1.0 PROJECT SUMMARY SHEET

PROJECT TITLE NAME: White River, Phase I TMDL Assessment

NAME AND ADDRESS OF LEAD PROJECT SPONSOR:

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STATE: South Dakota

WATERSHED: White River Watershed
HUC # 101402

PROJECT TYPES: [ ] BASE [x] WATERSHED [ ] GROUNDWATER [ ] I&E

WATERBODY TYPES	NPS CATEGORY
[ ] Groundwater	[x] Agriculture
[ ] Lakes/Reservoirs	[ ] Urban Runoff
[x] Rivers	[ ] Silviculture
[x] Streams	[ ] Construction
[ ] Wetlands	[ ] Resource Extraction
[ ] Other	[ ] Stowage and Land Disposal
	[ ] Hydrologic Modification
	[ ] Other

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SUMMARIZATION OF MAJOR GOALS:

The goal of the Phase I White River Assessment Project is to locate and document sources of nonpoint source pollution (primarily excess sediment loading) in the watershed. This project will produce Total Maximum Daily Load (TMDL) reports for the listed segments of the waterbody and feasible restoration recommendations that may lead to a watershed implementation project.

PROJECT DESCRIPTION:

The White River discharges into the Missouri River Reservoir, Lake Francis Case. The watershed is approximately 9,940 square miles and is located in the south western portion of South Dakota and crosses into Nebraska. Land use is primarily rangeland with some dryland farming. White River was listed on the 2002 303(d) list for violation of total suspended solids standards. The White River carries a natural load of colloidal clays and small sands. A major emphasis of this proposal will be to separate the amount of total suspended solids from natural background versus induced by activities within the watershed. Through analysis of historic water quality and stream flow, along with land use analysis and benthic/periphyton collection and analysis, the sources of impairment to the river and the watershed will be document. Feasible recommendations for restoration will be presented in the final project report.

319 funds requested (FY-03) $48,000	Match	$32,000
	Total Project Cost	$80,000

2.0 STATEMENT OF NEED

2.1 The South Dakota Department of Environment and Natural Resources (SD DENR) is responsible for assessing all impaired water bodies listed in the 2002 South Dakota 303(d) Water Body List. SD DENR has identified the following impairments in the White River Watershed as high priorities for the preparation of a TMDL:

- Total suspended solids (TSS) for the Little White River from Todd County line to the mouth of the River.
- TSS and fecal coliform in the White River upstream of the Nebraska border.

Beneficial uses of both the Little White River and White River, along with the applicable standards, are listed as:

- Warm water semipermanent fish life propagation (TSS: 90 mg/L 30 day average; 158 mg/L daily maximum)
- Limited contact recreation (fecal coliform: 1,000/100 ml mean, 2,000/100 ml single sample)
- Fish and wildlife propagation, recreation, and stock watering (pH: 6.5–9.5 pH units)
- Irrigation (specific conductance: 2,500 μohms/cm 30 day average; 4375 μohms/cm daily maximum).

2.2 The White River Watershed starts in the Nebraska counties of Sioux, Dawes, Sheridan, and a small portion of Cherry and flows into the South Dakota counties of Fall River, Shannon, Bennett, Jackson, Todd, Millette, Jones, Lyman, and Tripp. A small portion of the watershed is in Pennington County (Figure 2-1). Portions of the Pine Ridge and Rosebud reservations are within the watershed as well as Buffalo Gap National Grassland and Badlands National Park.

2.3 The White River Watershed is approximately 9,940 square miles in size and is identified as Hydraulic Unit 101402 (10140201, 1040202, 10140203, and 10140204). Major rivers include White River, Little White River, Bear in the Lodge Creek, Black Pipe Creek, and other small creeks which feed into White River. There are a number of permitted point source discharges within the watershed, such as wastewater treatment facilities for small communities.

2.4 The White River watershed is within the Northwestern Great Plains ecoregion. More specifically, the most significant Level IV ecoregions are Keya Paha Tablelands and Subhumid Pierre Shale Plains. The less significant ecoregions are River Breaks and White River Badlands.

The Keya Paha Tableland's physiography is unglaciated, level to rolling plains. Elevation can range from 2,200 to 3,600 feet. The soils are Anselmo, Kadoka, Keith, Manter, Rosebud, Epping, Keota, Ronson, and Vetal. The precipitation ranges from 16–20 inches. Natural vegetation includes blue grama, sideoats grama, western wheatgrass, little bluestem, and needleandthread. Land use and cover includes cattle ranching with some dryland farming for alfalfa and winter wheat.

The Subhumid Pierre Shale Plains's physiography is also unglaciated, undulating plain. There are steep-sided incised streams. Elevation can range from 1,700 to 2,800 feet. The soils are Millboro, Lakoma, Opal, Promise, Sansarc, Midway, and Ottumwa. The precipitation ranges from 15–17 inches. Natural vegetation includes wheatgrass, grama grass, needlegrass, porcupine grass, and needleandthread. Land use and cover includes cattle grazing with some dryland farming for winter wheat, alfalfa, and sorghum.

2.5 Sediment data have been collected daily at United States Geological Society (USGS) site 06452000, White River, near Oacoma, South Dakota. Maximum daily mean for TSS was 72,300 mg/L, measured on April 15, 1974, and minimum daily mean was 15 mg/L measured on February 15, 1982. Measured maximum daily load was 1,640,000 tons measured on May 17, 1982.

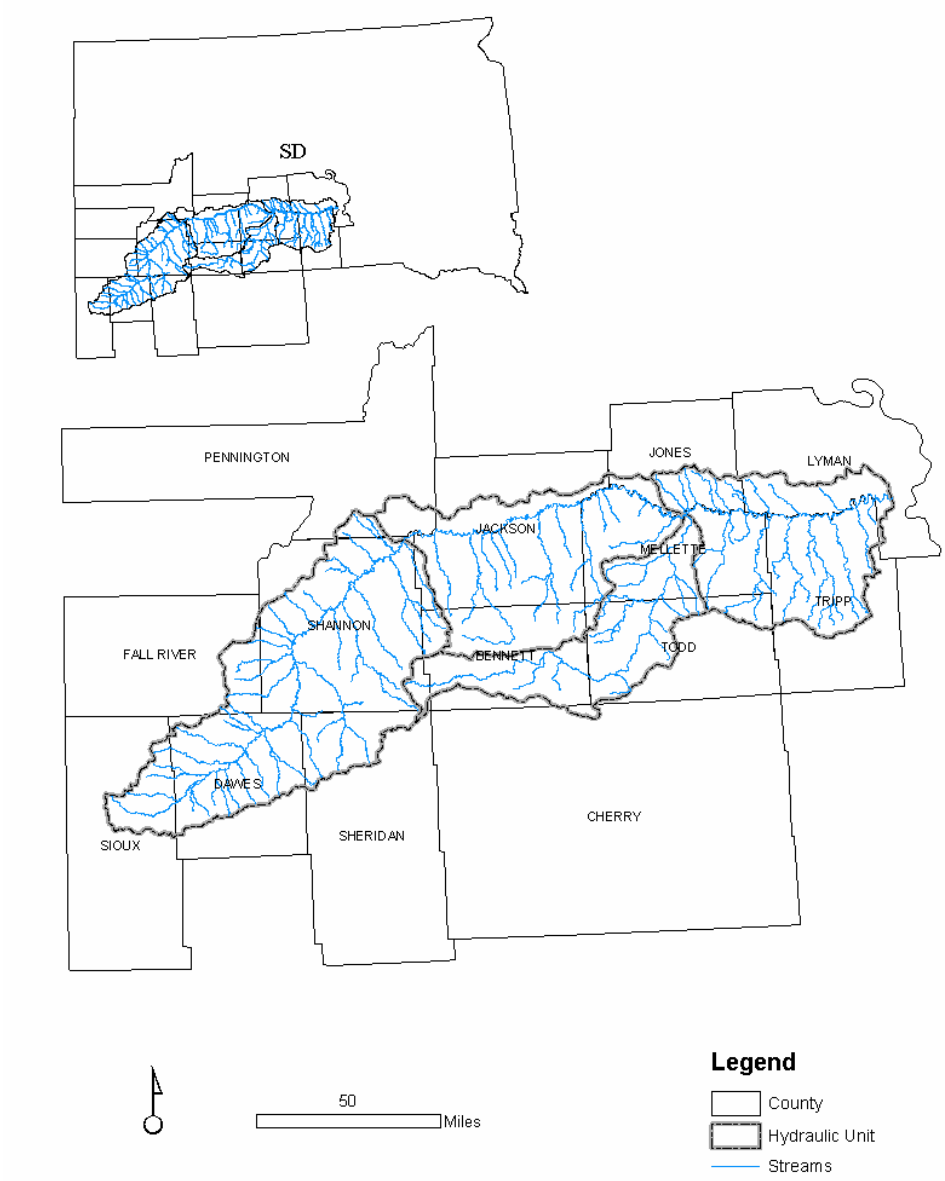

Figure 2-1. White River Watershed.

2.6 The following endangered species are identified by the South Dakota Game, Fish and Parks as located within the counties in the watershed: bald eagles, whooping crane, regal fritillary, paddlefish, black-footed ferret, pallid sturgeon, mountain lion, spiny softshell, least tern, piping plover, short-horned lizard. The implementation of this project will not impact any of these species.

3.0 PROJECT DESCRIPTION

3.1 GOALS

The goals of the White River Watershed Phase I Total Maximum Daily Load (TMDL) assessment are to locate and document major areas of impairment using existing data and to determine the need and scope of additional sampling

and analysis. The project process is a phased approach. In Phase I, analysis of existing data will be completed along with biological sampling and analysis at nine sites. This information will be used to support initial guidance for Best Management Practices (BMP) implementation. The Phase I report will present recommendations for additional monitoring and modeling assessment if required to further refine the identification of nonpoint source pollution in the watershed and produce feasible focused restoration recommendations. Phase II, if required, would implement the monitoring and modeling proposed in Phase I.

Specifically, Phase I will evaluate existing data for fecal coliform, and total suspended solids (TSS) from the USGS' and the SD DENR's sampling and flow measurements. Benthic and periphyton samples will be collected and analyzed at nine sites on the White River. This project will result in summaries of historical data, water quality statistics, and biologic statistics. Products will include hydraulic budget and sediment budget and will recommend BMPs for implementation. The report will also recommend additional monitoring and modeling, if required, along with suggested TMDL scope of work for the White River Watershed, South Dakota. This proposal covers Phase I.

To accomplish the goals of Phase I of the White River Watershed TMDL, the effort has been divided into four major objectives. These objectives are:

1. Compile and Analyze Historical Flow Data
2. Compile and Analyze Historical Water Quality Data
3. Identify High Potential Sediment Load Contributors Outside the Riparian Zone
4. Collect and Analyze Benthic and Periphyton Data Along With Stream Assessment at the Sites.

Figure 3-1 presents a conceptual process flow diagram of the approach to the project. Each objective and subtasks are discussed in more detail in the following paragraphs.

3.2 OBJECTIVES AND TASKS

OBJECTIVE 1: Compile and Analyze Historical Flow Data

Flow records for this watershed date back to 1928. Most of the USGS gauge stations started collecting flow information before 1945 with a few newer stations initiated in 1980. The objective is to compile this data and develop statistical comparisons between stations for the years available.

Task 1.1 **Retrieve and Develop Hydraulic Budget for the White River Watershed**

There are numerous long-term and temporary USGS flow gauge stations within the watershed. Table 3-1 lists the more significant USGS sites. The data from these stations will be compiled and evaluated using various statistical methods to determine seasonality and to develop the hydrologic budget for the watershed. Seasonality will be determined by evaluating the monthly flow data and by examining statistical differences using nonparametric techniques such as Kruskall-Wallis. Regression analysis techniques will be used to look for relationships between USGS flow measurement stations. The hydraulic budget will present the major contributors and, if appropriate, compare their contribution based on seasonality of the flow regime.

Task 1.2 **Develop Statistical Flow Relationships Between Stations**

Flow records at the long-term stations and temporary stations will be analyzed using regression techniques to confirm the flow relationships between stations. This relationship will be critical to understand the water quality data when flows were not measured (majority of the historic SD DENR data does not have associated flows). Using this information, flow will be estimated for the dates and temporary stations when chemical data were collected.

Products: Hydraulic budget and estimated flow for water quality samples taken without flow data.

Cost: $10,300

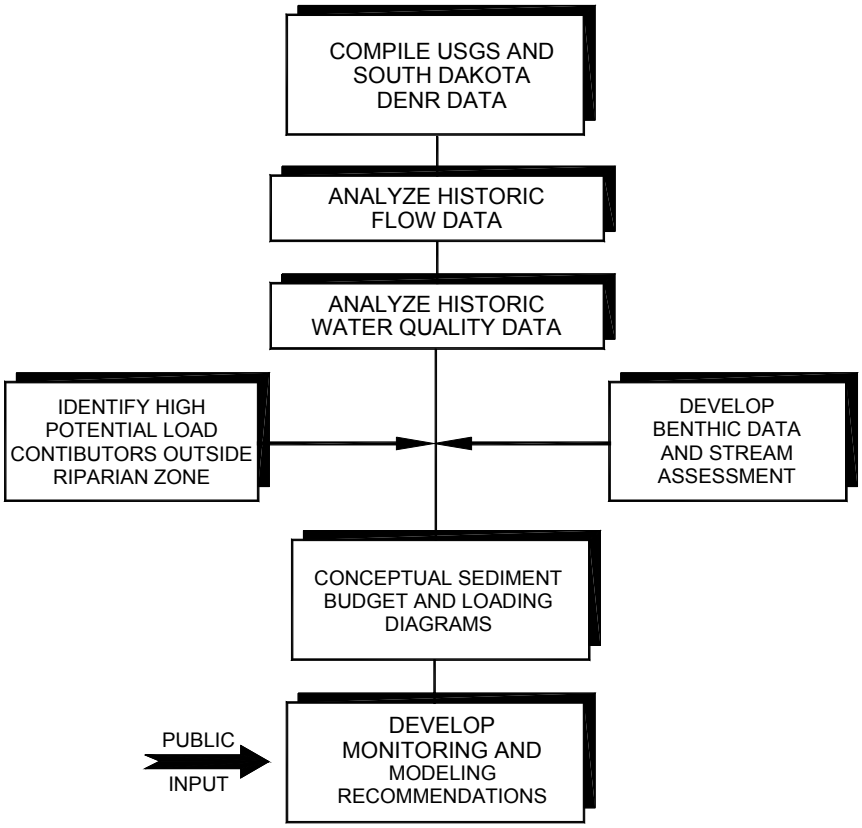

Figure 3-1. Schematic Diagram of the White River Phase I Total Maximum Daily Load Assessment Project.

OBJECTIVE 2: Compile and Analyze Historical Water Quality Data

Water samples were collected and analyzed by many organizations in the past. SD DENR, USGS, and United States Army Corps of Engineers (USACE) have collected the most samples. USGS has been collecting daily TSS samples during different time periods for over 20 years at USGS 06452000, White River near Oacoma, South Dakota (USACE has collected samples before 1971). This incredible data source provides a great foundation to compare other "grab sample type" water quality results within the watershed and to look for relationships that further our understanding of the nonpoint source pollution and potential remediation measures.

Task 2.1 **Retrieve TSS Data for the White River Watershed**

The data will be compiled from the Internet and by contacting the appropriate people at the three responsible agencies. There is a great historical record of TSS that can be used to develop statistical comparisons of precipitation and flow with other water quality monitoring stations similar to the analysis described in Task 1.1. The cost for this task assumes that the data are available in electronic format and can be easily imported into Excel and **MiniTab**.

Task 2.2 **Develop Statistical Comparisons for TSS at the Oacoma Site**

Statistical comparisons will be developed at the Oacoma site for TSS versus seasonality, precipitation, and flow. Flow, concentration, and load diagrams will be developed for the period of record. Annual trends will be investigated. To develop the relationship of flow and concentration, **FLUX**, a computer program developed by USACE, will be used. **FLUX** is designed for use in estimating the loadings of suspended solids or other water quality components passing a tributary sampling station over a given period of time. A relationship of flow and concentration is developed using the available samples.

Then, this relationship is used to develop an extrapolated concentration using the long-term daily flow records for the USGS stations. Finally, a loading estimate is developed by multiplying the daily flow and concentration for the USGS stations resulting in a tons/month estimate. Seasonality and precipitation relationships to suspended solids will be evaluated using a regression analysis. The data analysis at this site will be a cornerstone for the comparison analysis using the data from the other sites. It is expected that there will be seasonality in flow data as well as a good relationship between flow and TSS. Thus it is expected that there will be a seasonality relationship using the TSS data. The relationship between TSS and precipitation will be evaluated to determine the contribution of surface runoff to TSS.

Table 3-1. USGS Stations Within the White River Watershed

USGS Station Number	Name	Hydraulic Unit
06445685	White River near Nebraska-South Dakota State Line	10140201
06446000	White River near Oglala	10140201
06446700	Bear in the Lodge Creek near Wanblee	10140202
06447000	White River near Kodoka	10140202
06447230	Black Pipe Creek near Belvidere	10140202
06447500	Little White River near Martin	10140203
06448000	Lake Creek above Refuge, near Tuthill	10140203
06449000	Little Creek below Refuge, near Tuthill	10140203
06449100	Little White River near Vetal	10140203
06449500	Little White River near Rosebud	10140203
06450500	Little White River below White River	10140203
06452000	White River near Oacoma	10140204

Task 2.3 **Develop Statistical Comparison for TSS at Other Water Quality Monitoring Stations and USGS Gauge Sites Within the White River Watershed**

Statistical comparisons will be developed at water quality monitoring stations for TSS versus seasonality, precipitation, and flow similar to the approach described for Task 1.1. A summary of the active water quality monitoring stations managed by SD DENR is presented in Table 3-2. Additional historic data for other stations are assumed to be available from SD DENR.

Task 2.4 **Develop TSS Concentration Comparison by Location for the White River**

Using a logic similar to that described for the Oacoma site, flow, concentration, and load diagrams will be developed for the period of record for the USGS gauge stations and water quality monitoring stations where sufficient data exists. A combination of **FLUX** and regression will be used to investigate these relationships.

Task 2.5 **Develop Conceptual Sediment Budget for the White River**

Based on the analysis and literature from similar studies, a qualitative conceptual sediment budget diagram will be prepared. The diagram will present potential sources of sediment and relative contributions to the system.

Table 3-2. Water Quality Monitoring Stations Within the White River Watershed

SD DENR Station Number	Name	Hydraulic Unit
WQM 11	White River near Kadoka	10140202
WQM 12	White River near Oacoma	10140204
WQM 13	Little White River near White River	10140203
WQM 42	White River near Oglala	10140201
WQM 152	White River at Highway 83 Crossing	10140202

Task 2.6 **Compile Fecal Coliform Data for the White River**

Water quality data from SD DENR, USGS, and USACE will be compiled for fecal coliform.

Task 2.7 **Develop Statistical Comparison for Fecal Coliform at the USGS Gauge Sites and SD DENR Water Quality Monitoring Stations Within the White River Watershed**

Statistical comparisons will be developed at sites for fecal coliform versus TSS, seasonality, precipitation, and flow. Recent literature in this area has documented cases where there is a strong relationship between TSS and fecal coliform. Stepwise regression analysis will be preformed using the water quality data to investigate a relationship between TSS, fecal coliform, and other water quality parameters. If TSS and fecal coliform do not have a strong relationship, **FLUX** will be used to investigate the flow concentration relationship with fecal coliform.

Task 2.8 **Develop Fecal Coliform Concentration Comparisons by Location for the White River**

Flow, concentration, and load diagrams will be developed for the period of record for the USGS gauge stations and water quality monitoring stations where sufficient data exists (similar to those described in Task 2.4). A combination of **FLUX** and regression analysis will be used to investigate these relationships.

Products: Flow, concentration, and load diagrams for TSS and fecal coliform, conceptual sediment diagram.

Cost: $21,000

OBJECTIVE 3: Identify High Potential Sediment Load Contributors Outside the Riparian Zone

Using existing geographic information system (GIS) coverage of soil erodibility (USDA-NRCS State Soil and Geographic Database (STATSGO)), slope, distance to the stream, and land use, develop a map rating the area within the White River Watershed for the relative potential to contribute surface soils to the stream system as TSS.

Products: Map of high potential surface erosion areas.

Cost: $5,000

OBJECTIVE 4: Collect and Analyze Benthic and Periphyton Data Along With Stream Assessment at the Sites

Biologic indicators can be used to indicate longer-term quality of a water body. Some of the advantages of biologic monitoring are the following:

- Biological communities reflect overall ecological integrity. Thus biosurvey results directly assess the status of a water body relative to the primary goal of the Clean Water Act.
- Biological communities integrate the effects of different stressors and, thus, provide a broad measure of their aggregate impact.

- The status of the biological communities is of direct interest to the public as a measure of a pollution-free environment.

Therefore, biological communities may be a better indication of the overall water quality than grab samples that measure the quality of water at the instant of sampling.

Task 4.1 **Benthic and Periphyton Sample Locations**
Determine nine sample location for benthics on the White River and major tributaries. Biologic sampling of the Little White River is planned for 2003 under a different study. Thus samples will not be collected on the Little White River; however, the resulting data will be included in Task 4.5. The specific location of biological sampling sites will take into consideration potential impacted sites within the watershed. Additionally, sample sites will be coordinated with water quality sampling sites.

Task 4.2 **Collect Benthic and Periphyton Samples**
One composite benthic macroinvertebrate sample will be collected at nine sites. The sampling technique will be consistent with methods identified in the *Standard Operating Procedures for Field Samplers, Tributary and In-Lake Sampling Techniques* [South Dakota Department of Environment and Natural Resources, 2003][1].

Task 4.3 **Stream Channel Classification**
The stream channel at each of the benthic sites will be classified using SD DENR stream assessment protocol.

Task 4.4 **Benthic and Periphyton Analysis**
Benthic samples will be sent to an independent laboratory for taxonomic identification to genus species (including Chironomidae and Oligochaeta). Periphyton taxonomic identification enumerated from diatoms to species. The determination of periphyton and dry ash weight will also be conducted.

Task 4.5 **Taxometric Analysis**
The taxonomic data will be reported and simple metrics (40 metric) of biological indices calculated including abundance, taxonomic diversity, family biotic index, and EPT/C ratio. Relative impairment will be evaluated using the Kruskal-Wallis test for each of the indices. In addition, multiple regression analyses will be performed to determine if a relationship exists between the biological indices and TSS fecal coliform.

Products: Collection of data and relative impairment analyses of nine sites using benthic metrics.

Cost: $30,400

3.3 SCHEDULE

The schedule is shown in Figure 3-2. The project schedule assumes approval before October 2003 and completion the end of August 2004. Critical to the project schedule is the collection of benthic data in October 2003 before the river freezes. The next opportunity to collect benthics would be in late-summer 2004 during the summer low flows. Because of the time required for analysis, this would delay the project by approximately 4 months. The schedule is also compatible with a graduate student's schedule.

[1] **South Dakota Department of Environment and Natural Resources, 2003.** *Standard Operating Procedures for Field Samplers, Tributary and In-Lake Sampling Techniques,* Vol. 1 and 2, Pierre, SD.

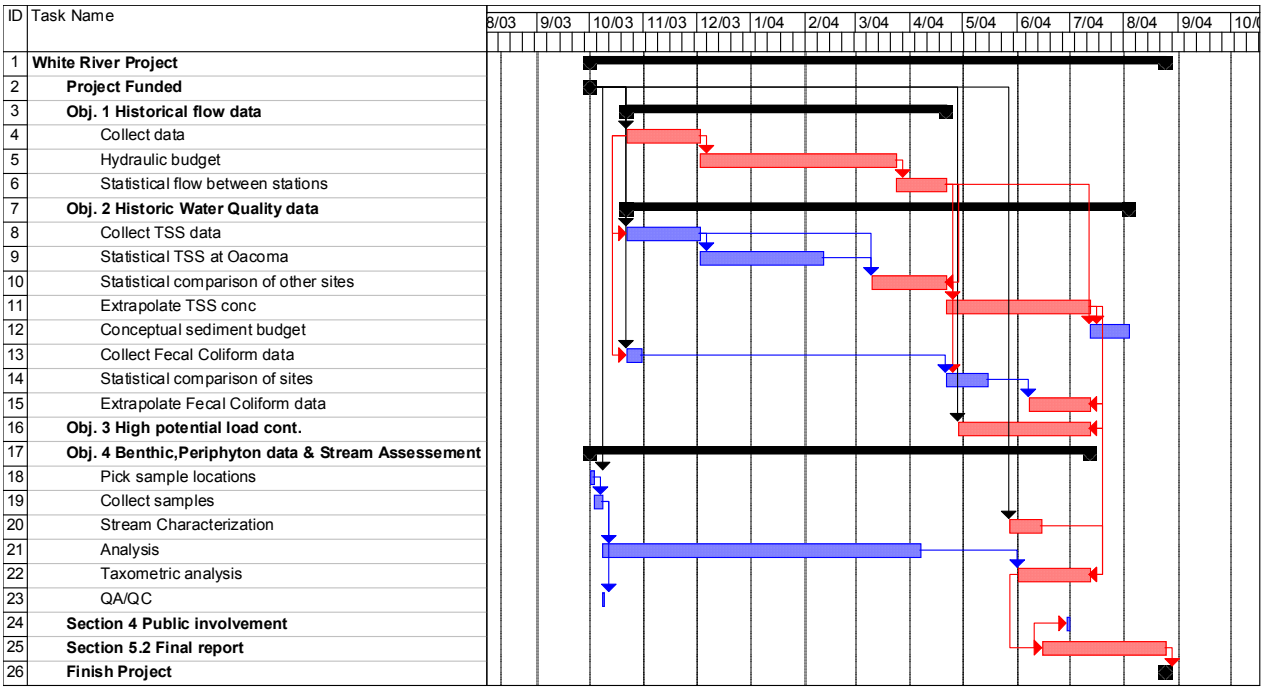

Figure 3-2. White River Watershed Phase I Total Maximum Daily Load Schedule.

4.0 COORDINATION PLAN

In addition to soliciting the participation of interested public agencies, the principal investigators will participate in two public meetings with interested stakeholders to review the results of this study. The following agencies will be contacted and encouraged to participate in the project by providing data, developing consensus on the methodology, and resulting conclusions:

- SD Department of Environment and Natural Resources
- United States Army Corps of Engineers
- United States Geological Survey
- Natural Resource Conservation Service
- United States Bureau of Indian Affairs
- Counties of and cities within the White River Watershed
- Rosebud Indian Reservation
- Pine Ridge Indian Reservation.

5.0 EVALUATION AND MONITORING PLAN

5.1 QUALITY CONTROL AND ASSURANCE

The collection of all field data will be performed in accordance with the *Standard Operating Procedures for Field Samplers, Tributary and In-Lake Sampling Techniques*. A minimum of 10 percent (1 sample) of all biological samples collected will be quality assurance/quality control (QA/QC) samples. QA/QC samples will consist of field duplicates or field replicate samples. One biological quality assurance sample will be collected during the project.

5.2 FINAL REPORT

A final report will be developed with one hard copy and one electric copy supplied at the end of the project. The final report will include:

- Electronic file of historic discharge measurements and other water quality data from USGS, USACE, and SD DENR.
- Summary of the hydraulic budget for the watershed.

  Flow relationships between gauge stations and analytical methodology will be presented. In addition, the method and results of estimating the flow for samples collected without flow measurements will be documented.
- Summary of statistical comparison of TSS, flow, precipitation, seasonality, and fecal coliforms.
- Summary of flow, concentration, and loading diagrams for TSS and fecal coliform.
- Summary of high potential sediment load contributors.
- Summary of benthic data and analysis along with stream characteristics data.
- Summary of conceptual sediment budget.
- Recommended BMPs and projected load reductions.
- Recommended Phase II scope, including additional monitoring and modeling recommendations.

6.0 BUDGET

This projected is proposed as a fixed-price contract of $80,000. Tables 6-1 and 6-2 provide a breakdown of the project cost by objective. RESPEC is responsible for the project budget, scope, and technical direction. South Dakota School of Mines & Technology (SDSM&T) is responsible to provide a graduate student, and Dr. Kenner is responsible for providing technical review of the project, final report, and participating in two public meetings. The total project is estimated to take approximately 1,000 hours, with the following allocation: 70 percent SDSM&T and 30 percent RESPEC. SDSM&T will bill monthly based on hours completed.

Table 6-1. White River Watershed Phase I Budget by Year

Funding Sources	Year		
	2003	2004	Total
EPA Section 319 Funds	$13,000	$35,000	$48,000
State/Local Match			
DENR Funds	$8,000	$24,000	$32,000
Total Budget	$21,000	$59,000	$80,000

Table 6-2. White River Watershed Phase I Budget by Objective

Section 319 Federal Budget	2003	2004	Total Costs	319 Funds	DENR Match
Salary and Fringe	$17,458	$51,542	$69,000	$41,400	$27,600
Travel	$1,381	$4,079	$5,460	$3,276	$2,184
Equipment and Supplies	$127	$373	$500	$300	$200
Subtotals	$18,966	$55,994	$74,960	$44,976	$29,984
Objective 4: Benthics/Periphyton					
Macroinvertebrate Analysis		$2,241	$2,241	$1,345	$896
Periphyton Analysis		$2,025	$2,025	$1,215	$810
Biomass (Ash Free Dry Weight)		$270	$270	$162	$108
Chlorophyll A (by SD DENR)		$0	$0	$0	$0
Subtotals	$0	$4,536	$4,536	$2,722	$1,814
QA/QC					
Macroinvertebrate Analysis		$249	$249	$149	$100
Periphyton Analysis		$225	$225	$135	$90
Biomass (Ash Free Dry Weight)		$30	$30	$18	$12
Chlorophyll A (by SD DENR)		$0	$0	$0	$0
Subtotal	$0	$504	$504	$302	$202
Objective 1: Flow	Cost associated in Items 1–3 above				
Objective 2: TSS & Fecal Coliform	Cost associated in Items 1–3 above				
Objective 3: GIS	Cost associated in Items 1–3 above				
Section 4: Public Participation	Cost associated in Items 1–3 above				
Section 5.2: Reporting	Cost associated in Items 1–3 above				
Total 319/Nonfederal Budget	**$18,966**	**$61,034**	**$80,000**	**$48,000**	**$32,000**