections:	*******				
Installation of equipment:	****				
Collection of data:	**********				
Soil characterization:	**********				
Data analysis:	**********				

C1a6. Status:

Progress: Agricultural tile line water quality has been monitored since May 1992 at the Merle Anderson farm near St. James and since May of 1994 at two sites on the John Rollings farm near Vernon Center. Subsurface and surface tile inlets are being studied at both sites. Water flow and weather parameters are recorded continuously on electronic data loggers. Water quality samples are collected by event- triggered automatic samplers during recharge (rain and snow melt) events. The concentrations of sediments, nutrients, pesticides and dissolved ions are being measured in the recharge event samples. Tracers have been used to measure the transit times from the field surfaces to the tile lines. All of these measurements are on-going and the complete analysis of the results will come at the end of the current biennium.

Initial observations: Water Discharge - 1. Tracer measurements at the Merle Anderson site indicate that rainfall can pick up dissolved materials from the surface and reach the tile lines in minutes. Tile discharge at the John Rollings sites responds as soon as 30 minutes after rainfall. The fast response may occur by macropore flow through the silty clay loam soils. 2. The response to recharge is most rapid and intense in the spring and fall in both surface runoff and tile line flows. The speed and intensity of response decrease through the growing season. Sediment Discharge - 3. The peak total suspended sediments (TSS) in the surface runoff is always greater than the peak TSS in the tile line flows. Peak TSS in the surface runoff range up to 80,000 ppm. 4. The peak TSS in both surface runoff and tile line flows tend to occur in the initial stage of the recharge hydrographs. Nitrate and Pesticide - 5. Nitrate-nitrogen in the surface runoff is much lower than the nitrate-nitrogen in the tile line flows. 6. Alachlor was present in both surface runoff and tile line flows during snow melt recharge events at the Merle Anderson site. Alachlor applied at the John Rollings farm in 1992 was measured in 1994 tile line flows.

Topography and soil characteristics for the John Rollings farm have also been determined. Activities completed include the development of a topographic map using 1 foot contours, description of soil, installation of piezometers, measurements of saturated conductivity, bulk density, desorption curves, and particle size distributions. This information provides insight into the response of the watersheds. Many of the parameters are needed in the modeling effort as well.

C2. Title: D velop a tile drainage model for the Minnesota River Basin.

C2a. Activity: Model development.

C2a1. Context within the project: Minnesota weather is highly variable from year to year. Hydrologic research has clearly shown that it is risky to use one or two years of data to draw conclusions about the typical (or long-term average) response of a basin. Physically-based models can be used to simulate several years of flows using either historical or stochastically generated weather data. Another major benefit of simulation is that it is relatively simple to evaluate different management practices. The collection of experimental data is very expensive. Simulation is therefore the only realistic approach for evaluating numerous potential drainage BMPs and their impact on the water quality of the Minnesota River Basin over a reasonably long time period.

C2a2. Methods: To evaluate several years of meteorological data and alternative BMPs, a physically-based, continuous simulation model will be developed for the tile drainage systems in the Minnesota River Basin. The model will rely heavily on previously developed algorithms developed at the North Carolina State University and the Ohio State University. These algorithms will have to be modified for the conditions of the Minnesota River Basin, in particular for the colder climate.

As discussed under Objective C3, the model will be calibrated to the observed data gathered under C1. This calibration will be used to determine parameter values for the Minnesota River Basin and to detect possible limitations of the modeling approach.

C2a3. Materials: Microcomputer will be purchased and dedicated to the modeling effort of this project. This will ensure that the post-doctorate student working on the project will have adequate computer resources. Miscellaneous computer materials and supplies will also be required.

C2a Budget:

Item	Amount
Post-doctorate (18 months + fringe)	$60,000
Computer resources	$ 5,000
Travel & miscellaneous expenses	$ 3,000
Total	$68,000

Amount Budgeted: $68,000
Amount Remaining: $-0-

C2a5. Timeline:

	July 93	Jan 94	July 94	Jan 95	July 95
Modification of hydrologic components:	**********				
Modification of water quality component:		**********			
Incorporation of routing system			**********		
Hydraulic of surface inlets:				*******	

C2a6. Status:
Problems: As previously reported, the simulation model called AGNPS was to be used to generate flow and water quality parameters to the tile inlet. The continuous simulation version of this program is not yet available. The principal investigator has therefore been forced to select an alternative simulation model. The Water Erosion Prediction Project (WEPP) has been selected. The post- doctorate student hired for this project experienced medical problems preventing him from working full-time for the months of May and June. Both of these problems have delayed the completion of the modeling component until September 15, 1995.

Progress: A literature review of previous models of drainage model has been completed. Parameters of the proposed model have been discussed with University and MPCA personnel. Procedures have been identified to

estimate these parameters for each of the two experimental sites. Computer code has been written to route water down channel reaches. Code has also been written to simulate the sedimentation process of ponded water at the surface inlet. This algorithm is important in evaluating possible best management practices that retain water at the surface tile inlet. Code has been written to evaluate the trapping of vegetation around the surface tile inlet. Once again, this code is of value in considering the use of buffer strips as a best management practice. Code has been written to link the simulated results obtained with WEPP with the other channel routing and retention and filtering BMPs.

C3. Title: Calibrate and apply the drainage model to evaluate long-term average and alternative best management practices for tile systems.

C3a. Activity: Model calibration, validation and evaluation.

C3a1. Context within the project: As previously stated, the calibrated model will be used to determine the typical response of the tile system for a number of annual weather patterns and for different management practices. Here the management practices will focus on surface inlet options.

C3a2. Methods: Under this objective the data gathered for C1 will be used to calibrate the model developed under C2. This approach will allow parameters to be determined for the specific conditions of the Minnesota River Basin. There are a large number of calibration procedures that can be used. These range from simple eyeball fit of curves to rigorous multifunctional bayesian procedures. The calibration will be done carefully such that parameters dependent on management practices can be evaluated in later simulations. Successful completion of this objective will require careful coordination of efforts under C1 and C2 to ensure compatibility between the model and the observed data.

The calibrated model will be used to simulate several years of flow and water quality data using historical or stochastically generated weather data. This record will be used to determine long term averages, possible extremes and other statistics. The calibrated model will also be used to assess the impact of different surface inlets, including those inlets designed to control the rate of discharge from a depression.

C3a3. Materials: Only miscellaneous computer materials and supplies will be required to complete this objective.

C3a4. Budget:

Item	Amount
Post-doctorate (6 months + fringe)	$ 20,000
Travel and miscellaneous expenses	$ 2,000
Total	$ 22,000

Amount Budgeted: $22,000
Amount Remaining: $-0-

C3a5. Timeline:

	July 93	Jan 94	July 94	Jan 95	July 95
Calibration of model:				********	
Simulation runs:					****

C3a6. Status:

Progress: Land use parameters for the experimental watersheds have been determined as input into WEPP. These parameters were determined using the site and soil characteristics obtained as part of Objective 1 and by using standard tabular data. Observed rainfall data are being used to evaluate the accuracy of the WEPP model. After this step is completed, the continuous version of the model will be used to simulate a longer period of record and to evaluate potential best management practices.

D. Total of Objective: Educational development through Extension.

D1. Narrati[illegible]ducation has been identified as a very important [illegible]onent of the state's nonpo[illegible]ource pollution control strategy. MRAP is identi[illegible]g nutrients as having negative water quality impacts in the Minnesota River system. Nutrient management plans consistent with Minnesota Department of Agriculture's BMP recommendations will be implemented through the University of Minnesota's Extension Service.

D2. Procedures: Manure-nutrient Management Project.

Pollution of ground and surface waters due to the over-application of animal wastes to farmland will be decreased by developing and implementing manure management plans. Farm operators will be recruited to cooperate with a field scientist in planning the application of animal wastes and chemical fertilizers to their farm land. A plan will be developed to maximize the nutrient value of the animal wastes and minimize the threat of pollution of surface water or ground water. Farm operators would be advised on soil testing, setting of yield goals, manure testing, manure spreader calibration, and manure handling.

A qualified field scientist will be hired for a two-year term. The field scientist will survey the management of animal wastes in a defined geographic area and will recruit farm operators to cooperate in developing manure management plans. The field scientist will then work with the farm operator in developing a plan which will maximize the use of the nutrients in the manure and prevent the over-application of manure to any one field. The field scientist will maintain contact with each farmer during implementation of the plan. A field scientist could work with up to 100 farm operators during the two years of the program.

The program will be designed with two underlying assumptions: farm operators will be able to continue using the manure management plans without the presence of the field scientist; and this program will not attempt to compete with private consultants. At the end of the two years, the cooperating farm operators will have received sufficient information to continue the manure management program.

Mini-clinics will be held on several of these cooperators farms to demonstrate to nearby farm operators how the program works and encourage them to develop a management plan for their operation.

Equipment needs [illegible]ll include portable scales and manure analysis eq[illegible]ment. This equipment will enable the field scientist to calibrate manure spreaders and to determine the nutrient concentrations in the manure immediately before application.

D3: Amount Budgeted: $85,000
Amount Remaining: $-0-

D4. Timeline:

	July 93	Jan 94	July 94	Jan 95	July 95
Survey of manure management	*******				
Recruitment of Cooperators	**********				
Soil Sampling	**********	**********	**********	**********	**********
Manure Analysis	**********	**********	**********	**********	**********
Manure Management Plans Made		**********	**********	**********	**********
Mini-clinics Conducted		**********	**********	**********	**********

D5. Final Status:

The objective of this project was to develop and implement an educational program to improve the management of manure in the Minnesota River Basin. The goals of the project were to develop manure management plans with cooperating producers, conduct field clinics on manure management, and develop educational materials and programs in manure management.

Excessive nutrients have been identified as a water quality concern in the Minnesota River (MRAP Report). Surveys conducted in several locations in Minnesota have indicated that farmers apply approximately ½ of the manure nitrogen in excess of crop needs. Improved management of nutrients in manure will help control losses of nutrients from agricultural lands to the Minnesota River.

Procedures followed those given in the original proposal. The basic procedures were:

1. An extension educator for manure management was hired.
2. Equipment was purchased for conducting the project. Equipment included scales for calibrating manure spreaders, portable computer for developing plans and analysis equipment.
3. Cooperating livestock producers were recruited in south central Minnesota. The livestock industry is expanding in this area and there are concerns over manure management in the region.
4. Manure management plans were developed and farmers were assisted in implementing the plans. Approximately seventy plans were developed impacting more than two million pounds of nitrogen.
5. Field mini-clinics were conducted on calibrating manure spreaders and developing plans.
6. Educational programs were implemented. Sessions were conducted on manure management at many events.
7. An evaluation of the program was conducted. Producers and county personnel were surveyed concerning the impact of the program.

Description of Implementation:

The implementation of each procedural step in the preceding list is described below.

1. A field scientist was hired in November 1993. Hiring was delayed because of necessary procedures in transferring funds to the University of Minnesota. The position was refilled after about 8 months because of the resignation of the first employee due to an offer for a permanent job. There was some difficulty in recruiting qualified personnel who were willing to work on a short-term project. The two people that filled the position were effective and received good evaluations from their supervisor.

2. Equipment was purchased for conducting the educational programs.

   Portable scales were acquired for calibrating manure spreaders. These scales enabled personnel to weigh manure spreaders before and after spreading the manure on a field. They were valuable in conducting field clinics and in assisting individual farmers in determining their rate of manure application. These scales will continue to be used in the region in conducting manure management programs.

   A portable computer was acquired to assist in developing manure management plans. This computer was valuable for running computer programs such as the Manure Application Planner (MAP), other manure management programs, and for writing the manure management plans. The portability was important in that MAP could be run at field clinics and for individual producers. This computer will continue to be used for manure management education.

   Analysis equipment was acquired to provide for rapid determination of nutrients in manures. A method was developed and tested for use on manures. The equipment performed well and allowed for the rapid determination of nitrogen and phosphorus in manure. These results were predominantly used for educational purposes, but they could be used for actual recommendations for producers. There has been some interest by custom applicators to have this or other types of equipment to do on-site analysis of manure. This equipment will continue to be used for manure analysis in educational programs.

3. Cooperating producers were recruited for developing manure management plans. An effort was continually made to not compete with consultants who may have been offering similar services. It was the goal of this project to avoid competition and to actually promote the development of manure management plans by industry. Names of potential cooperators were generally obtained through county feedlot officers, Natural Resources Conservation Service District Conservationists, county Extension Educators, and promotionals at clinics, field days, etc. Some names were obtained by interested producers calling our office because they had heard about the program from a neighbor. Most of the county personnel (82%) surveyed felt that obtaining names from county personnel was effective. This method is helpful in that it helps assure that producers contacted will be open to developing a manure plan.

4. Manure agement plans were developed with cooperating ucers. The Manure Application Plan (MAP) and other computer programs were used in the development of plans. Manure management plans covered the following topics:

- Amount of manure produced
- Nutrients contained in manure
- Nutrient availability from manure
- Nutrient needs of crop
- Nutrient balance for the farm
- Recommended application rates
- Value of nutrients in manure
- Summary including comments on erodible land, crop residue management, safety concerns, calibration of equipment, coverage, compaction, timing, and rotation of application.

Approximately 70 plans are completed. There was some delay in the work due to the delay in hiring until November 1993, and the interruption in the work due to personnel changes. There are several more producers that were recruited whose plans will be developed by existing personnel during the next few months. The goal of 100 manure management plans should nearly be reached when these additional plans are developed.

5. Manure management field mini-clinics were conducted in several counties. These mini-clinics informed producers of:

- Manure spreader calibration
- Nutrient content of manure
- Development of manure management plan
- Practical aspects of applying manure

All of the counties in the area were contacted and offered the opportunity to have a mini-clinic. These clinics usually were organized by the county Extension Educator. Attendance varied considerably by county. One mini-clinic was conducted for a large poultry company for the drivers of manure spreading trucks. Comments on mini-clinics were generally positive. Media coverage helped promote manure management and inform the general public of efforts to improve manure m ment. Mini-clinics will continue to be conduct County personnel have been shown the means for conducting these clinics and equipment is now available to calibrate spreaders.

6. Educational programs were developed and conducted to promote improved manure management. Displays on manure management were shown at field days at the Southern Experiment Station and the Southwest Experiment Station. Talks were given at various meetings sponsored by Extension, Clean Water Partnerships, etc. Offering the programs gave opportunity to recruit cooperators for developing manure management plans.

7. In order to evaluate the impact of the program, county personnel and a randomly selected group of the cooperating producers were surveyed. County Extension Educators, NRCS District Conservationists, and Comprehensive Water Plan Coordinators from the counties in the area were surveyed (see survey form attached). Approximately ¼ of the cooperating producers were surveyed (see attached survey) and were contacted by telephone. Results on the quantitatively answered questions are given on the attached surveys.

A survey of county personnel and cooperators was conducted with the following results:

Survey of County Personnel - About 60% of the county personnel responded. Respondents were generally positive about the manure management extension educator (MMEE). Somewhat surprising was the slightly negative response to private consultants doing the work done by the MMEE. Respondents felt that county extension educators should be offering these services. They indicated that technical support should be offered to county personnel. They indicated that the one to one contacts with farmers were the most valuable part of the project. They also indicated that counties may be willing to give some support ($2000/year or less) to a position such as the MMEE.

Survey of Cooperators - Approximately ¼ of the cooperators (22) were sent surveys and were contacted by telephone. Results indicated that producers were about 50% likely to have changed their manure management. Telephone surveys indicated a 70% chance of changing their manure management. Responses were

positive as to the usefulness of the information. They were somewhat less positive on needing future assistance or the need to continue the program. Respondents indicated that they felt that the MMEE person was adequate. Respondents indicated that manure analysis, information on recommended rates, coordination with the Minnesota Pollution Control Agency, information on economic value, and information on incorporation of manure were the most valuable. Most of the respondents indicated that their contact with the MMEE came through the county extension office.

Estimation of Impact on Nutrient Management:

Estimates of Manure and Nitrogen in Manure Management Plans

Liquid	Solid
58,000,000 gal	34,000 tons
1,900,000 lb. N	300,000 lb. N

There is an estimated total of about 2,200,000 lb. of N in the manure in the plans developed. Approximately ½ of this N will be available during the year of application. Results from surveys conducted in conjunction with the Minnesota Department of Agriculture and the Brown-Nicollet-Cottonwood Clean Water Partnership have indicated that approximately ½ of the manure nitrogen is added in excess. Assuming this to be true with the cooperating producers before development of a manure management plan and using the average of 60% of the producers changing their management, about 300,000 lb. of N per year may have been kept from over application. On an annual basis, the cost of keeping this excess nitrogen from being applied would be approximately $0.11 per pound of N. This ignores any benefits to the producer, second year nitrogen crediting, better phosphate management, or continuous benefit in future years.

D6. Benefits: This project will demonstrated the effectiveness of accelerating manure and BMP adoption through one-on-one technical assistance to landowners.

Presently, most manure is applied to agricultural land without knowing the nutrient content of the manure and without giving credit for the nutrients in the manure when planning the application of chemical fertilizers. The over-application of nutrients to soils can lead to excessive leaching of nitrate to ground water or to surface water through tile drains. Ignoring the nutrient content of manure is also costly to the farm operator. If 50 pounds of available N per acre is ignored when planning the application of chemical fertilizer, the extra cost would be approximately $8 per acre. Similar values would exist for phosphorus, as well.

Some education efforts were already in place for manure management. These programs usually included clinics and demonstration plots. However, there was a need to actually help the farm operator in implementing a management plan on his/her farm. This program was effective in improving manure-nutrient management, and has become a model for future programs in the state. This objective was coordinated with Mary Hanks, Sustainable Agriculture Coordinator and Bruce Montgomery, Agronomy Services, Minnesota Department of Agriculture and Mike Schmidt and Gyles Randall, University of Minnesota.

The manure management education project had the following impacts:

- Approximately 70 manure management plans were developed. Additional plans are still being developed.
- Manure management plans may affect the application of more than 2 million pounds of nitrogen and similar amounts of phosphate.
- Education programs reached producers with information on manure management.
- Project made equipment available for continued educational efforts.
- Project provided technical support for county personnel and stimulated other educational efforts that will likely continue.
- The project was very timely because of the public attention to manure management problems in south central Minnesota.

E. Title of Objective: Educational development through schools.

E1. This objective will be to facilitate an environmental curriculum in the secondary schools in the basin.

E2. Procedures: Accelerated environmental curriculum in schools.

In order to a :ate the implementation of environmental curric in schools in the basin. Seed money will be available to those schools which volunteer to incorporate the Midwestern Rivers Curriculum into their educational programs. This program provides a comprehensive inclusion of environmental curriculum in science, English, social studies and use of computers. An evaluation of the Rivers Curriculum will be required by the participating schools.

E3. Amount Budgeted: $15,000
Amount Remaining: $-0-

E4. Timeline:

	July 93	Jan 94	July 94	Jan 95	July 95
Selection of schools for curriculum implementation	*******				
Training of teachers	**********				
Implementation		**********	**********	**********	
Evaluation				**********	

E5. Status:

Problems: None

Progress: The goal of the Rivers Curriculum Project was to work with 15 high schools in the Minnesota River Basin on an interdisciplinary education program that is designed to foster stewardship in rivers and streams. The program required the participation of three teachers from each school: a science teacher, English teacher and social studies teacher. The project is based on a program that began at Southern Illinois University in 1990. Several schools in Minnesota have participated in the past, most of which were located on or near the Mississippi River. In the Minnesota River Basin, four schools had participated prior to this project: St. Peter High School, Eden Prairie High School, and Belle Plaine Junior High.

The MPCA used its grant to provide monitoring equipment and curriculum materials for each of the schools and also to hold training sessions for teachers who are participating in the project.

In the science p the curriculum, students sample for water qual ing Hach kits and the *Field Manual for Water Quality Monitoring* by Mitchell and Stapp. All the schools in the project monitor the river during the same week twice a year. Schools send their data by modem to Southern Illinois University to a computer database that collects all the water quality data from several states.

In the social studies part of the curriculum, students study the history and geography of the river and changes in the river system. English teachers incorporate activities such as special meetings, preparing videos, newsletters, newspapers, reports and poems. Southern Illinois University collects student essays and poems and prints them annually in a publication titled *Meanderings*. Teachers were encouraged to solicit and send student writings each year to Illinois.

Two training sessions were held to train teachers in use of the monitoring equipment and the curriculum materials. The first training session was held on May 10 and May 11, 1994 at Mankato State University. Mankato was chosen as the location because it is centrally located in the Minnesota River basin and within a couple of hours drive from most of the schools. Four teachers from Anoka High school conducted the training, which included hands-on sampling and work with the test kits as well as exercises that demonstrated how to use the English and social studies curriculum.

Twelve schools in the Minnesota River basin participated in the 1994 training. These schools were: Mankato West, Chaska Alternative School, Carver-Scott Cooperative, Mankato East, Shakopee, Jordan, Sleepy Eye, St. Mary's Junior and Senior High in Sleepy Eye, Lynd School, Loyola High School, Minnesota New Country School and LeSueur-Henderson High School. Teachers who attended the training in May 1994 worked with students on the river for the first time in the fall of 1994. More than 600 students in the Minnesota River watershed participated in the project's first sampling days on October 18-19, 1994.

A second training session was held for the Rivers Curriculum Project in May 1995. This session was a joint effort between the Minnesota Pollution Control Agency and the Dakota County Environmental Education Program. By pooling resources, the two agencies were able to train more schools in the program. This training was held at the Minnesota Valley National Wildlife Refuge in Bloomington and the sampling activities took place at Fort Snelling State Park, near where the Minnesota River joins the

Mississippi River. Schools joining the program in May 1995 included the School for Environmental Studies at the Minnesota Zoo, Lakeville High School, Lake Crystal-Welcome Memorial Middle School, Burnsville High School, Dakota County Alternative Learning Center and Nicollet Junior High.

Although the grant funds have ended, some additional follow-up activities are being planned for schools who have participated in the Rivers Curriculum Project. The MPCA, Dakota County and the Anoka High School teachers are planning a Rivers Congress for spring 1996. The goal of the Congress would be to bring students together to share what they have learned while studying the river. Students would be active participants in the Congress by giving group presentations, displaying artwork, writings and video projects and performing skits or plays. The Congress will be open to schools that have participated in the Rivers Curriculum Project on the Mississippi River or Minnesota River. The MPCA will also be looking at ways in which the schools in the Minnesota River basin can share data and information.

E6. Benefits: Accelerating the inclusion of a school-based environmental curriculum related to rivers has helped to educate students on the importance of rivers to our quality of life. The program has also helped foster stewardship of the Minnesota River among many of the students who have been involved, with many students participating in activities such as river cleanups and storm drain stenciling. This project has also helped students to become familiar with water quality and the different kinds of water quality testing that exist. Work by the students in many areas has also helped create awareness of river issues in the wider community.

Educational coordination for this program is through Dr. Robert Williams, University of Illinois.

F. Title: Trend Monitoring in the Minnesota River Basin.

F1. Narrative: Water quality and quantity monitoring would be conducted over the two years of this proposal at selected locations throughout the Minnesota River Basin. This monitoring would allow the tracking of water quality and quantity changes over time.

F2. Procedures: A monitoring network will be established to evaluate water quality trends at selected locations across the Minnesota River Basin. Personnel from the MPCA and the USGS will conduct the monitoring and evaluation.

F3. Amount Budgeted: $60,000
Amount Remaining: $-0-

F4. Timeline:

	July 93	Jan 94	July 94	Jan 95	July 95
Detailed Design	*****				
Fieldwork/Sampling	**********	**********	**********	**********	
Chemical Analysis	**********	**********	**********	**********	
Data Synthesis		**********	**********	**********	
Final Report					**********

F5. Status:

Work carried out under part six was a continuation of monitoring that was first initiated for the Minnesota River Assessment Project (MRAP) during 1989-1993. The purpose was to continue to monitor water-quality conditions at the Minnesota River at Mankato and the Blue Earth River at Mankato. Effort was focused on problematic water-quality constituents that were identified during the MRAP study.

Samples were collected and analyzed for suspended sediment, nitrogen (nitrate and ammonia), phosphorus, and algal productivity. Samples were collected once per week from March through August during 1994 and 1995. The sampling schedule provided for the collection of 48 same-day sample sets so that the relative contribution of the Blue Earth River Basin to the Minnesota River could be determined. In addition to the samples collected on a weekly basis, suspended-sediment samples were collected daily in the Blue Earth River. The daily sediment sampling provided a means to track water-quality fluctuations on a daily basis and to provide sufficient data to compute an annual sediment load. The daily sediment record obtained for the Blue Earth River provides a means for comparison with the daily sediment record for the Minnesota River at Mankato, which has been obtained by the U.S. Geological Survey since 1968.

Nitrate conce ons in the Blue Earth River ranged from 2.0-11. L during 1994. Only two of the samples collected in 1994 had nitrate concentrations that exceeded the 10 mg/L drinking water standard. This indicated a decrease from the 1990-93 period when nitrate concentrations frequently exceeded the standard and reached levels above 20 mg/L. Data collected through June 30, 1995, however, indicate that nitrate concentrations increased in late March 1995 to 12 mg/L and remained above the 10 mg/L drinking water standard in all subsequent samples except for the sample collected on May 24, 1995, which had a nitrate concentration of 9.7 mg/L. The peak nitrate concentration in the Blue Earth River during 1995 was 15 mg/L.

Nitrate concentrations in the Minnesota River at Mankato were not as high as those in the Blue Earth River at Mankato. Nitrate concentrations in the Minnesota River ranged from 1.4-9.0 mg/L during 1994. During 1995, nitrate concentrations in the Minnesota River ranged from 1.5-10.0 mg/L. The information gathered on nitrate during 1994-95 indicates that the Blue Earth River Basin continues to be the primary source of nitrate loading to the Minnesota River.

Total phosphorus concentrations were high in both rivers, a continuation of conditions observed during the MRAP study. Total phosphorus concentrations ranged from 0.05-7.70 mg/L in the Blue Earth River and from 0.05-0.64 mg/L in the Minnesota River. The paired samplings indicate that high phosphorus loadings are occurring in both the Blue Earth River Basin and in the portion of the Minnesota River Basin above the confluence with the Blue Earth River.

The effects of the phosphorus loading was reflected in chlorophyll a concentrations that frequently indicated very high levels of algae production. Chlorophyll concentrations in the Blue Earth River ranged from a low of 0.8 µg/L on March 8, 1995, to a high of 75 µg/L on September 1, 1994. Chlorophyll concentrations in the Minnesota River ranged from 1.6 µg/L on May 4, 1994, to 60 µg/L on April 13, 1994.

Problems: Limited fieldwork has been initiated due to flooding and the completion of the final MRAP report. This coming spring, automatic sampling equipment will be installed at key locations. Streamflow and water quality samples will be collected on the Minnesota River.

Progress: A deta nonitoring design has been prepared by the US id submitted to the MPCA.

Trend data are currently being collected at key locations on the Minnesota River and the Blue Earth River. Automatic sampling equipment has been installed for two of the three demonstration watersheds. All monitoring equipment is anticipated to be in place by the end of May 1994. Monitoring is continuing on schedule.

F6. Benefits: Remedial actions taken in the Minnesota River Basin will bring about improvements in the water quality throughout the system. Tracking that improvement is very important to guiding long-term water quality management decisions and policy.

V. EVALUATION: This project will initiate the transition from assessment of the Minnesota River System to implementation. Demonstrations, education, monitoring and evaluation will provide the knowledge for state and local water planners, natural resource and water managers, and landowners to further basin wide implementation. Successful activities will be environmentally effective and technically and economically practical, and transferable within the Minnesota River Basin.

VI. CONTEXT: Improvement of water quality in the Minnesota River Basin will require a wide variety of implementation activities applied through the 16,000 square mile watershed. This proposal will initiate several of those activities. Implementation is the responsibility of several agencies. Water quality coordination for nonpoint source and for this project is the responsibility of the MPCA. The current LCMR project assessing the Minnesota River Basin is providing a basis for understanding the river system and setting goals for needed improvements. This project will translate the current work into action by demonstrating what improvements it is possible to achieve through installing the necessary BMPs, and by developing new and innovative BMPs for those areas where they currently do not exist. Further implementation beyond this project will be guided by the Minnesota River Basin Plan currently under development.

VII. QUALIFICATIONS:

1. Program Manager:

Wayne P. Anderson, P.E.
Nonpoint Source Supervisor
Nonpoint Source Section
Water Quality Division
Minnesota Pollution Control Agency

* Bachelor of Agricultural Engineering, University of Minnesota - 1973

The program manager has been involved in all aspects of nonpoint source control work in Minnesota since 1984, as supervisor of nonpoint source control in the Water Quality Division. Activities have included assessment, planning, watershed modeling, Best Management Practice development, and watershed implementation. Mr. Anderson is currently the program manager for the LCMR project assessing nonpoint source pollution in the Minnesota River Basin. Mr. Anderson's role will be program manager and oversight of overall project.

Time on this project:

* 30 percent on all objectives.

2. Cooperators/Other Investigators:

James L. Anderson

Qualifications:

* Ph.D. in Soil Science
* 14 years of experience in teaching soil science courses
* Extensive extension experience in the use of soil information
* Applied research experience using demonstration and field plots
* Administrative experience as director of U of M Center
* Successfully managed external supported research grants

2. Cooperators/Other Investigators (Continued)

* Advised and supervised graduate students
* Experience with agricultural practices in the Minnesota River Basin

Institution Association:

* 1990-present: University of Minnesota, Professor, Soil Science
* 1986-present: Director, Center for Agricultural Impact on Water Quality
* 1985-1990: University of Minnesota, Associate Professor, Soil Science
* 1978-1985: University of Minnesota, Assistant Professor, Soil Science
* 1976-1978: Hennepin Soil and Water Conservation District, Soil Scientist

Time on this project:

* 10 percent on Objective C.

Bruce Wilson, P.E.

Qualifications:

* Ph.D. in Agricultural Engineering with emphasis in water resources
* 9 years of experience in teaching hydrology of agricultural watersheds
* Extensive research experience in modeling water and contaminant transport
* Recipient of four national awards for research of exceptional merit
* Successfully managed externally supported research grants
* Advised and supervised graduate students
* 10 years of experience with agricultural practices in southwestern Minnesota

Institution Association:

* 1991-present: University of Minnesota, Assistant Professor, Ag. Engr.
* 1987--1991: Oklahoma State University, Associate Professor, Ag. Engr.
* 1983-1987: Oklahoma State University, Assistant Professor, Ag. Engr.

2. Cooperators/Other Investigators (Continued)

Time on this project:

* 15 percent on Objective C.

Emmit Calvin Alexander, Jr.

Qualifications:

* Ph.D. in chemistry with emphasis in geochemistry
* More than 20 years of experience in teaching natural resources courses
* Extensive research experience in geohydrology and geochemistry
* Successfully managed externally supported research grants
* Advised and supervised graduate students
* Conducted research project related to drainage practices in Minnesota

Institution Association:

* 1987-present: University of Minnesota, Professor, Geology
* 1978-1987: University of Minnesota, Associate Professor, Geology
* 1973-1978: University of Minnesota, Assistant Professor, Geology
* 1970-1973: University of California, Research Chemist

Time on this project:

* 16.7 percent on Objective C.

Ronald Harnack
Executive Director
Board of Water and Soil Resources

Time on this project:

2. Cooperators/Other Investigators (Continued)

* 15 percent of a Regional Board Conservationist time on Objective B.

Greg Payne
Senior Hydrologist
U.S. Geological Survey
St. Paul, Minnesota

B.S. Wildlife Biology and Management, University of Minnesota - 1969

Greg has served with the USGS for eighteen years, and his duties have included; conducting several time-of-travel studies on major river systems, water quality studies of urban lakes and Voyageurs National Park, and flood stage modeling on large rivers. Greg has served as Project Chief on a large sediment runoff study of Garvin Brook, Minnesota, and has experience in statistical analysis of data. Greg is leading the physical/chemical assessment portion of the current LCMR project investigating sources of nonpoint pollution in the Minnesota River.

Time on this project:

* 10 percent on Objective F, plus 75 percent of a technician time on Objective F.

Lowell M. Busman
Program Manager
Water Quality Extension Educator

Qualifications:

* B.A. in chemistry and math, Southwest State University, Marshall, MN - 1972
* M.S. in Soils, University of Minnesota, St. Paul, MN - 1976
* Ph.D. in Soil Chemistry, Iowa State University, Ames, IA - 1984

2. Cooperators/Other Investigators (Continued)

Work Experience:

* Present - Water Quality Extension Educator
* 1990-1992: Assistant Professor of Soils, University of Minnesota, Waseca
* 1987-1990: Assistant Professor of Soil Chemistry, Oklahoma State University
* 1984-1987: Farmer/consultant in southwest Minnesota
* 1975-1980: High School Chemistry instructor, Faribault Public Schools

Time on this project:

* 20 percent on Objective D.

Tim Larson
Project Coordinator
Minnesota Pollution Control Agency
St. Paul, Minnesota

* B.A. Biology and Chemistry, Mankato State University - 1974
* M.A. Biology, Mankato State University - 1982

Tim has served with the MPCA for 13 years. He has much experience in point and nonpoint source water pollution control and abatement. Activities at the MPCA. have included working with both municipal and industrial point source generators in the areas of permitting and pollution control methodology development. In addition, he has worked in the area of nonpoint source control throughout the development of the state's current program. Mr. Larson is the project coordinator for the current LCMR project assessing nonpoint source pollution in the Minnesota River.

Time on this project:

* 100 percent on all objectives.

VIII. REPORTING REQUIREMENTS: Semiannual status reports will be submitted not later than January 1, 1994 and July 1, 1994, January 1, 1995, and a final status report by June 30, 1995.