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Natural Resources
Conservation Service

Blaine Soil
Conservation District

Preliminary Investigation Report
Silver Creek Watershed

Blaine County, Idaho

November 1996

SILVER CREEK WATERSHED

PRELIMINARY INVESTIGATION

Blaine County, Idaho

Requested by:

Blaine Soil Conservation District

Prepared by:

U.S. DEPARTMENT OF AGRICULTURE
Natural Resources Conservation Service

In Consultation with:

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PREFACE

The philosophy of a preliminary investigation (PI) is to identify and assess an area's problems, develop potential solutions, and evaluate their relative impacts in a cost efficient manner. Furthermore, a preliminary investigation is intended to provide decision makers with information regarding the appropriateness of project action, the magnitude of project costs and benefits, and the potential for program eligibility and funding.

In developing the information contained in this report, the interdisciplinary, interagency team of specialists relied on numerous published reports and interviews with local, state and federal representatives and private landowners. This information was combined with personal observations, field measurements, and professional experience and judgment to produce the preliminary investigation report.

This preliminary, cost conscious exercise requires that a large number of assumptions are made and used by the team specialists. These are detailed in this report, particularly in Appendix A, Investigation and Analysis. Although further study is recommended before proceeding with actual implementation, the USDA - Natural Resources Conservation Service (NRCS) feels that the results presented are both reasonable and reliable for this stage of planning and decision making.

SUMMARY

The Blaine Soil Conservation District (SCD) requested assistance from the USDA, Natural Resources Conservation Service (NRCS) to complete a preliminary resource assessment of the water quality problems associated with the Silver Creek Watershed.

Based on the 1991 Idaho Water Quality Status Report and Non-Point Assessment, the following designated beneficial uses are "supported but potentially at risk". 1) cold water biota, 2) salmonid spawning, 3) primary contact recreation, and 4) secondary contact recreation.

Silver Creek is listed as a priority stream segment (USB 0517 and 0518) in the revised 1991 Idaho Agricultural Pollution Abatement Plan. The creek was nominated as a stream segment of concern (SSOC) in both 1989 and 1991. Both segments of Silver Creek, 0517 Kilpatrick Bridge to Little Wood River, and 0518 Stalker Creek Headwaters to Kilpatrick Bridge are contained on the SSOC list. Silver Creek (source to mouth) is also designated as a special resource water (IDHW - DEQ 1992).

Numerous planning and implementation activities associated with water quality improvement in the Silver Creek Watershed have occurred. The majority of these activities have taken place on individual farms and ranches. The Blaine SCD, with technical assistance from the NRCS has installed such BMP's as streambank seeding, fencing of springs, and improved irrigation systems. The Nature Conservancy (TNC) has acquired approximately 805 acres of land it currently owns, 7,726 acres of land in conservation easements and 987 acres in management agreements.

Based on the need to reduce further water quality degradation in the Silver Creek Watershed, the Blaine SCD established the following objectives for the purpose of conduction the preliminary investigation. 1) Identify the major point and nonpoint pollution sources that are impairing or threatening the beneficial uses: 2) develop alternative solutions that will reduce point and nonpoint source loading and protect the beneficial uses of Silver Creek and the tributaries and the world class fishery: 3) coordinate the PI with all past, current and future planning activities to minimize duplication of effort, and provide a balanced and coordinated resource management approach: 4) determine the appropriateness of future project action: 5) identify the potential for program eligibility and funding: 6) maintain the existing quality of the Silver Creek fisheries.

Based on the sponsors objectives, the PI team focused on an inventory of all major point and nonpoint sources of pollution. In addition, data was collected to summarize all existing water quality monitoring results and the quality of existing aquatic habitat.

Technical assistance to implement water quality improvements could be provided through the NRCS Conservation Operation Program (CO-01).

Future planning and implementation funding to provide for additional water quality improvements could be obtained from a variety of programs as outlined in the PI.

It was the consensus of the PI team that a total watershed approach must be utilized to treat all major point and nonpoint sources of pollution. Emphasis must be placed on all major contributors, if water quality improvements are to be realized.

It was also the consensus of the PI team that Silver Creek would probably receive a low priority rating for an Idaho State Agricultural Water Quality (SAWQP) project since the creek is not a "303d" water quality limited stream segment. However, the team concluded that the **high quality water** of Silver Creek must be protected.

OBJECTIVES

The Blaine Soil Conservation District developed the following objectives to address the water quality related problems present in the Silver Creek Watershed.

- Identify the major point and nonpoint pollution sources that are impairing or threatening the beneficial uses.
- Develop alternative solutions that will reduce point and nonpoint source loading and protect the beneficial uses of Silver Creek and the tributaries and especially the world class fishery.
- Coordinate the preliminary investigation with all past, current and future planning activities in order to minimize duplication of effort and provide for a balanced and coordinated approach to watershed treatment.
- Determine the appropriateness of future project action.
- Identify the potential for program eligibility and funding.
- Maintain the existing quality of the fisheries of Silver Creek.

PROJECT SETTING

Location, Size, and Topography

Silver Creek (PNRS# 518 and 519) is located in the Little Wood River hydrologic basin. Silver Creek emerges as numerous springs and seeps from the valley floor in the northern part of the watershed and leaves near Picabo in the southeast. The study area is roughly a triangle, bordered on all sides by mountains. The area extends southerly to the stream's confluence with the Little Wood River near the Blaine County/Lincoln County boundary. The topography of the area includes mountains that rise 2,000 to 3,000 feet above the valley floor. Elevations range from 7,988 feet at Bell Mountain to an elevation of 4,650 where Silver Creek joins the Little Wood River. The valley floor where the creek originates is gently sloping to the south with an average elevation of about 4,900 feet.

Climate

The average annual precipitation is 14 inches. Only 23 percent of this precipitation occurs during the 131 day frost free growing season. The majority of the precipitation occurs during the winter months as snow. The Silver Creek aquifer which feeds the numerous springs, has a limited capacity. When the aquifer is full, it spills into the Snake River aquifer near Picabo.

Land Ownership

The majority of the land on the valley floor in the Silver Creek Watershed is in private ownership. Two separate small parcels of land in the valley floor are owned by the Idaho Department of Fish and Game (IFG). The majority of the mountains surrounding the valley floor are public land administered by the Bureau of Land Management (BLM). The watershed land ownership is summarized as:

OWNERSHIP	ACRES
Private	43,700
State	3,840
BLM	20,660
Total	68,200

Land Use

The predominant land use within the watershed is cropland and pastureland. Typical crops produced in the area are barley, alfalfa, and pasture with small amounts of wheat, canola, and potatoes.

Land Use	
Cropland and pastureland	35,000 ac.
Rangeland	28,200 ac.
Recreation and Wildlife	1,800 ac.
Urban and Subdivision	3,200 ac.
Total	68,200 ac.

Crops Grown (1994)	
Pasture	15,020 ac.
Barley	10,570 ac.
Alfalfa	6,820 ac.
Potatoes	1,370 ac.
Oats	560 ac.
Wheat	410 ac.
Canola	250 ac.
Total	35,000 ac.

Irrigation Methods (1994)	
Sprinkler	21,220 ac.
Gravity	5,860 ac.
Sub-irrigated	1,470 ac.
Non-irrigated	6,450 ac.
Total	35,000 ac.

Geology

The Big Wood River valley is a structural depression that has been filled with sediments. During the Pliocene the Big Wood River flowed through the southeastern gap near the present town of Picabo. Basalt flows of the Challis Volcanics in the Pleistocene epoch blocked the southeast channel forming a lake that resulted in graded deposition of sediments from coarse to fine grained down the valley. Eventually, the increasing lake elevation caused the river to breach at the southwest outlet near Stanton Crossing at the location of the present channel of the Big Wood River.

A second basalt flow dammed the southwest outlet forming a new lake and forcing the Big Wood River to again flow through the southeast outlet. This sequence apparently occurred several times with a lake forming periodically. Periods of alpine glaciation in the headwaters of Big Wood River were concurrent with the formation of lakes and caused deposition of coarse grained, poorly sorted materials over the valley. This sequence of events caused the deposition of alternate layers of coarse and fined sediments that comprise the current aquifer system.

The valley floor slopes from north to south with a low topographic divide between the Big Wood River and Silver Creek drainage. High ground water levels eventually formed surface springs in the southern part of the area. These spring-fed streams combined to form Silver Creek which now flows southeast and out of the area.

Soils

The primary soils in the Silver Creek Watershed are:

- Little Wood - Balaam - Adamson : very deep, well drained soils that formed in alluvium on slopes of 0 to 4 %. These soils are found in the northern two-thirds of the watershed.

- Picabo - Hapur - Bickett : very deep, somewhat poorly drained to very poorly drained soils that formed in alluvium on slopes of 0 to 2%. These soils are found in the southern one-third of the watershed.

- Friedman - Elksel - Starhope : moderately deep and deep soils that formed in colluvium and residuum derived from volcanic rock on slopes of 4 to 60%. These soils are found on the east and south of the watershed.

Hydrology

Surface Water:

There are two main sources of surface water in the watershed; the Big Wood River and Silver Creek including the tributaries. Water from the Big Wood River is diverted into the watershed through irrigation diversions. Irrigation usually begins in April and continues through October. These diversions include individual and multiple-user canals and laterals. High water in the Big Wood River generally peaks the end of May. Water from the Big Wood River is used to irrigate the upper parts of the watershed. Water from Silver Creek is also diverted and used for irrigation. Hydrographs of Silver Creek tributaries show distinct flow patterns. The flow generally rises in June immediately after irrigation begins and peaks in October. Flows start declining at the end of October, reaching the minimum in January - February, and remain low until the start of the next irrigation season.

Ground Water:

Water is available in the fluvioglacial sediments and basalt from both confined and unconfined aquifers. Unconfined or water table conditions exist in most of the study area. Ground water is the major source of water to meet domestic and stockwater needs and serves both primary and supplemental irrigation needs. Numerous ground water springs sustain Silver Creek and its habitat. Land owners started using ground water for irrigation in the early 1940's. Development of modern wells started in 1947. These wells are generally used to supplement canal irrigation supplies; however many of these wells serve as the sole source of irrigation water. The rapid

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development of irrigation wells and declining water levels in the valley has resulted in a moratorium of drilling new wells.

In the northern part of the valley, ground water moves in a southerly direction. In shallow systems, ground water movement follows the surface drainage, moving southeast towards Picabo. The deeper ground water that moves toward Silver Creek flows eastward through the confined aquifer toward the basalt aquifer underlying the southeastern part of the valley. The ground water in the basalt aquifer flows toward Picabo and out of the area.

Ground water levels in the area rise and fall in response to recharge and discharge from the aquifer. In general, water levels rise in late spring in response to recharge from snow melt and flood flows in the Big Wood River and continue to rise through early summer as the irrigation water recharges the aquifer. Water levels begin declining in July and continue to decline until the end of the season. Maximum fluctuations in ground water levels take place in Poverty Flats and Picabo areas (36 and 18 feet, respectively). Minimum fluctuations of 5 to 10 feet in water levels generally occur throughout the southern part of the area.

The major sources of recharge to ground water are irrigation, snow melt, and precipitation. A significant contribution to recharge is made by the percolation of excess irrigation water applied to crops, leakage from canals and ditches, and seepage in the northern part of the Wood River channel and tributary streams. Land owners also divert surplus canal water to designated recharge ponds to recharge the aquifer. Most of the recharge water is diverted during the later part of summer when most crops are harvested.

Water Quality

Water quality within the Silver Creek Watershed is currently being impacted to varying degrees by irrigated and non-irrigated cropland, rangeland, animal holding/feeding areas, road construction and maintenance, riparian management, flow modification, channelization, recreation and rural/urban development.

Direct impacts of sediment and suspended solids within the water column are for the most part quite small. However, the most significant water quality impact in Silver Creek and its tributaries is likely from sediment and other suspended solids. Effects of sediment in the Silver Creek stream system are most pronounced as indirect impacts to the bottom substrates, sediment and other settleable materials which sink to the bottom adversely impact invertebrate populations, become embedded in and cover spawning gravels, cover deposited eggs and depending on the organic composition remove dissolved oxygen from within the water column. Although this is important in Silver Creek, it is especially important in the tributaries to Silver Creek where the majority of Salmonid spawning occurs. Sources of sediment originate from exposed streambanks, adjacent riparian areas with inadequate plant cover and farming activities which encroach into the riparian zone.

Generally, nitrate nitrogen concentrations in Silver Creek, the tributaries, and in ground water near Silver Creek, during the period 1976-1995 were found above the concentration (0.3 mg/l) recommended to prevent the development of biological nuisances and accelerated eutrophication. However, nitrate nitrogen concentrations in Silver Creek are a direct result of ground water discharge and therefore reflect ground water concentrations.

Orthophosphate phosphorus concentrations and pathogens (fecal coliform counts) were typically found within recommended levels. These water quality variables, in addition to nitrate nitrogen, do not appear to be causing pronounced water quality problems in Silver Creek.

Water temperatures and dissolved oxygen concentrations were typically found within the Idaho water quality standards. These water quality variables, for the most part, also do not appear to be causing pronounced water quality problems in Silver Creek, except during years of critical low flows and during isolated early morning hours. On June 23, 1992 a fish kill of over 50 large trout occurred when dissolved oxygen levels reached 2.5 ppm at the Point of Rocks access.

Data collected on macroinvertebrate populations indicate that overall water quality conditions in upper Silver Creek, especially in certain sections, support some of the highest numerical standing crops of macroinvertebrates in the Rocky Mountain region and possibly for the world. The dependable volume of clear, cold, nutrient rich water together with the homogeneous habitat, deposition substrate and extensive macrophyte communities are largely responsible for the productivity of Silver Creek as a major trout fishery (Manuel - Faler. et.al., 1982).

Sedimentation

Sediment loading was identified as one of the problems in Silver Creek. Agriculture, cattle grazing, and wind blown silt are the primary sources of sediment deposition in the stream channel. Interviews with local residents and previous studies indicate sediment loading occurs during winter and spring runoff in February or March, from localized precipitation events, and during the irrigation season. Silver Creek's streamflow velocities are relatively slow and constant year around because the majority of Silver Creek's streamflow results from ground water. A large percentage of the channel bottoms are covered in sediment with a vegetative cover. Elsewhere, the channel bottoms are composed of gravel or a clay lining. The vegetation appears to be holding the sediment in place. Previous studies indicate that the sediment load is fairly stable and immobilized by the vegetation and low velocities. Sediment is transported downstream during higher winter velocities and when vegetation cover and growth is at its minimal stage.

Several studies on Silver Creek's hydrology and sedimentation have been completed in the past. These studies include investigations of sediment depths on Silver Creek's tributaries and Silver Creek. A sediment study in 1979, which was about three years after the Nature Conservancy (TNC) became stewards of the land, indicates that the majority of sediment load is from Stalker Creek (Manuel, Griffith, and Minshall, 1979). The following table illustrates their results:

Stalker Drainage	Grove Drainage	Loving Drainage
52% of area	26% of area	26% of area
32% of discharge	49% of discharge	17% of discharge
62% of sediment load	23% of sediment load	15% of sediment load

Wildlife

Terrestrial wildlife in the watershed is driven by the availability of food, water and cover. The quality of habitat is influenced by the management of the area for recreational and agricultural purposes.

Big game species utilizing the watershed include mule deer and elk. The south portion of the watershed is considered a major winter range for mule deer and elk. Practices that enhance native rangeland, pastureland and haylands in areas of overlapping winter range will benefit these species. Maintaining diverse vegetative communities of shrub/grass forage for cover and food on winter range on south and west facing slopes should be promoted in the watershed.

Common furbearers include coyote, skunk, fox, badger, weasels, mink, beaver, and muskrat. Many of these species are dependent on the quality and quantity of riparian and wetland area in the watershed. Historically beavers have played a major role in the development of the meadows associated with Silver Creek and the tributaries. Over the last 50 years beavers have not played a significant role in sustaining the functions and values of the riparian/wetland areas in the watershed. The removal of beavers and loss of woody riparian vegetation has reduced this species, and the historical functions and values in Silver Creek. Restoration of riparian and wetland areas focusing on the regeneration of woody plant communities along Silver Creek and associated tributaries will enhance habitat for furbearers.

Upland game birds in the rangeland foothills of the area include sage grouse, mourning doves and limited pheasant and partridge populations. The extreme winter climate has limited the areas suitable for game birds such as pheasant and partridge. Rangeland habitat with diverse shrub/grass communities offer the best available habitat for sage grouse.

Waterfowl and shorebirds utilize Silver Creek, the tributaries and associated wetlands. Over 150 species of birds have been found within the Silver Creek watershed. Common species include mallard, great blue heron, common merganser, common snipe and sandhill crane. Over 9,000 acres of land in Silver Creek watershed are categorized as having hydric soils. Typically these soils in their natural state exhibit hydric characteristics and the plant communities exhibit hydrophyitic characteristics and are classified as wetlands. The diverse waterfowl and shorebird populations are attributed to these riparian/wetland areas. Practices to restore and or enhance these areas will enhance waterfowl and shorebird habitats in the watershed. Currently many of these areas are adversely impacted from agricultural and recreational uses. Protected nesting cover and brood rearing areas are needed to enhance habitat for these water birds.

Reptiles and amphibians that may be found in the watershed include tiger salamander, western toad, woodhouse's toad, sagebrush lizard, short-horned lizard, western skunk, rubber boar, racer, gopher snake, common garter snake, western garter snake and great basin rattlesnake. Springs, wetlands and riparian areas play a major role in the life history of many of these animals. Protecting springs, wetlands and riparian areas from recreational impacts and agricultural activities will have the most direct benefit to these creatures.

Nongame avian wildlife utilizing the watershed include belted kingfisher, marsh wren, raven, crow, sage thrasher, western bluebird, Fosters tern, warbler sp., red-winged blackbird, yellow headed blackbird, American goldfinch and vesper sparrow. Many of these species are migratory in nature spending the breeding season in the Silver Creek watershed. The majority are tied to riparian areas for part or all of their habitat needs. Many of the remaining riparian areas are lacking the woody component in the plant community impacting habitat potential for these species.

Riparian areas in the Silver Creek watershed are visited by many of the game and nongame species that reside or migrate through the watershed. Outside of the Silver Creek Preserve many riparian areas on Silver Creek and it's tributaries are lacking woody vegetation in the plant community. Historically these riparian areas supported a diverse plant community of herbaceous and woody vegetation. With the change of management in the watershed to an agricultural and recreational land base, riparian areas have gradually changed to a herbaceous plant community dominated by reed canarygrass and isolated woody vegetation. Practices that will emphasize diverse multi-level riparian habitat will have the most direct benefit to all terrestrial wildlife.

Fisheries

Aquatic resources in the watershed are dependent on Silver Creek and the tributaries. The major tributaries include Patton, Chaney, Mud, Wilson, Loving, Grove Creeks, and Stalker Creek. Silver Creek and the tributaries are largely spring-fed. Fish species include rainbow, brook and brown trout, mountain whitefish, longnose dace, bridgelip sucker, redside shiner, speckled dace, paiute and Wood River sculpin.

Remove Catch & Release on Browns ?

Historically, Silver Creek supported a population of redband trout as the main native fishery in the watershed. Introductions of rainbow, brook and brown trout to Silver Creek has changed the fish community structure over time. Based on recent data collected by Wilkison, density and biomass estimates of brown and rainbow trout in Silver Creek were among the highest measured in the United States for mixed salmonid fisheries. Brown trout populations in Silver Creek may have a direct impact on other fisheries in the system. The piscivorous feeding habits of brown trout, their habitat use and behavioral characteristics, gives the brown trout a competitive advantage and allows the brown trout to be less vulnerable to aerial predation and anglers. Brown trout populations are expanding in Silver Creek. Total trout density and biomass in upper Silver Creek has increased with the introduction of brown trout. Long term effects of brown trout populations on resident trout populations are not fully understood at this time and will need to be monitored in the future.

Numerical standing crops of benthic invertebrates in certain reaches of Silver Creek are among the highest recorded for the Rocky Mountain region. The species composition is dominated by a few taxa that are characteristic of streams dominated by depositional substratum and an abundance of macrophytes. It is not known if the abundance of benthic organisms in Silver Creek is a limiting factor for fish populations, but based on recent fish diversity surveys is not a likely factor. Tributaries of Silver Creek have varying biomass values for benthic organisms.

Threatened and Endangered Species

Threatened and endangered species were identified in the watershed using the Idaho Conservation Data Center's computer data base. The following list identifies threatened, endangered, candidate or species of concern in the watershed:

SPECIES	LISTING	OCCURRENCE
Bald eagle	Threatened	Wintering/nesting
Wood River sculpin	Species of Concern	Silver Creek
Mourning milkvetch	Species of Concern	Sagebrush hillsides
Pygmy rabbit	Species of Concern	Sagebrush hillsides
White-faced ibis	Species of Concern	Seasonal in watershed
Trumpeter swan	Species of Concern	Seasonal in watershed
Northern goshawk	Species of Concern	Seasonal in watershed
Ferruginous hawk	Species of Concern	Seasonal in watershed
Black tern	Species of Concern	Seasonal in watershed
Interior redband trout	Species of Concern	Watershed

The bald eagle winters along the Big Wood River from Magic Reservoir to Hailey and also includes Silver Creek. Wintering eagles utilize tall trees to roost and view the waters of Silver Creek. The abundance of fish and waterfowl in Silver Creek offers an excellent prey base for wintering bald eagles. Land development and poor land management practices that impact aquatic habitat and water quality, result in a reduced aquatic prey base and fewer roosting sites for the eagle.

An active bald eagle nest was observed on the Nature Conservancy (TNC) Silver Creek Preserve in 1996. Nesting bald eagles have been observed adjacent to the TNC Silver Creek Preserve since 1984, although hatchlings have never been produced.

The Wood River sculpin was first collected in 1893 from the Little Wood River near Shoshone. The sculpin has been collected on the TNC Silver Creek Preserve and it's tributaries. The sculpin is mainly a bottom-living fish of cold waters. Sculpins have been used as indicators of waters of high quality, i.e. high oxygen, cool temperatures, and low levels of pollution. Water diversion and poor land management practices, with the resulting degradation of the aquatic habitat and water quality, seem to be the immediate threat to this species.

Mourning milkvetch is a plant that has been observed on the sagebrush hillsides north of Picabo. This species habitat includes gravely soil. Associated species include sagebrush, sandberg bluegrass, cheatgrass and longleaf phlox. Land development and poor management on these rangeland areas has slowly reduced populations of this milkvetch.

Wetlands

The Silver Creek Watershed is unique in being spring-fed and having many wetland areas. Over 9,000 acres of soils are identified as having hydric characteristics. Hydric soils typically indicate that conditions exist that may constitute a wetland. Hydrophytic vegetation associated with the wetlands in the watershed include sedge, rush, and willow.

Many wetland areas have been impacted from past and present management and drainage. Subsurface tile, open draining, land leveling, and woody vegetation removal have been the typical conversion activities in the watershed. Riparian wetland areas, although stable in terms of sediment movement, are in many reaches lacking the woody component critical for terrestrial and aquatic resources.

Practices that will reduce impacts to wetland areas from recreational activities, livestock and cropping will positively impact wetland habitat conditions in the watershed.

Cultural Resources

Prehistoric and historic cultural resources have been identified in the watershed. Historic resources in the watershed include buildings used by early settlers in the late 1800's. Native Americans utilized the watershed because of the abundance of large and small game, fisheries and abundant plant resources.

PROBLEM IDENTIFICATION

Introduction

Silver Creek, world famous as a blue-ribbon trout stream, is being threatened on a number of fronts. The quality and quantity of water in the Silver Creek watershed is impaired from crop production, livestock grazing, rapid population growth, and recreationists are "loving it to death." The Blaine Soil Conservation District and the Nature Conservancy (TNC) have been putting major efforts into protecting the quality and quantity of Silver Creek for over 20 years.

Between 1976 and 1993 the percentage of the watershed irrigated with sprinkler systems has increased from 13% to 74% (an increase of 17,500 acres). While this Best Management Practice (BMP) decreases irrigation return flows and improves water quality, it also reduces stream flow by reducing aquifer recharge. Silver Creek stream flow is supplemented, by water which is diverted from the Big Wood River, through the irrigation canals.

Between 1976 and 1980, TNC purchased 780 acres of land within the Silver Creek Watershed. Since then, their efforts have concentrated on securing conservation easements. To date, they have easements or management agreements on 8,713 acres. The easements are designed to protect streams, habitat, and water quality on the acres they cover and are maintained annually.

Because Silver Creek is a spring fed stream arising out of the valley floors, water quality and water quantity are interrelated. The absence of high spring flows prevents the flushing that normally occurs in mountain streams. Water pollutants, mainly sediment, once in the system remain for long periods of time.

Limited water quality studies done by TNC have shown that dissolved oxygen, and high sediment loadings pose the greatest threats to the water quality of Silver Creek. However, limited data exists for the spring runoff period.

There is little doubt that the water quality of Silver Creek exceeds that of most of Idaho's streams and rivers. The objective is to maintain that quality.

Problem Statement

Earth cover changes and subsequent land use and management within the Silver Creek Watershed have affected the hydrological function of the basin resulting in detrimental effects to the instream and downstream water uses of:

- Salmonid Spawning
- Agricultural Water Supply
- Primary Contact Recreation
- Secondary Contact Recreation
- Cold Water Biota
- Wildlife Habitat
- Aesthetics

Pollutants and Sources of Pollutants:

The 1991 Idaho Water Quality Status Report lists the beneficial uses of Silver Creek as being "supported but potentially at risk". The beneficial uses of the creek are being threatened mainly by temperature, dissolved oxygen, sediment, bacteria and nutrients.

Major sources of pollutants include:

- Cropland production
- Increased recreational use
- Increased urbanization
- Pastureland
- Hydrologic/habitat modifications (including channelization, removal of riparian vegetation and streambank destabilization)
- Bridge and road maintenance

Causes of Pollution

Agricultural (including grazing lands) related nonpoint source pollution appears to be caused by:

- Loss of riparian vegetation.
- Tillage operations too close to the streambanks.
- Improper livestock grazing in riparian wetland areas and springheads.
- Lack of structural BMP's to control irrigation return flows.
- Concentrated spring runoff from rangeland.
- Conventional tillage practices which pulverize the soil surface, leaving inadequate residues.
- Sediment and nutrient loading

Additional pollution appears to be caused by:

- Improper road and bridge construction and maintenance
- Increased irrigation
- Increased recreational use.

Effects of Pollutants

The following impacts and effects have resulted from the hydrological and habitat modification that have occurred in the Silver Creek Watershed:

- Increased eutrophication
- Increased water temperature
- Decreased dissolved oxygen
- Loss of spawning gravel due to sedimentation
- Reductions in wildlife populations and species diversity due to riparian and wetland habitat loss.
- Sedimentation of the channels.

RESOURCE INVENTORY AND DATA COLLECTION

Scoping of Concerns

Based on the sponsors water quality objectives, the preliminary investigation (PI) team focused on an inventory of all major suspected point and nonpoint sources of pollution on all land uses in the Silver Creek Watershed. In addition, existing water quality monitoring and aquatic habitat quality was reviewed and summarized.

Irrigated Cropland

There are approximately 20,100 acres of irrigated cropland within the Silver Creek watershed. Two cropland treatment units were established for inventory and evaluation purposes. A treatment unit is defined as a unit of land with similar soil and water conservation problems requiring similar combinations of conservation treatment. Cropland treatment units developed for the Silver Creek Watershed are:

Treatment Unit 1: Surface irrigated 0-4% slope -5300 ac. Predominant soil type: Picabo silt loam, Hapur silt loam, Bruneel loam and Little Wood gravely loam.

Treatment Unit 2: Sprinkler irrigated 0-4% slope 14,800 ac. Predominate soil type: Little Wood gravely loam, Picabo silt loam and Bruneel loam.

Current Conditions:

The typical crop rotation in the watershed consists of a barley/alfalfa rotation. Some fields have been cropped with barley continuously for over 20 years. In recent years, increased acreages of potatoes and canola have been raised within the watershed. There are no Conservation Reserve Program (CRP) contracts within the watershed. Approximately 1 percent (200 acres) of the total cropland acres are classified as Highly Erodible Land (HEL) under the 1995 Food Security Act (FSA). Within the watershed, it is estimated that 80% of the landowner/operations are participating in USDA programs.

Pastureland

There are approximately 14,000 acres of irrigated pastureland and 1,000 acres of non-irrigated pastureland within the watershed. Two pastureland treatment units were established for inventory and evaluation purposes: Pastureland treatment units developed for the watershed include:

Treatment Unit 3: Irrigated Pastureland 0-4% slope 14,000 ac. Predominant Soil Types: Little Wood gravely loam, Picabo silt loam, Bruneel loam and Hapur silt loam.

Treatment Unit 4: Non-irrigated pastureland 0-4% slope 1,000 ac. Predominant Soil Types; Picabo silt loam, Bruneel loam and Hapur silt loam.

The majority of the irrigated pastureland in the Silver Creek watershed is in fair to poor condition with a stable to downward trend. The species composition is mostly bluegrass or tall fescue with a clover component.

The non-irrigated pasture is mostly native vegetation and is also in fair to poor condition. The trend is stable to downward.

The grazing system is season long. It is a common practice to feed hay to livestock on these pastures during the winter months.

Riparian

There are approximately 65 miles of streams within the Silver Creek Watershed. Assuming a riparian area 50 feet wide on each side of the streams, the watershed has 800 acres of riparian area.

The riparian areas within the Silver Creek Watershed are highly variable, depending principally upon stream channel morphology, water table elevation, streambank soil texture, and land use activities. Using Rosgin's Classification of Natural Rivers, however, two stream types predominate.

The upper two-thirds of the Silver Creek system, from its origin as spring-fed tributaries to where it enters the lava flow region just southeast of Picabo, is almost entirely a Rosgen "C" stream type. They are characterized by a low gradient channel which meanders across a broad floodplain. These streams form in alluvial valleys and develop a riffle-pool morphology with point bars and corresponding cut-banks or undercut banks. Riparian zones are typically wide. In this channel type, a vigorous riparian plant community is important for protecting streambanks against erosion and for trapping sediment. These streams are vulnerable to damage caused by improper land use activities, such as livestock overgrazing of riparian vegetation and farming activities which encroach into the riparian corridor.

The lower one-third of Silver Creek, from where it enters the lava flow just southeast of Picabo to the confluence with the Little Wood River, is a combination of a Rosgen "A" stream type and a "C" type. The "A" channels are characterized by a confined channel with a steep gradient. They develop a step-pool morphology and a relatively narrow riparian zone lined with shrubs capable of withstanding the high flow velocities. Even though the riparian areas along these rock-armored streams play only a small role in stabilizing the stream channel, they none the less provide critical habitat for many terrestrial and aquatic animals. Unlike Rosgen C stream types, Rosgen A types are much more resistant to degradation by improper land use activities.

Treatment Unit 5: Riparian zone 800 acres; predominate soil types: Bickett mucky peat, Hapur silt loam and Balaam-Adamson - Riverwash complex.

Current Conditions:

Despite a wealth of inventory data on fish in the Silver Creek system, almost no data exists on riparian vegetation. Furthermore, the fisheries population surveys were linked to channel substrate or aquatic plants and weakly linked to riparian cover.

In May of 1996, a reconnaissance level riparian inventory was completed using 1984 color infrared aerial photographs. All perennial streams and their tributaries within the Silver Creek watershed shown on 7 ½ minute topographic quadrangle maps were measured with a planimeter. Using ocular estimates, stream segments with less than 50 percent riparian shrub cover (percent streambank canopy cover) were considered inadequate while stream segments with more than 50 percent riparian shrub cover were considered adequate. Since the actual presettlement riparian shrub cover may never be known, a conservative 50 percent cutoff value was selected.

Of the 40 miles of tributary streams that form Silver Creek, only 33% (approximately 13 miles) were found to have adequate riparian shrub cover. Only 14% of the main Silver Creek channel (3.5 miles out of 25 miles) has adequate riparian shrub cover.

The results of the ocular riparian inventory clearly indicate a large deficiency in riparian shrub cover, when compared to other streams of similar geomorphology, climate, and water regime. Some local landowners, however, feel that there were never very many willows or other woody riparian plants along streams in the Silver Creek watershed. While this is possible, it is unlikely. The loss of riparian shrubs was probably a rapid event that culminated shortly after the first homesteaders and beaver trappers arrived in the area in the late 1800's and early 1900's. To these early pioneers, woody riparian plants were undesirable, so their decline was not only acceptable but preferred. Today, however, the increasing recognition of the importance of healthy riparian vegetation is slowly replacing many of these traditional views, largely through demonstrations and increased public awareness.

Rangeland

Of the 28,200 acres of rangeland within the Silver Creek Watershed, 20,660 acres (73%) is public land administered by the Bureau of Land Management (BLM). This rangeland forms the east and south boundaries of the watershed. It is composed primarily of a sagebrush and bunchgrass community. Limited acreage of the rangeland has been reseeded, to introduced varieties of grass.

Treatment Unit 6: Rangeland: 2- 75% slope. 28,200 ac. Predominate soil type: Povey gravelly loam, Milligan very cobbly loam, Elksel very cobbly loam, Friedman cobbly loam and Starhope very cobbly loam.

Current Conditions:

The rangeland within the Silver Creek Watershed is generally in fair to good condition. Most of the rangeland is managed by the BLM as part of a larger allotment. Although the rangeland is relatively steep, soil erosion rates are generally less than 1 ton per acre per year.

Small areas are experiencing higher erosion rates with the resulting sedimentation reaching Silver Creek in the spring runoff. Drinking water for livestock is provided by developed springs within each allotment.

Economic Evaluation

Silver Creek has many important economic benefits to the greater Wood River Valley. This evaluation does not look at Silver Creek as a whole, but rather at the economic impacts as they relate to the 825 acre preserve operated by the Nature Conservancy. It should be looked at as an indicator of value of the Silver Creek resource and the importance of maintaining and improving the resource.

The value of the Silver Creek Preserve as outlined here is for such items as travel, food and beverage, accommodations, sporting equipment, guides, and other retail, and is the amount spent by visitors to the area. The value of the environmental qualities are not included.

Annual visitor days to the Silver Creek Preserve have grown from approximately 1,000 in 1975, the year the preserve was established, to 9,318 in 1995. Recreational uses from 1993 survey information consist of fishing, bird watching, hiking, and boating.

The total estimated dollar expenditure at the Preserve for the 1995 fishing season is estimated at:

Silver Creek Preserve User			
Use Category	Local Resident	Rest of State	Out of State
Destination Fishermen			$706,100
Primary Destination		$98,400	1,034,500
General Recreation		40,100	2,011,500
Non-Recreation		89,100	534,200
Other	$58,400		
Totals	$58,400	$227,600	$4,286,300
Grand Totals			$4,572,300

The Silver Creek Preserve is located in an area with a variety of recreational activities. The total expenditures by visitors should be kept in perspective with these other activities. The $4,572,300 should not be considered specific to the Preserve. Expenditures under all categories spill over into the greater Wood River Valley.

POTENTIAL ALTERNATIVE SOLUTIONS

Formulation Process

Alternative formulation followed the inventory and evaluation of known and suspected point and nonpoint sources of pollution in the Silver Creek Watershed.

Formulation proceeded with an analysis and selection of alternatives designed to protect and enhance the beneficial uses within the Silver Creek Watershed.

Potential Alternatives

The P.I. team listed the following alternatives to achieve the sponsors objectives:

1. Land Treatment
2. Easements
3. Aquifer Recharge
4. Protection
5. Land Use
6. Improved Irrigation Diversions
7. Information and Education Programs
8. Coordination
9. Regulations
10. Dredging

Discussion of Alternatives

1. Land Treatment:

   Best management practices applied to the land would improve and protect the beneficial uses. Efforts should center on controlling and treating irrigation return flows and spring runoff from cropland, pastureland, and rangeland and reestablishing woody vegetation along the streams.

2. Easements:

   Currently, The Nature Conservancy (TNC) has entered into conservation easements or management agreements with private landowners on 8,713 acres within the watershed. The majority of these easements and agreements are along Silver Creek and not the tributaries. Although this effort should continue, TNC should include the tributaries, since these areas are critical for salmonid spawning and rearing and directly influence the quality and quantity of water entering Silver Creek. The Blaine SCD could act as a catalyst between the landowners and TNC. Other easements such as the Wetland Reserve Program and USF&WS easements are available.

3. Aquifer Recharge

The conversion of surface irrigated cropland to sprinkler irrigated cropland and the increased use of irrigation wells within the watershed has decreased flow into Silver Creek. In 1976, a total of 142,580 acre-feet of irrigation water was diverted from the Big Wood River. This number decreased to 92,240 acre feet by 1993. As a result, the spring flows feeding Silver Creek have decreased to 89,700 acre feet in 1993 as compared to 124,330 acre feet in 1976. If the existing canal system, recharge ponds and the natural channel of the Big Wood River were utilized for a longer time period during the year, the flow in Silver Creek would increase. In 1997 the second phase of the Big Wood River, Silver Creek aquifer study will be conducted by the University of Idaho for TNC. The study will provide recommendations relating to aquifer recharge activities.

4. Protection

The Federal Clean Water Act provides for states to designate "Outstanding Resource Waters". Such a designation is primarily to protect existing water quality by not allowing the water quality to degrade below the current level. With the proper local support, Silver Creek could be designated as an Outstanding Resource Water.

5. Land-Use

Blaine County has a riparian protection ordinance, stream channel alteration ordinance, and a land use plan. These local laws are being used to help protect the beneficial uses of Silver Creek.

As older bridges on Silver Creek and the tributaries need replacing, the county is using culverts instead of bridges. Culverts have the potential to restrict fish passage and add to streambank erosion if not properly designed and installed.

County property tax incentives could help keep the land in agricultural use.

6. Improved Irrigation Diversions

Irrigation water is currently diverted from Silver Creek or its tributaries at several locations. The diversion structures back up water and creates a pond. The irrigation ditches are not screened from fish passage. Likewise, the diversion can act as a barrier to fish passage during certain times of the year.

The ponds behind the diversion dams have acted as sediment traps resulting in muddy stream channel bottoms and vegetative growth. Improved diversions would improve the flow through Silver Creek, and assist with flushing the sediment.

7. Information and Education

The Blaine Soil Conservation District, and The Nature Conservancy both publish newsletters that contain water quality information. Likewise the USDA Natural Resources Conservation Service has an ongoing information and education program.

Efforts could be coordinated to educate the landowners of the benefits of improving the water quality in Silver Creek.

8. Coordination

   Several Federal, State and local government programs and efforts exist to protect Silver Creek. Likewise, private groups, organizations and individuals are involved in protecting the watershed.

   However, coordination among these parties is limited. The Blaine SCD, The Nature Conservancy or both together could coordinate water quality efforts to improve efficiency of efforts. A Watershed Advisory Group (WAG) could also serve that purpose.

9. Idaho Department of Fish and Game Regulations

   The current population of rainbow trout has the potential of being threatened by the introduction of brown trout. The piscivorous feeding habits of the brown trout on rainbow trout and their habitat use and behavioral characteristics give them a competitive advantage and make them less vulnerable to aerial predation and anglers. Brown trout populations are expanding in Silver Creek. A different bag limit or regulation for brown trout may need future evaluation.

10. Dredging

    Limited dredging in the past few years has removed sediment and improved the amount of spawning gravels on the stream channel bed. Additional dredging would improve spawning and rearing success.

POTENTIAL SOURCES OF FUNDING

The following are potential sources of technical and financial assistance for planning and implementation which the Blaine SCD would be eligible to pursue in addressing the identified problems associated with the Silver Creek Watershed. Some of these sources are programs which deal with individuals, while others are oriented towards working with groups of individuals on a project action basis.

NRCS Assistance to Conservation Districts - Public Law 46

Under the authorities of this program, the USDA Natural Resources Conservation Service, through local Soil Conservation Districts, assists both individuals and groups in the planning and application of needed soil and water conservation practices on private land. The amount and timing of this technical assistance is determined and prioritized by the local NRCS Field Office and Soil Conservation District. This assistance is typically referred to as the Conservation Operation Program.

Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP), established by the 1996 Farm Bill, combines the functions of the Agricultural Conservation Program, Water Quality Incentives Program, Great Plains Conservation Program, and the Colorado River Basin Salinity Control Program. The NRCS is the lead agency to implement EQIP. The EQIP program establishes conservation priority areas where significant water, soil, and related natural resources problems exist, in cooperation with state and federal agencies and with the State Technical Committee. EQIP gives higher priority to areas where state or local governments offer financial or technical assistance or where agricultural improvements will help meet water quality objectives.

EQIP will provide program delivery with 5 to 10 - year contracts for technical assistance and 75 percent cost-share of conservation practices for the treatment of resource problems for all agricultural land uses, riparian areas, and water quality improvements. EQIP requires activities under a contract to be carried out according to a conservation plan. Land eligible for EQIP includes agricultural land that poses a serious problem to soil, water, or related resources. The program limits total cost-share and incentive payments to any person $10,000 annually, and to $50,000 for the life of the contract.

Conservation of Private Grazing Land (GLCI)

The 1996 Farm Bill established a grazing lands provision to ensure technical, educational, and related assistance is provided to landowners on the nation's 642 million acres of private grazing lands. NRCS is the lead agency to implement the GLCI.

Wildlife Habitat Incentives Program

This provision of the 1996 Farm Bill will provide technical assistance to landowners to improve wildlife habitat on private lands. The program will provide cost-sharing to landowners for developing habitat for upland wildlife, wetland wildlife, endangered species, fisheries and other wildlife. The NRCS is the lead agency to implement the program and will consult with the State Technical Committee to set priorities for cost-share measures and habitat development projects.

The Wetlands Reserve Program and Conservation Reserve Program

The WRP and CRP provide landowners with options for protecting wetlands and highly erodible lands. In the Wetlands Reserve Program, landowners can choose either permanent or 30-year easements or restoration only cost-share agreements. The NRCS is the lead agency for this program. The CRP protects highly erodible and environmentally sensitive lands with grass, trees and other long-term cover. New enrollments can replace expired or terminated contracts as well as new acreages. The Farm Service Agency (FSA) is the lead agency for the CRP.

Resource Conservation and Rangeland Development Program

This program is administered by the Idaho Soil Conservation Commission. It provides long-term low-interest loans to farmers and ranchers for conservation improvements. Eligible purposes include the installation of permanent conservation practices for the treatment of all land uses, riparian protection and water quality improvements. Small grants up to $10,000 are also available for range or riparian demonstration projects.

Watershed Protection and Flood Prevention Act - Public Law 83-566

The PL 566 program, administered by the NRCS, provides both technical and financial assistance for the protection of watershed areas through the establishment of land treatment measures to reduce off-site damages which degrade surface and ground water quality, impair fish and wildlife, especially threatened and endangered species, and degrade municipal works of improvement. Cost-share rates vary from 50 - 75 percent.

Idaho Agricultural Water Quality Program (SAWQP)

The Idaho Agricultural Water Quality Program provides technical and financial assistance to landowners and operators having control of agricultural lands designated as critical areas in approved project areas. The program is administered by the Idaho Department of Health and Welfare - Division of Environmental Quality and the Idaho Soil Conservation Commission. Grants made to selected Soil Conservation Districts provide funding for technical assistance, information activities, project administration and cost-sharing for installation of BMPs.

Resource Conservation and Development (RC&D)

Blaine County is located within the boundaries of the Wood River RC&D area. Technical assistance to identify and secure potential funding sources to treat the identified problems is available through the Wood River RC&D.

Habitat Improvement Program (HIP)

This program, administered by the Idaho Department of Fish and Game (IDFG), provides cost-sharing, primarily to landowners, for the development and improvement of wildlife habitat for both upland game birds and waterfowl.

Idaho Department of Water Resources (IDWR)

IDWR authorizes the state to make loans and/or grants to legal entities of government for water resource projects which are in the public interest.

Revolving Development Fund:

* Activities must be all construction related
* This is a loan program
  - Rate is 5%
  - $500,000 maximum amount of loan
  - 10-15 year payback period
  - Applicant must be local unit of government, irrigation company, SCD, Water User's Association

Water Management Loan/Grant Program:

* Can provide either loans or grants
* Must be water quality driven
* Maximum amount = $50,000
  IDWR likes amounts between $5,000 and $10,000
* Can be used to procure preliminary engineering studies
* Also construction projects

US Fish and Wildlife Service (USFWS) Partners Program

This program, administered by the USFWS, provides cost-share incentives to landowners for the restoration and protection of wetland and riparian habitats.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The 1991 Idaho Water Quality Status Report and Non-Point assessment listed the following designated beneficial uses as "supported but potentially at risk: 1) cold water biota, 2) salmonid spawning, 3) primary contact recreation, and 4) secondary contact recreation. The primary source of pollutants are identified as agricultural crop production and grazing.

It was the conclusion of the PI team that certain land use and management within the Silver Creek Watershed is threatening the beneficial uses of Silver Creek.

Attention needs to be focused on the following alternatives to provide water quality benefits within the watershed: 1) Land treatment, 2) easements, 3) aquifer recharge, 4) designation as an outstanding resource water, 5) land use, 6) improved irrigation diversions, 7) an information and education program, 8) coordination between programs, and 10) dredging.

It should be noted that the PI team recognizes that no single alternatives or practice can accomplish the sponsors objectives. A combination of alternatives must be explored to allow for water quality improvement in the Silver Creek Watershed.

It was the consensus of the PI team that a total watershed approach must be utilized to treat all major point and nonpoint sources of pollution. Emphasis must be placed on all major contributors, if water quality improvements are to be realized.

Recommendations

The cost of alternative solutions were not developed for the purpose of this PI.

It should also be noted that the physical, social and environmental impacts and effects associated with the various alternatives were not developed during this PI. Future planning activities dealing with water quality improvements, could be provided through the NRCS, Conservation Operations (CO-01) and Resource Conservation and Development (RC&D) programs.
The PI team recognized and used the numerous water quality studies developed for Silver Creek. However, many of the studies sampled water quality only in the summer months. There is a need for intense chemical analysis during the spring runoff period. The timing of the event could vary by as much as 2-3 months.

There is also a need to do a bio-assessment of the watershed. The PI team recommends that these gaps in the monitoring of Silver Creek water quality and condition be filled. The Nature Conservancy should be commended for their leadership in monitoring the watershed conditions. It is recommended that the IDH&W, Division of Environmental Quality (DEQ) use the Beneficial Use Reconnaissance Process (BURP) to collect some of this needed data.

The PI team recommends that any Watershed Advisory Group (WAG) established in the Wood River basin include the Silver Creek Watershed. It is recommended that because of limited funds and the fact that Silver Creek is not listed as a water quality limited stream segment on the 303-(d) list that the Blaine SCD not pursue a SAWQP planning grant at this time. However, the results of the recommended monitoring could change the priority for SAWQP funding.

It is further recommended that the Nature Conservancy and the Blaine SCD work together to coordinate easement and other water quality efforts within the watershed.

APPENDIX A

INVESTIGATION AND ANALYSIS

ORP (redox for lakes STAGNANT zone

Conductance - measures salinity NOT a whole lot's close PK

TDS → → Productive water

N → stim plant growth
organic matter (most finest form) Source Energy Carbon

use O_2

Nitrogen → Ammonia Nitra
↳ NH_3 gas
NH_4 liquid / solid
measure both in water
inorganic form Nitrate
Ammonia
Ammonium

www2.state.ID.us/DEQ

INVESTIGATION AND ANALYSIS REPORT

WATER QUALITY

By: Jim Wood, Water Quality Specialist, USDA-NRCS, Boise SO

Current designated uses for Silver Creek from source to mouth (PNRS # 518, Stalker Creek to Kilpatrick Bridge; and PNRS # 517, Kilpatrick Bridge to Little Wood River) as listed in the Idaho water quality standards include Domestic Water Supply, Agricultural Water Supply, Cold Water Biota, Salmonid Spawning, Primary and Secondary Contact Recreation, Wildlife Habitat and Aesthetics (IDHW-DEQ, 1992a). Based on several published reports, it is apparent that there is some inconsistency in the designated uses and the status of these uses. The status of the designated uses of Silver Creek and the designated uses and status of several tributaries to Silver Creek are as follows:

Silver Creek (PNRS # 517, Kilpatrick Bridge to Little Wood River) (IDHW-DEQ, 1989)

Cold Water Biota (Supported but "potentially at risk")
Salmonid Spawning (Supported but "potentially at risk")
Primary Contact Recreation (Supported but "potentially at risk")
Secondary Contact Recreation (Supported but "potentially at risk")
Wildlife Habitat (Not Evaluated)
Aesthetics (Not Evaluated)

Silver Creek (PNRS # 517, Kilpatrick Bridge to Little Wood River) (IDHW-DEQ, 1992b)

Cold Water Biota (Partial Support)
Salmonid Spawning (Partial Support)
Wildlife Habitat (Not Evaluated)
Aesthetics (Not Evaluated)

Stalker Creek (PNRS # 520, Headwaters to Mouth) (IDHW-DEQ, 1992b)

Agricultural Water Supply (Supporting)
Cold Water Biota (Support but Threatened))
Salmonid Spawning (Support but Threatened)
Primary Contact Recreation (Partial Support)
Secondary Contact Recreation (Support but Threatened)
Wildlife Habitat (Not Evaluated)
Aesthetics (Not Evaluated)

Grove Creek (PNRS # 520.01, Headwaters to Mouth) (IDHW-DEQ, 1992b)

Agricultural Water Supply (Supporting)
Cold Water Biota (Support but Threatened))
Salmonid Spawning (Support but Threatened)
Primary Contact Recreation (Partial Support)
Secondary Contact Recreation (Support but Threatened)
Wildlife Habitat (Not Evaluated)
Aesthetics (Not Evaluated)

Loving Creek (PNRS # 519, Headwaters to Mouth)

Not Evaluated

Silver Creek (from source to mouth) was designated as a Stream Segment of Concern in 1990 and again in 1992 (WQWAC, 1990 and 1993). Silver Creek (from source to mouth) is also designated as a special resource water (IDHW-DEQ, 1992a). Special resource water recognizes at least one of the following characteristics:

a. The water is of outstanding high quality, exceeding both criteria for primary contact recreation and cold water biota;

b. The water is of unique ecological significance;

c. The water possesses outstanding recreational or aesthetic qualities;

d. Intensive protection of the quality of the water is in the paramount interest of the people of Idaho;

e. The water is part of the National Wild and Scenic River System, is within a State or National Park or wildlife refuge and is of prime or major importance to that park or refuge;

f. Intensive protection of the quality of the water is necessary to maintain an existing, but jeopardized beneficial use.

In addition, point source discharges to special resource waters and their tributaries shall be restricted such that "no new point source can discharge pollutants, and no existing point sources can increase its discharge of pollutants above the design capacity of its facility, to any water designated as a special resource water or to a tributary of, or to the upstream segment of a special resource water: if such pollutants significant to the designated uses can or will result in a reduction of the ambient water quality of the receiving special resource water as measured immediately below the applicable mixing zone".

Water quality within the Silver Creek Watershed is currently being impacted to varying degrees by irrigated and non-irrigated cropland, rangeland, animal holding/feeding areas, road construction and maintenance, riparian management, flow modification, channelization, recreation and rural/urban development.

Numerous studies have been conducted on and around Silver Creek. Data collected on water quality includes Idaho Department of Water Administration, 1972; USGS data (1974-1994, no formal report specific to Silver Creek); IDHW-DOE data (1975 and 1976, no formal report specific to Silver Creek); Silver Creek Preserve Stream Quality Monitoring Summary 1991-1995 (Nature Conservancy), Manuel-Faler et. al., 1982; and IDWA, 1972;. The following discussion of water quality conditions is based on data that has been collected as described above.

Ammonium - liquid - NH_4^+
Ammonia - gas NH_3 (un-ionized) → an intermediate breakdown product
Nitrate NO_3^- (ionized) → most common in unpolluted waters
Nitrite NO_2^-

Sediment

Suspended sediment concentrations were generally low and were all found to be well below the maximum level of 100 mg/L recommended for moderate protection of cold water biota (Lloyd, 1987). From data collected by DEQ, suspended solids in Silver Creek at four locations and several tributaries ranged from 9-46 mg/L (average of 20.25 mg/L, n=12) and 2-31 mg/L (mean of 13.0 mg/L, n=13), respectively. From USGS data, suspended sediment in Silver Creek at the Sportsman's Access ranged from 1-76 mg/L (average of 13.9 mg/L, n=8). Although Silver Creek is primarily ground water fed and does not experience large flows necessary for flushing accumulated sediments downstream, suspended sediment concentrations are highest during peak runoff events following snow-melt, rain on snow or rain on frozen soil.

Turbidity measurements were also collected and continue to be collected by the Nature Conservancy. Since turbidity is closely correlated with suspended solids, turbidity was likewise low. Turbidity measurements for Silver Creek at various locations averaged less than 5 NTU's (Nature Conservancy, 1995; USGS and DEQ, unpublished data). The ability of salmonids to sight feed is adversely affected by elevated turbidity and reduced growth rates occurs at levels near 25 NTU (Sigler et. al., 1984). Recommended maximum turbidity levels or standards for the most part do not exist. For protection of freshwater fish and other aquatic life the general criteria is that the depth of the photosynthetic compensation point should not be reduced by more than 10 % from the seasonally established norm for aquatic life (EPA, 1986). Since seasonally established norms typically do not exist, this criteria is difficult to evaluate.

Based on the previous discussion direct impacts of sediment and suspended solids within the water column are for the most part quite small. However, the most significant water quality impact in Silver Creek and its tributaries is likely from sediment and other suspended solids. Effects of sediment in the Silver Creek stream system are most pronounced as indirect impacts to the bottom substrate. Sediment and other materials which sink to the bottom adversely impact invertebrate populations, become embedded in and cover spawning gravels, cover deposited eggs and depending on the organic composition remove dissolved oxygen from within the water column. Although this is important in Silver Creek, it is especially important in the tributaries to Silver Creek where the majority of salmonid spawning occurs.

The most important sources of sediment include exposed streambanks, adjacent riparian areas in poor condition and newly tilled cropland or cropland with sparse cover directly adjacent to streams.

Nitrogen

Nitrogen can occur as dissolved and particulate, and each can be further separated into inorganic nitrogen (ammonium NH_4^+, un-ionized ammonia - NH_3, nitrate - NO_3^-, and nitrite - NO_2^-) and organic nitrogen (total kjeldahl nitrogen less total ammonia).

In aquatic ecosystems nitrates (NO_3^-) are the most common form of nitrogen, especially in un-polluted waters. Un-ionized ammonia, which is an intermediate breakdown product of organic nitrogen, fertilizers and animal waste, may also be present. Inorganic forms of nitrogen are immediately available for biotic uptake and consequently directly influence primary production in aquatic ecosystems.

Ammonia (NH_3) can be acutely toxic to some aquatic invertebrates and fish at concentrations (un-corrected for pH or temperature) of 0.08 mg/L (EPA, 1986). For salmonids, reported LC50 ranged from 0.083 to 1.09 mg/L and for non-salmonids from 0.14 to 4.60 mg/L. Ammonia concentrations were not measured above 0.08 mg/L (USGS, unpublished data and Nature Conservancy, 1995)

Nitrate (NO_3^-) and nitrite (NO_2^-) nitrogen concentrations considered to be toxic in aquatic ecosystems are rarely found in nature (96-hour LC50 of 1310 mg/L NO_3-N in fresh water Chinook salmon), and restrictive criteria are not recommended. Nitrate nitrogen, however, is readily utilized by aquatic biota and most non-toxic effects occur as potential increases in primary production towards eutrophication. Cline (1973) reported that a nitrate concentration of <0.3 mg/L would probably prevent eutrophication. A total inorganic nitrogen concentration of 0.3 mg/L is considered to be the limit for preventing the development of biological nuisances and accelerated eutrophication.

During 1954 ground water nitrate nitrogen concentrations near Silver Creek ranged from 0.07 to 1.4 mg/L (average of 0.60 mg/L, n=15) (IDWA, 1972). During 1976 through 1990 nitrate nitrogen concentrations in Silver Creek at the sportsman's access ranged from 0.3 to 1.7 mg/L (average of 0.68 mg/L, n=18); from 1992 through 1993 nitrate nitrogen concentrations at the same location ranged from 0.6 to 0.86 mg/L (average of 0.75 mg/L, n=3): and ground water nitrate nitrogen concentrations near Silver Creek from 1991 through 1994 ranged from 0.28 to 2.2 mg/L (average of 0.97 mg/L, n=5) (USGS, unpublished data). From February 1975 through February 1976 nitrate nitrogen concentrations at various locations in Silver Creek ranged from 0.25 to 0.78 mg/L (average of 0.43 mg/L, n=39); likewise for the same time period nitrate nitrogen concentrations in several tributaries to Silver Creek collected twice during May and October ranged from 0.39 to 0.78 mg/L (average of 0.55 mg/L, n=20) (IDHW-DOE, unpublished data). Nitrate nitrogen concentrations measured below the "S-turns" from July 1993 to July 1995 ranged from 0.62 to 1.14 mg/L (average of 0.85 mg/L, n=8) (Nature Conservancy, 1995).

Generally nitrate nitrogen concentrations were found above 0.3 mg/L. However, nitrate nitrogen concentrations in Silver Creek are a direct result of ground water discharge and therefore reflect ground water concentrations.

Potential sources of nitrogen include ground water, sediment attached nitrogen, animal waste directly adjacent to the stream or nitrogen transported via overland flow to the stream (livestock and wildlife), septic tanks, as well as cropland areas where deep percolation and corresponding leaching of nitrates occur.

Phosphorus

Typically phosphorus is the limiting nutrient in most aquatic systems. Soluble phosphorus is most readily available for plant growth and therefore has the greatest potential to impact water quality. Soluble phosphorus represents the link between phosphorus in soil and phosphorus in water. The predominant trend in the phosphorus cycle is for more active forms (dissolved soluble and plant available - essentially orthophosphates) to be converted to more stable forms (particulate, typically attached to soil particles). Generally, only orthophosphates are available for biotic uptake. In water, orthophosphates as well as other phosphate ions which are not organically bound, are readily assimilated by aquatic plants and microorganisms or bonded chemically to sediments. Because of this, phosphate concentrations tend to be small and erratic. Consequently, water quality objectives for phosphorus are set at extremely low levels.

Orthophosphate phosphorus concentrations during 1976 through 1990 in Silver Creek at the sportsman's access ranged from <0.01 to 0.03 mg/L (average of 0.015 mg/L, n=6); from 1992 through 1993 orthophosphate phosphorus concentrations at the same location ranged from <0.1 to 0.02 mg/L (average of 0.013 mg/L, n=6): and ground water orthophosphate phosphorus concentrations near Silver Creek from 1991 through 1994 ranged from <0.01 to 0.07 mg/L (average of 0.03 mg/L, n=5) (USGS, unpublished data). From February 1975 through February 1976 orthophosphate phosphorus concentrations at various locations in Silver Creek ranged from <0.01 to 0.31 mg/L (average of 0.04 mg/L, n=39); likewise for the same time period orthophosphate phosphorus concentrations in several tributaries to Silver Creek collected twice during May and October ranged from 0.01 to 0.11 mg/L (average of 0.03 mg/L, n=20) (IDHW-DOE, unpublished data). Orthophosphate phosphorus concentrations measured below the "S-turns" from July 1993 to July 1995 ranged from <0.05 to 0.01 mg/L (average of <0.05 mg/L, n=7) (Nature Conservancy, 1995).

Orthophosphate phosphorus concentrations were typically found below the concentration of 0.1 mg/L total phosphate phosphorus which is recommended to prevent accelerated eutrophication for streams that do not enter directly into lakes or reservoirs (EPA, 1986). In addition, orthophosphate phosphorus concentrations in Silver Creek are a direct result of ground water discharge and therefore reflect ground water concentrations.

Potential sources of phosphorus include ground water, sediment attached phosphorus, animal waste directly adjacent to the stream or nutrients transported via overland flow to the stream (livestock and wildlife), septic tanks, exposed streambanks, adjacent riparian areas in poor condition, as well as newly tilled cropland areas directly adjacent to streams.

Pathogens

Fecal coliform bacteria reside in the intestines of warm blooded animals, including humans, and are the most commonly tested bacteria used as indicators of organic pollution. The presence of fecal coliform bacteria does not necessarily confirm pollution from pathogens, but indicates pollution from animal sources and a potential health hazard. When average concentrations of fecal coliform bacteria are found below the water quality standard, it is assumed that the water is safe for that beneficial use and pathogens do not likely represent a significant threat to human health (APHA, 1989).

During 1989 through 1993 fecal coliform counts in Silver Creek at the sportsman's access ranged from <1 to 130 counts/100 ml (average of 8 counts/100 ml, n=12) (USGS, unpublished data). From February 1975 through February 1976 fecal coliform counts at various locations in Silver Creek ranged from <2 to 580 counts/100 ml (average of 70 counts/100 ml, n=36); likewise for the same time period fecal coliform counts in several tributaries to Silver Creek collected twice during May and October ranged from 2 to 500 counts/100 ml (average of 105 counts/100 ml, n=20) (IDHW-DOE, unpublished data).

Generally fecal coliform counts were found below the Idaho water quality standard of 500 counts/100 ml and 800 counts/100 ml for primary and secondary contact recreation, respectively. Only samples collected during October 1975 in Silver Creek (580 counts/100 ml) and in the Buhler Drain (500 counts/100 ml) were above the standard for primary contact recreation. No samples were found above the secondary contact recreation standard.

Sources of fecal coliform contamination include animals directly adjacent to the stream or pathogens transported via overland flow to the stream (livestock and wildlife), and to a small extent faulty septic tanks and potential recreational activity (human).

Temperature

Water temperature is a critical factor effecting any stream ecosystem. It is the net result of an assortment of energy transfer processes. Typically elevated temperatures are limiting to the beneficial uses of cold water biota and salmonid spawning.

During 1974 through 1994 water temperatures in Silver Creek at the sportsman's access ranged from -1.0 to 21.5 ^{o}C (average of 9.3 ^{o}C, n=170) (USGS, unpublished data). From February 1975 through February 1976 water temperatures at various locations in Silver Creek ranged from 3.0 to 20.0 ^{o}C (average of 9.3 ^{o}C, n=39); likewise for the same time period water temperatures in several tributaries to Silver Creek collected during May and October ranged from 5.0 to 9.0 ^{o}C (average of 7.6 ^{o}C, n=20) (IDHW-DOE, unpublished data). Water temperatures measured in Silver Creek and tributaries to Silver Creek monthly from June 1991 to September 1994 ranged from 0.0 to 21.6 ^{o}C (Nature Conservancy, 1995). Additional data collected by the Nature Conservancy during the extreme summer of 1994 (June 29 - July 13) measured Silver Creek water temperatures in the afternoon (pm) from 14.4 to 23.3 ^{o}C at the visitors center and from 18.3 to 25.6 ^{o}C at the Picabo Bridge.

Stream water temperatures were generally found below the Idaho Water Quality Standard of <22 ^{o}C for cold water biota. Stream temperatures, however, were occasionally found above the Idaho Water Quality Standard of <13 ^{o}C necessary to support salmonid spawning during periods of spawning and incubation (April through June). Fortunately June was the only month where water temperatures exceeded 13 ^{o}C. Although spawning and incubation vary slightly from year to year, the majority of spawning and incubation is typically completed by the end of May. As indicated by the data collected by the Nature Conservancy during 1994, water temperatures are very much dependent on climatic variations and during extreme years water temperatures may also reach extremes.

The most important factor influencing stream temperatures is the amount of riparian vegetation providing stream shading, especially in the tributaries to Silver Creek. Additional factors influencing stream temperature include low flow conditions, stream morphology (shallow and wide versus deep and narrow), and warmer irrigation return flows.

Dissolved Oxygen

Adequate dissolved oxygen (DO) concentrations are critical for respiration of cold water biota and salmonids, as well as to the breakdown of organic debris. Water quality standards for Idaho have established DO concentrations > 6 mg/L for cold water biota and salmonid spawning (IDHW-DEQ, 1992b).

Dissolved oxygen concentrations during 1989 through 1994 in Silver Creek at the sportsman's access ranged from 7.8 to 13.2 mg/L (average of 10.4 mg/L, n=13) (USGS, unpublished data). From February 1975 through February 1976 dissolved oxygen concentrations at various locations in Silver Creek ranged from 7.6 to 12.1 mg/L (average of 10.1 mg/L, n=39); likewise for the same time period dissolved oxygen concentrations in several tributaries to Silver Creek collected twice during May and October ranged from 8.0 to 12.4 mg/L (average of 9.7 mg/L, n=20) (IDHW-DOE, unpublished data). Dissolved oxygen concentration measured in Silver Creek and tributaries to Silver Creek monthly from June 1991 to September 1994 ranged from 3.9 to 15.0 mg/L (Nature Conservancy, 1995). Additional data collected by the Nature Conservancy during the extreme summer of 1994 (June 29 - July 13) measured Silver Creek dissolved oxygen concentrations in the morning (am) from 5.1 to 6.6 mg/L at the visitors center and from 4.6 to 6.3 mg/L at the Picabo Bridge.

Since dissolved oxygen saturation is inversely proportional to temperature, the lowest DO concentrations were found in the summer during periods of elevated stream temperatures. Dissolved oxygen is also influenced by the amount of respiration and biochemical oxygen demand (BOD) of substances in the water. Photosynthesis in excess of respiration is a source of oxygen during the day, but at night when photosynthesis ceases respiration continues causing the lowest DO concentrations sometime just after day break. Although the water column is relatively free of excess substances causing a high BOD, the bottom substrate, especially in Silver Creek, is rich with sediments likely having a high BOD. During summer periods when water temperatures reach their maximum, DO concentrations in water at saturation are lowest and BOD rates are highest.

Generally DO concentrations were found well above the Idaho Water Quality Standard of >6.0 mg/L, however, during periods of critical low flows, elevated stream temperatures and early morning hours, DO concentrations were found below 6.0 mg/L. This is especially critical at more downstream locations (Kilpatrick bridge to major stream gradient change) where water temperatures, sediments, nutrients and BOD increase and riparian cover decrease.

Macroinvertabrates

Composition and densities of aquatic macroinvertebrates are important indicators of past water quality conditions as well as the overall health of the aquatic ecosystem. Aquatic invertebrates are most useful due to their diversity, sensitivity to habitat change, relative ease of identification, and subjection to fewer extraneous controlling factors (MacDonald et al., 1991). Aquatic invertebrates are also important because they consume attached algae (scrapers), coarse particulate organic matter (shredders), other organisms (predators), and fine particulate organic matter (filterers). Consequently they fill the intermediate trophic level between microorganisms and fish (Hynes, 1970).

Monitoring of macroinvertebrate populations were conducted in June, August and November 1981 and again in May 1982 (Manuel-Faler et. al., 1982). Six sites were used to describe macroinvertebrate populations: 1) Upper Stalker Creek; 2) Lower Stalker Creek; Grove Creek; 4) Upper Silver Creek; 5) Middle Silver Creek; and 6) Lower Silver Creek. Overall Grove Creek was rated as "best" and Upper Stalker Creek was rated as "worst" in terms of habitat for and production of macroinvertebrates. Of the Silver Creek sites, there was a progressive downstream degradation of conditions important to macroinvertebrate populations. In general taxonomic richness, total abundance and Shannon-Weiner diversity index declined downstream. The numerical standing crops of macroinvertebrates at the Grove Creek, Upper Silver Creek and Middle Silver Creek sites were among the highest recorded for the Rocky Mountain region and possibly for the world.

The most notable conclusion which should be considered in the future direction of any type of project activity is that the dependable volume of clear, cold, nutrient rich water together with the homogeneous habitat, depositional substratum and extensive macrophyte communities are largely responsible for the productivity of this portion of Silver Creek as a major trout fishery.

Summary

Water quality within the Silver Creek Watershed is currently being impacted to varying degrees by irrigated and non-irrigated cropland, rangeland, animal holding/feeding areas, road construction and maintenance, riparian management, flow modification, channelization, recreation and rural/urban development.

Direct impacts of sediment and suspended solids within the water column are for the most part quite small. However, the most significant water quality impact in Silver Creek and its tributaries is likely from sediment and other suspended solids. Effects of sediment in the Silver Creek stream system are most pronounced as indirect impacts to the bottom substrate. Sediment and other settleable materials which sink to the bottom adversely impact invertebrate populations, become embedded in and cover spawning gravels, cover deposited eggs and depending on the organic composition remove dissolved oxygen from within the water column. Although this is important in Silver Creek, it is especially important in the tributaries to Silver Creek where the majority of salmonid spawning occurs. The most important sources of sediment include exposed streambanks, adjacent riparian areas in poor condition and newly tilled cropland or cropland with sparse cover directly adjacent to streams.

Generally nitrate nitrogen concentrations were found above the concentration recommended to prevent the development of biological nuisances and accelerated eutrophication. However, nitrate nitrogen concentrations in Silver Creek are a direct result of ground water discharge and therefore reflect ground water concentrations.

Orthophosphate phosphorus concentrations and pathogens (fecal coliform counts) were typically found within recommended levels. These water quality variables, in addition to nitrate nitrogen, do not appear to be causing pronounced water quality problems in Silver Creek.

Water temperatures and dissolved oxygen concentrations were typically found within the Idaho water quality standards. These water quality variables, for the most part, also do not appear to be causing pronounced water quality problems in Silver Creek, except during years of critical low flows and during isolated early morning hours.

Data collected on macroinvertebrate populations indicate that overall water quality conditions in upper Silver Creek, especially in certain sections, support some of the highest numerical standing crops of macroinvertebrates in the Rocky Mountain region and possibly for the world. The dependable volume of clear, cold, nutrient rich water together with the homogeneous habitat, deposition substratum and extensive macrophyte communities are largely responsible for the productivity of Silver Creek as a major trout fishery (Manuel-Faler et. al., 1982).

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INVESTIGATION AND ANALYSIS REPORT

RIPARIAN AREA ASSESSMENT

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Overview of Riparian Resources

The riparian areas within the Silver Creek watershed are highly variable, depending principally upon stream channel morphology, water table elevation, streambank soil texture, and land use activities. Using Rosgen's Classification of Natural Rivers (Rosgen 1985), however, two stream types predominate.

The upper two-thirds of the Silver Creek system, from its origins as spring-fed tributaries to where it enters the lava flow region just southeast of Picabo, is almost entirely a Rosgen C stream type that is characterized by a low gradient channel which meanders across a broad floodplain. These streams form in alluvial valleys and develop a riffle-pool morphology with point bars and corresponding cut-banks or undercut banks. Riparian zones are typically wide. In this channel type, a vigorous riparian plant community is important for protecting streambanks against erosion and for trapping sediments (Swanson 1989).

Healthy riparian vegetation is also important for trout cover and may be a major limiting factor within the Silver Creek system, especially in the smaller tributary streams. Cover is widely recognized as one of the essential components of trout streams. Boussu (1954) was able to increase the number and weight of trout in stream sections by adding artificial brush cover and to decrease numbers and weight by removing brush cover and undercut banks. Lewis (1969) reported that the amount of cover was important in determining the number of trout in sections of a Montana stream.

Rosgen C stream types, which get their stability from streambank plants, are vulnerable to damage caused by improper land use practices, such as livestock over-grazing of streamside vegetation or farming activities which encroach upon the riparian zone. Without specific management practices in place to enhance and protect riparian vegetation, these streams often lose willows and other woody plants. Uncontrolled livestock access often results in excessive streambank trampling and the loss of undercut banks. Over many years, a wider, shallower stream is created.

The lower one-third of Silver Creek, from where it enters the lava flow region just southeast of Picabo to the confluence with the Little Wood River, is a combination of a Rosgen A stream type and a C type. Rosgen A channels are characterized by a confined channel with a steep gradient. They develop a step-pool morphology and a relatively narrow riparian zone lined with shrubs capable of withstanding high flow velocities. Even though the riparian areas along these rock-armored streams play only a small role in stabilizing the stream channel, they none the less provide critical habitat for many terrestrial and aquatic animals. Unlike Rosgen C stream types, Rosgen A types are much more resistant to degradation by improper land use activities.

Riparian Inventory

Despite a wealth of inventory data on fish in the Silver Creek system, almost no data exists on riparian vegetation. Furthermore, the fisheries population surveys were linked to channel substrate or aquatic plants and weakly linked to riparian cover.

In May of 1996, a reconnaissance level riparian inventory was completed using 1984 color infrared aerial photographs.. All perennial streams and their tributaries within the Silver Creek watershed shown on 7 1/2 minute topographic quadrangle maps were measured with a planimeter. Using ocular estimates, stream segments with less than 50 percent riparian shrub cover (percent streambank canopy cover) were considered inadequate while stream segments with more than 50 percent riparian shrub cover were considered adequate (Table 1). Since the actual presettlement riparian shrub cover value may never be known, a conservative 50 percent cutoff value was selected.

Of the woody riparian species observed in the Silver Creek watershed, the most common included Yellow willow (Salix lutea), Coyote willow (Salix exigua), and birch (Betula sp.). Common herbaceous riparian plant species include Nebraska sedge (Carex nebraskensis), water sedge (Carex aquatilis), baltic rush (Juncus balticus), Kentucky bluegrass (Poa pratensis), and Reed canarygrass (Phalaris arundinacea).

The results of the ocular riparian inventory clearly indicate a large deficiency in riparian shrub cover (when compared to other streams of similar geomorphology, climate, and water regime). Some local landowners, however, feel that there never were very many willows or other woody riparian plants along streams in the Silver Creek watershed. While this is possible, it is unlikely. The loss of riparian shrubs was probably a relatively rapid event that culminated shortly after the first homesteaders and beaver trappers arrived in the area in the late 1800's and early 1900's. To these early pioneers, woody riparian plants were undesirable, so their decline was not only acceptable but preferred. Today, however, the increasing recognition of the importance of healthy riparian vegetation is slowly replacing many of these traditional views, largely through demonstrations and increased public awareness.

Table 1. Extent of adequate riparian shrub cover along perennial streams within the Silver Creek watershed (based on ocular estimate).

Stream	Segment	Total Length (feet)	Adequate Riparian Shrub cover (feet)
1 Stalker Creek	HW to Silver Ck	26,450	2,650
2 Patton Creek	HW to Stalker Ck	25,160	5,030
3 Cain Creek	HW to Stalker Ck	23,570	23,660
4 Chaney Creek	HW to Cain Ck	11,600	2,320
5 Unnamed #1	HW to Stalker Ck	2,790	840
6 Unnamed #2	HW to Stalker Ck	2,030	200
7 Mud Creek	HW to Stalker Ck	30,470	9,150
8 Wilson Creek	HW to Silver Ck	14,570	4,370
9 Grove Creek	HW to Wilson Ck	37,320	11,200
10 Thompson Creek	HW to Grove Ck	6,230	1,870
11 Loving Creek	HW to Silver Ck	29,620	8,900
12 Butte Creek	HW to Loving Ck	2,000	600
Silver Creek	Wilson Ck to Little Wood R.	177490	
	C stream type	113,860	11,390
	A stream type	18,780	7,510
Totals (feet)		344,450	89,690

Recommendations

The most significant land use activities impairing the growth and establishment of riparian vegetation include:

1) Direct removal of riparian vegetation for pasture or farming
2) Stream channelization
3) Unrestricted livestock grazing

The direct removal of riparian vegetation should be strongly discouraged. In the long run, the loss of riparian vegetation may actually reduce the area available to grazing livestock and farming, since streambank erosion can proceed unchecked. Because structural solutions to controlling streambank erosion are often cost prohibitive, it becomes readily apparent that protecting and enhancing riparian areas is the most feasible and cost-effective streambank erosion control alternative in the Silver Creek watershed.

Channelization has repeatedly been shown to be detrimental to downstream land because the stream's velocity and bedload increase significantly in straightened sections. Channelization simply transfers the problem downstream. Today, with state and federal regulations in place, channelization activities have nearly stopped.

Finally, more than any other land use activity, a century of unrestricted livestock grazing has significantly degraded the riparian areas associated with Silver Creek and its tributaries. The importance of properly managing livestock grazing in riparian areas, particularly along Rosgen C stream types, has been well documented and repeatedly demonstrated throughout the western states. Improper livestock management, through excessive grazing and streambank trampling, can affect riparian-stream habitats by reducing or eliminating riparian vegetation, causing channel aggregation or degradation, causing widening or incisement of stream channels, changing streambank morphology, and as an accumulative result often lowering surrounding water tables (Platts 1986). Concentrated livestock use, as often occurs in uncontrolled season-long and some rotational grazing systems, may cause unacceptable damage to woody plants and streambank morphology (Clary and Webster 1989). Within the Silver Creek system, infrared aerial photographs clearly demonstrate the effect different land use practices, particularly livestock grazing, have on the density of riparian shrubs. To maintain or improve the vigor of riparian vegetation and provide streambank stability, Clary and Webster recommend that the residual stubble height of herbaceous riparian vegetation be maintained at 4 to 6 inches, as a minimum. This stubble height is consistent with Natural Resources Conservation Service (NRCS) recommendations. For pastures grazed in the fall, the retention of this standing stubble will normally prevent excessive browsing of willows and other woody plants.

To achieve the necessary standing stubble within the Silver Creek riparian area system, landowners will need additional control over when livestock graze riparian zones and better control of how much they eat while they are there. Good livestock grazing control is fundamental to proper riparian area stewardship.

Depending upon the level of degradation and the potential or desired rate of recovery, fencing can be an excellent tool to control livestock distribution, forage utilization, and season of use within riparian areas. Fencing can be used to exclude livestock or to create a separate riparian pasture. Where livestock fall-graze grain aftermath, temporary electric fencing is a practical, economical alternative to permanent fencing.

Within 7 years of conservation treatment, even the most severely degraded riparian areas in the Silver Creek system will show dramatic improvement through natural regeneration of riparian plants. Recovery can be greatly accelerated by planting native riparian shrub species. Complete riparian area restoration, however, may take decades.

Since most landowners and operators are skeptical about the benefits of protecting and enhancing riparian areas, demonstrating the recovery of a degraded stream, together with significantly offsetting the installation costs of conservation practices which benefit riparian areas, will go a long way toward restoring the functions and values of the Silver Creek system. The critical importance of healthy riparian areas and the benefits they provide, both on-site and off, justifies the need to maximize financial incentives. To maximize landowner appeal, cost-share programs should be creatively combined. Reasonable participation rates can be achieved as cost-share rates approach 100 percent. Additional incentives, such as cost-shared management practices, like livestock exclusion and proper grazing use, should be considered.

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INVESTIGATION AND ANALYSIS REPORT

WILDLIFE, T/E SPECIES, WETLANDS, AND CULTURAL RESOURCES

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<u>Wildlife - Terrestrial and Aquatic</u>

Terrestrial Wildlife:

Terrestrial wildlife in the watershed is driven by the availability of food, water and cover. The quality of habitat is influenced by the management of the area for recreational and agricultural purposes.

Big game species utilizing the watershed include mule deer, elk and moose. The south portion of the watershed is considered a major winter range for mule deer. Depending on the severity of the winter, mule deer are pushed into the lower elevation foothills for browse and at times can be seen in hay fields supplementing their diet. Elk also winter in the foothill slopes of the watershed and are seen in agricultural fields depending on the severity of the winter. Practices that enhance native rangeland, pastureland and haylands in areas overlapping winter range for mule deer and elk will benefit these species. Maintaining diverse vegetative communities of shrub/grass forage for cover and food on winter range on south and west facing slopes should be promoted in the watershed. Protection of special habitat components including travel corridors on ridges and along riparian areas will lower human disturbance of deer and elk on winter ranges.

Common furbearers include coyote, skunk, fox, badger, weasels, mink, beaver and muskrat. Many of these species are dependent on the quality and quantity of riparian and wetland areas in the watershed. Historically beaver has played a major role in the development of the meadows associated with Silver Creek and it's tributaries. Over the last 50 years beaver has not played a significant role in sustaining the functions and values of the riparian/wetland areas in the watershed. The removal of beaver and loss of woody perennial riparian vegetation has reduced the historical functions and values of Silver Creek. Activities that can enhance habitat for furbearers need to focus on riparian and wetland areas. Restoration of riparian and wetland areas focusing on the regeneration of woody plant communities along Silver Creek and associated tributaries will enhance habitat for furbearers.

Upland game birds in the rangeland foothills of the watershed include sage grouse and chukars. The agricultural areas have mourning doves and limited pheasant and partridge populations. The extreme winter climate has limited the agricultural areas suitable for game birds such as pheasant and partridge. Rangeland habitat with diverse shrub/grass communities offer the best available habitat for sage grouse. Practices that emphasize stability in rangeland plant communities and good to excellent rangeland conditions will enhance these areas for grouse and chukar.

Riparian areas are a vital component for upland birds. Practices promoting good riparian habitat conditions focusing on woody regeneration will enhance habitat conditions throughout the watershed. At the present time agricultural areas provide little habitat for upland game birds. Road ditches and irrigation delivery ditches are typically kept clean of vegetation for most of the year offering little or no cover for nesting and winter cover. Shrub and tree plantings are limited in the agricultural areas resulting in a monotypic stand of herbaceous or cropped land with little or no habitat value. Practices to create a more diverse habitat structure focusing on tree and shrub plantings will enhance the agricultural areas for upland birds. Grass buffer strips at ends of fields managed for nesting and winter cover will also enhance habitat in the agricultural areas. Current pasture management leaves little winter and nesting cover for upland birds. Pasture management to leave more suitable winter and nesting cover should be promoted in the watershed.

Waterfowl and shorebirds utilize Silver Creek and it's tributaries and associated wetlands. Common species include mallard, teal, great blue heron, common merganser, common snipe and sandhill crane. Over 9,000 acres of land in Silver Creek watershed are categorized as having hydric soils. Typically these soils in their natural state exhibit hydric characteristics and the plant communities exhibit hydrophytic characteristics and are classified as wetlands. The diverse waterfowl and shorebird populations are attributed to these riparian/wetland areas. Practices to restore and/or enhance these areas will enhance habitat for waterfowl and shorebirds in the watershed. Current conditions in many of these areas are adversely impacted from agricultural and recreational uses. Protected nesting cover and brood rearing areas are needed to enhance habitat for these water birds.

Reptiles and amphibians that may be found in the watershed include tiger salamander, western toad, woodhouse's toad, sagebrush lizard, short-horned lizard, western skink, rubber boa, racer, gopher snake, common garter snake, western garter snake and great basin rattlesnake. Springs, wetlands and riparian areas play a major role in the life history of many of these animals. Protecting springs, wetlands and riparian areas from impacts of recreational users and agricultural activities will have the most direct benefit to these creatures.

Nongame avian wildlife utilizing the watershed include belted kingfisher, marsh wren, raven, crow, sage thrasher, western bluebird, Foster's tern, warbler sp., red-winged blackbird, yellow headed blackbird, American goldfinch and vesper sparrow to name a few. Many of these species are migratory in nature spending the breeding season in the Silver Creek watershed. The majority are tied to riparian areas for part or all of their habitat needs. Many of the remaining riparian areas are lacking the woody component in the plant community.

Activities that will focus in on the need to restore and/or enhance woody shrubs and trees in riparian areas will address the most limiting factor impacting nongame avian species in the watershed.

Riparian areas in the Silver Creek watershed are visited by many of the game and nongame species that reside or migrate through the watershed. Outside of the Silver Creek Nature Preserve many riparian areas on Silver Creek and it's tributaries are lacking woody vegetation in the plant community. Historically these riparian areas supported a diverse plant community of herbaceous and woody vegetation. With the change of management in the watershed to a agricultural and recreational land base, riparian areas have gradually changed to a herbaceous dominated plant community dominated by reed canarygrass and isolated woody vegetation. Practices that will emphasize diverse multi-level riparian habitats will have the most direct benefit to all terrestrial wildlife.

Aquatic Wildlife:

Aquatic resources in the watershed are tied to Silver Creek and it's tributaries. The major tributaries include Patton, Chaney, Mud, Wilson, Loving and Grove Creeks. Silver Creek and it's tributaries are largely spring-fed. Fish species include rainbow, brook and brown trout, mountain whitefish, longnose dace, bridgelip sucker, redside shiner, speckled dace, paiute and Wood River sculpin.

Historically Silver Creek supported a population of redband trout as the main gamefish in the watershed. Introductions of rainbow, brook and brown trout to Silver Creek has changed the fish community structure over time. Brown trout populations in Silver Creek may have a direct impact on other fisheries in the system. The piscivorous feeding habits of brown trout and their habitat use and behavioral characteristics make the brown trout less vulnerable to aerial predation and anglers (McMichael and Kaya 1991; Robinson and Tash 1979; Cooper 1951). Brown trout populations are expanding in Silver Creek. Total trout density and biomass in upper Silver Creek has increased with the introduction of brown trout (Wilkison 1996). Long term effects of brown trout populations on resident trout populations are not fully understood at this time and will need to be monitored in the future.

Numerical standing crops of benthic invertebrates in certain reaches of the Silver Creek are among the highest recorded for the Rocky Mountain region (Platts et al 1982). The species composition is dominated by a few taxa that are characteristic of streams dominated by depositional substratum and an abundance of macrophytes. It is not known if the abundance of benthic organisms in Silver Creek is a limiting factor for fish populations. Tributaries of Silver Creek have varying biomass values for benthic organisms. As with Silver Creek the abundance of benthic organisms in tributary streams has not been linked to fish populations in the study area.

Aquatic habitat inventories of Silver Creek are few at this time. Physical habitat inventories related to aquatic resources have been limited to stream substrait evaluations. Studies related to amounts of undercut banks, overhanging vegetation, canopy cover, pools, riffles, width and depth ratios are needed to help identify limiting habitat conditions in the system.

Aquatic habitat in Silver Creek and it's tributaries have changed with the interest in the area for recreational development and agriculture. Water quality and loss of habitat, although not fully understood as limiting factors for fish populations in Silver Creek, have been adversely impacted over the years. Loss of woody vegetation from agricultural, recreational and rural development activities have resulted in a wider, shallower stream which increases solar absorption and results in higher water temperatures. Irrigation return flows from fields also increases water temperatures before the water is returned to the creek or streams in the watershed. Documented fish kills (due to low oxygen/high water temperatures) on lower Silver Creek and sediment being deposited in stream reaches indicate a need to protect and enhance existing aquatic resources. High water temperatures have been documented on Silver Creek during summer months. Visual observations of canopy cover on Silver Creek and it's tributaries during the preliminary investigation indicated some stream reaches with no multi-level riparian vegetation. Silver Creek below the Nature Conservancy has little woody vegetation in the riparian areas which contributes to high water temperatures throughout the summer months. Tributary streams to Silver Creek also exhibited a lack of woody vegetation on many reaches.

Although the tributary streams do not typically have water temperature problems, raising the water temperature in tributary streams delivers warmer waters to Silver Creek and thus requires less solar energy input to raise Silver Creek's water temperature to unhealthy levels.

Selected reaches of Silver Creek and tributary streams lack undercut banks, overhanging vegetation, canopy cover from shrub/trees and large organic debris. Typically this kind of physical habitat provides cover for young and mature fish and helps reduce solar energy input to the stream. Stream reaches lacking cover have little protection from predators including common merganser, Foster's tern, belted kingfisher, great blue heron, trout and mink. A lack of diverse physical habitat is related to a lack of woody riparian vegetation in selected reaches of the watershed.

Practices to enhance and restore multi-level riparian plant communities will provide a more diverse aquatic habitat over time. Agricultural activities (cropping and livestock) should be managed to promote the establishment of woody vegetation in riparian areas. Riparian areas should be wide enough to buffer sediment and related pollutants from entering Silver Creek and it's tributaries. Existing wetlands should be enhanced or preserved to effectively treat water quality concerns. Converted wetlands should be restored to also help treat water quality concerns and provide additional aquatic and terrestrial habitat.

The Nature Conservancy's (TNC) conservation easement program offers an excellent means to work on and protect riparian habitat in the watershed. The NRCS Wetland Reserve Program along with the USFWS Partners Program and IDFG Habitat Improvement Program (HIP) are also excellent ways to promote and protect aquatic and terrestrial habitat in the Silver Creek watershed. Since these programs are already available and funded, sponsors should continue to utilize them to treat the resource needs in the watershed.

Threatened And Endangered Species

Threatened and endangered species were identified in the watershed using the Idaho Conservation Data Center's computer data base. The following list identifies threatened, endangered, candidate or species of concern in the watershed:

SPECIES	LISTING	OCCURRENCE
Bald eagle	Threatened	Wintering/nesting
Wood River sculpin	Species of Concern	Silver Creek
Mourning milkvetch	Species of Concern	Sagebrush hillsides
Pygmy rabbit	Species of Concern	Sagebrush hillsides
White-faced ibis	Species of Concern	Seasonal in watershed
Trumpeter swan	Species of Concern	Seasonal in watershed
Northern goshawk	Species of Concern	Seasonal in watershed
Ferruginous hawk	Species of Concern	Seasonal in watershed
Black tern	Species of Concern	Seasonal in watershed
Interior redband trout	Species of Concern	Watershed

The bald eagle winters along the Big Wood River from Magic Reservoir to Hailey and also includes Silver Creek. Wintering eagles utilize tall trees to roost and view the waters of Silver Creek and Big Wood River for prey. The abundance of fish in Silver Creek offers an excellent prey base for wintering bald eagles. Land development and poor land management practices that impact aquatic habitat and water quality, results in a reduced aquatic prey base and roosting sites for the eagle.

An active bald eagle nest has been observed on the TNC Silver Creek Preserve in 1996. Nesting bald eagles have been observed adjacent to the TNC Silver Creek Preserve since 1984. The excellent prey base associated with Silver Creek makes the site suitable for nesting eagles.

The Wood River Sculpin was first collected in 1893 from the Little Wood River near Shoshone. The sculpin has been collected on the TNC Silver Creek Preserve and it's tributaries. The sculpin is mainly a bottom-living fish of cold waters. Sculpins have been used as indicators of waters of high quality, i.e. high oxygen, cool temperatures, and low levels of pollution. Land development, water diversion, and poor land management practices, with the resulting degradation of the aquatic habitat and water quality, seem to be the immediate threat to this species (Simpson and Wallace, 1978).

Mourning milkvetch is a plant that has been observed on the sagebrush hillsides north of Picabo. This species habitat includes gravelly soil. Associated species include sagebrush, sandberg bluegrass, cheatgrass and longleaf phlox. Land development and poor management on these rangeland areas has slowly reduced populations of this milkvetch.

Wetlands

The Silver Creek Watershed is unique in being spring-fed and having many wetland areas. Over 9,000 acres of soils are identified as having hydric characteristics. Hydric soils typically indicate that conditions exist that may constitute a wetland. Hydrophytic vegetation associated with the wetlands in the watershed include sedge spp., rush spp. and willow spp..

Many wetland areas have been impacted from past and present management and drainage. Subsurface tile, ditching and woody vegetation removal have been the typical conversion activities in the watershed. Riparian/wetland areas although stable in terms of sediment movement are in many reaches lacking the woody component so critical for terrestrial and aquatic resources.

Practices that will reduce impacts to wetland areas from recreational activities, livestock and cropping will positively impact wetland habitat conditions in the watershed.

Programs like the Wetland Reserve Program, USFW Partners Program, IDFG Habitat Improvement Program and The Nature Conservancy's Conservation Easement Program should be reviewed by the sponsors to help meet their objectives.

Cultural Resources

Prehistoric and historic cultural resources have been identified in the watershed. Historic resources in the watershed include buildings used by early settlers in the late 1800's. Native Americans utilized the watershed for it's abundance of large and small game, fisheries and abundant plant resources.

Practices that are considered land disturbing may impact cultural resources. Consideration for cultural resources should be completed during site specific on-farm planning. NRCS policy and procedures for considering cultural resources is explained in GM-420 part 401 and 601.

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INVESTIGATION AND ANALYSIS REPORT

GEOLOGY AND SEDIMENTATION

By: Ron Abramovich, Water Supply Specialist, USDA-NRCS, Boise SO

Geology

The geologic history of the Big Wood River and Silver Creek area is complex with several geologic changes occurring. During the Paleozoic Era, the area was covered by seas which deposited thousands of feet of sediment. These sediments were consolidated while faulting occurred creating the Big Wood Valley. During the Quaternary period, the Big Wood River flowed in what is now Silver Creek. Basalt flows occurred periodically throughout this region. Basalt flows south of Bellevue and in the southeast portion of the Big Wood valley eventually changed the course of the Big Wood River. The basalt flows allowed the Big Wood River to make a horseshoe bend turn and flow southwest in its present channel. A gently rise in surface elevation forms the basin divide between the Big Wood and Silver Creek drainages.

The hydro-geology of the Big Wood/Silver Creek is a complex interrelated system. The majority of Silver Creek's streamflow results from ground water percolation from the Big Wood River south of Hailey and irrigation water. There is a shallow ground water divide between the Big Wood/Silver Creek basins that parallels Highway 93 on the eastside. Ground water on the eastside of the divide eventually surfaces and forms Silver Creek or leaves the basin and joins the Snake River Aquifer.

There are two primary aquifers in the Silver Creek basin. The unconfined aquifer or shallow water table is composed of sand and gravel alluvial fill with few fine-grained sediments. The confined or artesian aquifer is a result of a clay layer in the southern half of the basin approximately 100 feet below the surface. This clay band slopes from north to south and is a maximum of 100 feet thick.

Sediment

Sediment loading was identified as one of the problems in Silver Creek. Agriculture, cattle grazing, and wind blown silt are the primary sources of sediment deposition in the stream channel. Interviews with local residents and previous studies indicate sediment loading occurs during winter and spring runoff in February or March, from localized precipitation events, and during the irrigation season. Silver Creek streamflow velocities are relatively slow and constant year around because the majority of streamflow results from ground water. A large percentage of the channel bottoms are covered in sediment with a vegetative cover. Elsewhere, the channel bottoms are composed of gravel or a clay lining. The vegetation appears to be holding the sediment in place. Previous studies indicate that the sediment load is fairly stable and immobilized by the vegetation and low velocities. Sediment is transported downstream during higher winter velocities and when vegetation cover and growth is at its minimal stage.

Several studies on Silver Creek hydrology and sedimentation have been completed in the past. These studies include investigations of sediment depths on Silver Creek tributaries and Silver Creek. A sediment study in 1979, which was about three years after the Nature Conservancy became stewards of the land, indicates that the majority of sediment load is from Stalker Creek (Manuel, Griffith, and Minshall, 1979). The following table illustrates their results:

Stalker Drainage	Grove Drainage	Loving Drainage
52% of area	26% of area	26% of area
32% of discharge	49% of discharge	17% of discharge
62% of sediment load	23% of sediment load	15% of sediment load

In the above analysis, the sediment load carried by Stalker Creek is not proportional to the drainage area size or discharge from the basin. However, this is a result of ground water producing the streamflow and not a result of overland flow from the basin.
Based on research by Manuel-Faler, 1982, sediment depth was the greatest in June and August (mean depth 86 and 82 cm) and the least in November and May (mean depth 66 and 52 cm). In comparing the results of the 1979 and 1982 studies of the annual mean sediment depths in Silver Creek, it appears that a small decrease in sediment levels occurred. This may also be a result of land use changes in the basin and purchasing easements along the stream after The Nature Conservancy became stewards of the land.

Sources of Sediment and Sediment Loading

The source of sediment for Silver Creek is probably coming from a combination of activities in the basin. These sources include: irrigation return flow, barren fields, cattle grazing in stream channels, and windblown silt. Previous studies tried to locate the sediment source and concluded that not one primary source existed. In Stalker Creek the sediment is probably from a combination of activities and effects in the basin such as channelization of the stream, irrigation canals, barren fields and windblown silt. After sediment is deposited in the stream channel, it is difficult to determine the actual source of sediment, whether it be from wind, overland flow or streambank erosion.

Typically, the sediment in most streams is a result of overland flow transporting sediment into the stream or streambank erosion. Gradually, sediment is moved through the basin overtime by flood events. However, because Silver Creek is primarily a ground water fed stream with slow velocities and low gradients, Silver Creek is probably carrying more sediment than other similar size streams in the area. Historically, Silver Creek may have had much less sediment in the channel and land use changes resulted in additional sediment deposition. It is difficult to determine if Silver Creek basin is at an equilibrium stage and the amount of sediment entering the stream is also leaving the basin.

Streamflow velocities play an important role in movement of sediment in a channel. As the velocity decreases, suspended sediments are deposited in the channel. Historic accounts of beavers in the area may have played an important role in the hydrology of the basin. Beaver dams would have decreased streamflow velocities while retaining sediment in the stream. However, historically, less sediment may have been in the stream channel as a result of less land use disturbance. The water level behind Purdy Dam was lowered in 1979. The net result was an increase of sediment leaving the basin as a result of increase stream velocities. Dredging or sediment removal has also occurred in the basin. This produced a temporary reduction in sediment depths at these locations.

Best management practices such as fencing off riparian areas, instream structures, bank fishing regulations, etc. are being or have been implemented in the basin. Additional practices that may help reduce sedimentation in Silver Creek are installation of additional road bars where springs cross the road, livestock water developments, additional instream structures and additional woody vegetation in the upland watersheds. Additional investigations and research of the analysis that has been performed on sediment source, sediment load, and equilibrium of sediment in basin may be beneficial for this project. These studies occurred several years ago and land use and cover changes have occurred.

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ECONOMIC EVALUATION

By: Denis Feichtinger, Agricultural Economist, USDA-NRCS, Boise SO

Silver Creek has many important economic benefits to the greater Wood River Valley. This evaluation does not look at Silver Creek as a whole, but rather at the economic impacts as they relate to the 825 acre preserve operated by the Nature Conservancy. It should be looked at as an indicator of value of the Silver Creek resource and the importance of maintaining and improving the resource.

The value of the Silver Creek Preserve as outlined here is for such items as travel, food and beverage, accommodations, sporting equipment, guides, and other retail and is the amount spent by visitors to the area. The value of the environmental qualities are not included.

Annual visitor days to the Silver Creek Preserve have grown from approximately 1,000 in 1975, the year the preserve was established, to 9,318 in 1995. Recreational uses from 1993 survey information is as follows:

Activity	Percent
Fishing	78
Bird Watching	10
Hiking	9
Boating	3

The value of the area was based upon 1988 survey information provided by visitors to the preserve. Users include:

Visitors	Percent 1988	Percent 1995
Local Residents	19	25
Rest of State	47	19
Out of State	34	56

The purpose of the visit to the area was considered in the total value and classified as a Primary Destination, General Recreation and Non-Recreation for rest of state; and Destination Fishermen, Primary Destination, General Recreation, and Non-Recreation for out of state visitors.

The estimated dollar expenditure for a typical visit to the Preserve is estimated at:

Silver Creek Preserve User			
Use Category	Local Resident	Rest of State	Out of State
Destination Fishermen			$1,032.00
Primary Destination		$97.00	819.00
General Recreation		111.00	780.00
Non-Recreation		259.00	725.00
Other	$25.00		

The estimated percent use of a typical visit to the Preserve is estimated at:

Silver Creek Preserve User			
Use Category	Local Resident	Rest of State	Out of State
Destination Fishermen			13.0%
Primary Destination		59.0%	24.0
General Recreation		21.0	49.0
Non-Recreation		20.0	14.0
Other	100.0%		

The total estimated dollar expenditure at the Preserve for the 1995 fishing season is estimated at:

Silver Creek Preserve User			
Use Category	Local Resident	Rest of State	Out of State
Destination Fishermen			$706,100
Primary Destination		$98,400	1,034,500
General Recreation		40,100	2,011,500
Non-Recreation		89,100	534,200
Other	$58,400		
Totals	$58,400	$227,600	$4,286,300
Grand Totals			$4,572,300

The Silver Creek Preserve is located in an area with a variety of recreational activities. The total expenditures by visitors should be kept in perspective with these other activities. The $4,572,300 should not be considered specific to the Preserve. Expenditures under all categories spill over into the greater Wood River Valley.

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APPENDIX B

LIST OF REPORT PARTICIPANTS

List of Report Participants

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APPENDIX C

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