Northern Middle Bear (Bear River)
Total Maximum Daily Load
Implementation Plan for Agriculture

Developed for

Idaho Department of Environmental Quality

Prepared by

Steven Smith
Idaho Soil Conservation Commission

Chris Banks
Idaho Association of Soil Conservation Districts

In cooperation with

Caribou Soil Conservation District
Franklin Soil and Water Conservation District
USDA-Natural Resources Conservation Service

September 2008

Table of Contents

ACKNOWLEDGEMENTS

Writing a TMDL Implementation Plan requires the time and cooperation of many people working together and brainstorming ideas to make each individual plan become as effective as possible.

We would like to give a special thanks to Mark Hogen of the Idaho Soil Conservation Commission for his help on cropland issues. Also, we would like to thank Justin Krajewski and Amy Jenkins for their help on the riparian and range section as well as the water quality monitoring section of this TMDL implementation plan.

INTRODUCTION

This Total Maximum Daily Load (TMDL) Implementation plan was written for the Idaho Department of Environmental Quality (IDEQ). It was also written to help the Caribou Soil Conservation District (CSCD) and the Franklin Soil and Water Conservation District (FSWCD) prioritize areas in greatest need of water quality improvement projects. Another purpose of this implementation plan is to give guidance to agencies on how to assist landowners with implementing Best Management Practices (BMPs). The Idaho Soil Conservation Commission (ISCC) and Idaho Association of Soil Conservation Districts (IASCD) staff has been in contact with landowners as well as the Soil and Water Conservation Districts to aid in the writing of this implementation plan.

Purpose

The Northern Middle Bear TMDL Implementation Plan for Agriculture outlines an adaptive management approach for implementation of BMPs and Resource Management Systems (RMS) on agricultural lands to meet the requirements of the Northern Middle Bear TMDL. Implementation activities will be phased in on a subwatershed basis due to the size and complexity of the subbasin.

Goals and Objectives

The goal of this plan is to provide a strategy for agriculture to assist and/or complement other watershed efforts in restoring and protecting beneficial uses for water quality impaired streams in the Bear River and §303d listed streams found in the Northern Middle Bear River subbasin. These water quality impaired stream segments are identified in IDEQ's [1998] §303(d) list for the Northern Middle Bear subbasin (Table 1 and Figure 3).

BACKGROUND

Project Setting

The Northern Middle Bear subbasin is located in the southeast portion of Idaho. The boundaries of the subbasin on the north extend from the dam at Alexander Reservoir (also the location of the Soda Springs Hydro Plant) to the head of the Oneida Narrows. The subbasin is bound on the west by the Portneuf Range and on the east by the Bear River Range. The two major reservoirs in the subbasin are Alexander and Oneida Narrows.

Oneida Narrows Reservoir was built in 1914 and Alexander Reservoir was built in 1924. The reservoirs in the subbasin are used to store water for irrigation and recreation. Hydropower is generated at dams near Oneida and Grace, Idaho. Cove Dam used to generate power, but it was in need of repairs and was decommissioned in 2006.

There are several diversions within the Bear River system flowing through the Northern Middle Bear subbasin. The largest diversion is the Last Chance Canal, located below Alexander Reservoir. It diverts 2.6 billion cubic feet of water per year. Near Grace, Idaho, water is completely diverted from the Bear River and routed to the Grace Power Plant. Due to this diversion, most of the water in Black Canyon, below Grace, comes from natural springs and local drainage.

Black Canyon is a deep, narrow gorge that cuts through a basalt formation below the town of Grace. Since the early 1900s, the water entering Black Canyon has been completely diverted into the Grace

Power Plant, making the river navigable only by canoe or kayak during extreme high flow years. Beginning in 2008, PacifiCorp will provide scheduled releases of whitewater flows into Black Canyon during the spring and early summer of each year.

The Northern Middle Bear subbasin encompasses nearly 217,991 acres. Elevations range from 4,000 to 9,000 feet above sea level in the subbasin. The climate usually consists of long cold winters and hot dry summers. The subbasin receives approximately 16 to 20 inches of precipitation at higher elevations and 12 inches or less at lower elevations, with most of the precipitation coming in the winter months in the form of snowfall followed by summer thunderstorms. The growing season is generally 80 to 120 days with the possibility of periodic frost in between.

Common ecosystems consist of native species such as bluebunch wheatgrass, Idaho fescue, and native shrubs and trees which are commonly found at higher elevations along mountain sides. Timothy, smooth bromegrass, reeds canary grass, creeping meadow foxtail, orchard grass and clover, grasses, sedges, rushes and a variety of woody species are typically found at lower elevations. Figure 1 is a map indicating the location of the Northern Middle Bear subbasin.

Ground and Surface Water Protection Area

Figure 2 is a map which indicates an area of ground and surface water protection. All of the streams that fall into the impaired category are outlined in red to show their location in the subbasin. The map also shows a nitrate priority area stretching through the Northern Middle Bear subbasin.

Subwatersheds and Water Quality Impaired Streams

This implementation plan will provide guidance to the CSCD, as well as the FSWCD, and agricultural producers in the Northern Middle Bear subbasin. Another purpose of this implementation plan is to help identify BMPs necessary to meet the requirements of the TMDLs on §303(d) listed streams. The objective of this plan is to reduce the amount of sediment, phosphorous, and nitrogen entering these water bodies from agricultural-related practices from both surface and ground water. Agricultural pollutant reductions will be achieved by on-farm conservation planning with individual operators and application of BMPs in agricultural critical areas.

The implementation of Resource Management Systems (RMS) will provide quality assurance for phased approaches of BMP implementation. This plan recommends BMPs needed to meet TMDL targets in the Northern Middle Bear River subbasin, and suggests alternatives for reducing surface and groundwater quality problems from agricultural related activities. Figure 3 is a map indicating the location of the Northern Middle Bear subwatersheds.

Table 1. [1998] §303(d) Listed Stream Segments in the Northern Middle Bear Subbasin

Stream Name	Description	Listed Pollutants
Bear River	Alexander Reservoir to Oneida Dam	Flow, Sediment, & Nutrients
Cottonwood Creek	Tributary 4 miles upstream to Bear River	Sediment
Densmore Creek	Headwaters to Bear River	Sediment & Nutrient
Whiskey Creek	Headwaters to Bear River	Sediment & Nutrients
Williams Creek	Right Fork Williams Creek to Bear River	Sediment & Nutrients

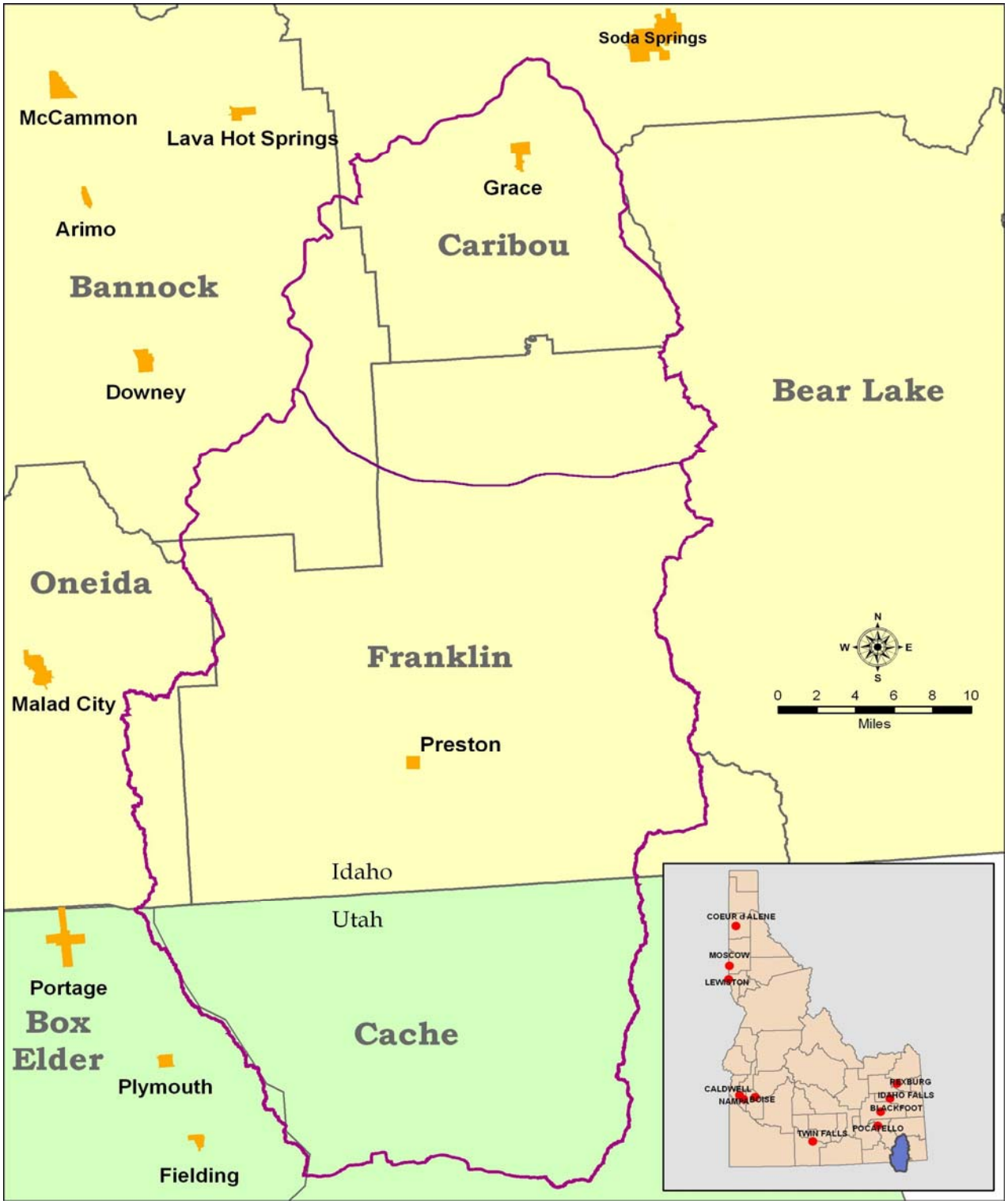

Figure 1. Location of the Northern Middle Bear Subbasin

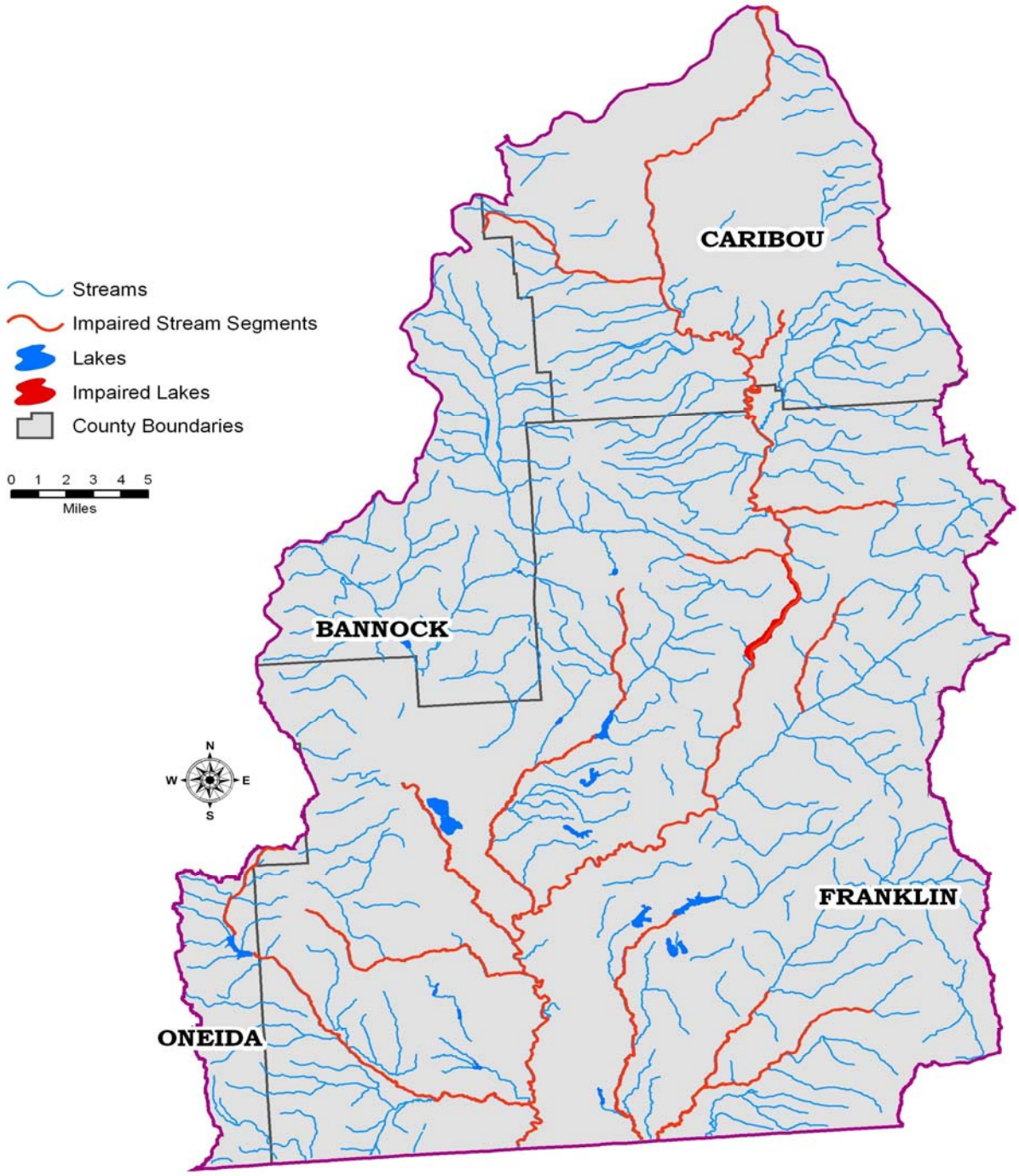

Figure 2. Ground and Surface Water Protection Areas

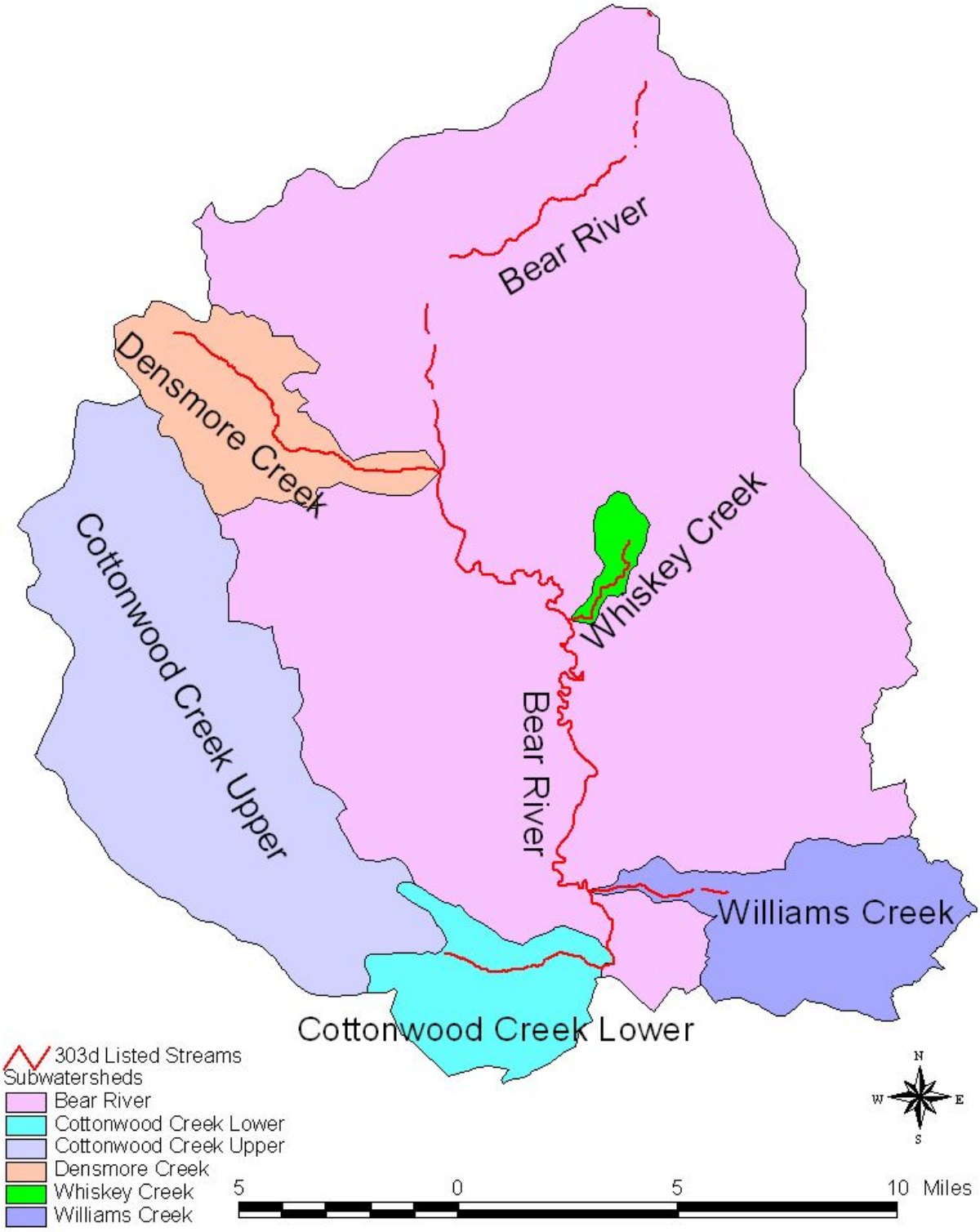

Figure 3. The Northern Middle Bear Subwatersheds

Land Ownership

There are approximately 217,991 acres in the Northern Middle Bear subbasin. Private land accounts for 125,848 acres which makes up approximately 58 percent of the subbasin. The Caribou Targhee National Forest (CTNF) makes up 18 percent of the subbasin totaling 38,095 acres. The Bureau of Land Management (BLM) controls 18,293 acres which makes up another 8 percent of the subbasin, and the State of Idaho owns 35,755 acres which is 16 percent of the subbasin (Table 2 and Figure 4).

Table 2. Land Ownership in the Northern Middle Bear Subbasin

Land Use Category	Acres	% of Subbasin
Private	125,848	58%
CTNF	38,095	18%
BLM	18,293	8%
State of Idaho	35,755	16%
TOTAL:	217,991 acres in subbasin	100%

Land Use

Private land in the subbasin is broken down by major land use categories in Table 3 and Figure 5. Cropland makes up the largest contingent of land in the Northern Middle Bear subbasin accounting for a combined total of 48 percent and is broken down into two subcategories. About 34,057 acres are irrigated cropland or 27 percent of the subbasin and 26,548 acres are dry cropland accounting for a total of 21 percent of the subbasin. Rangeland comes in a close second with 56,603 acres making up nearly 45 percent of the private land in the subbasin. Rivers and creeks add up to 3,027 acres or 2 percent of the private section of the subbasin. Finally, urban areas and roads account for 5 percent of the total private land use, spanning 5,613 acres throughout the subbasin.

Table 3. Private Land Use in the Northern Middle Bear Subbasin

Land Use Category	Acres	% of Subbasin
Irrigated Cropland (Row Crop, Grain Crop, Grass/Pasture/Hay)	34,057	27%
Dry Cropland (Grain Crop, Grass/Pasture/Hay)	26,548	21%
Rangeland (Shrub/Range, Forest)	56,603	45%
Streams (Water/Wetlands/Developed/Barren)	3,027	2%
Urban/Roads (Water/Wetlands/Developed/Barren)	5,613	5%
TOTAL:	125,848	100%

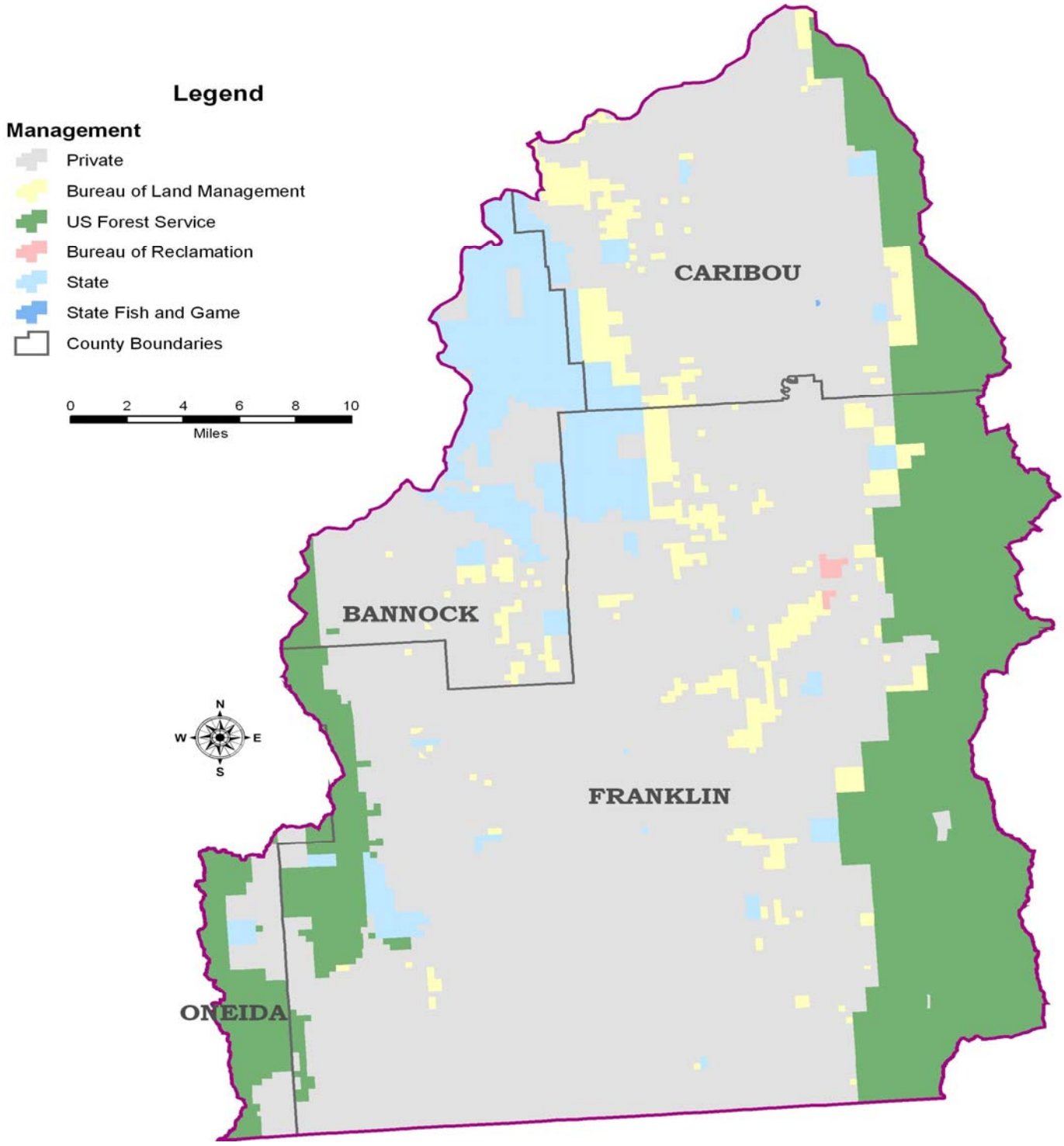

Figure 4. Land Ownership in the Northern Middle Bear Subbasin

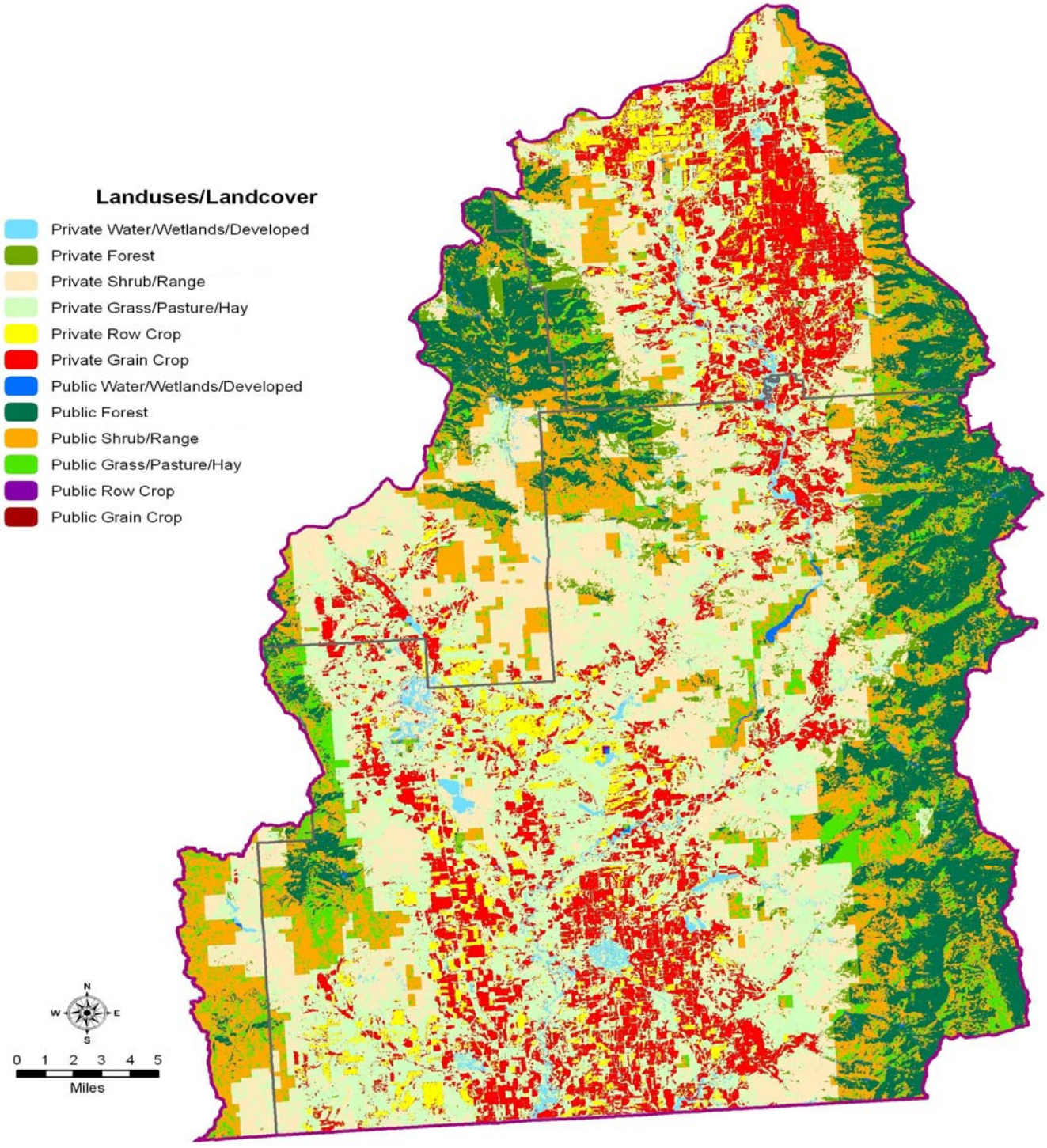

Figure 5. Land Use in the Northern Middle Bear Subbasin

Accomplishments

Below in Table 4, is a summary of agricultural BMPs which have been implemented throughout the Northern Middle Bear subbasin within the last five years.

Table 4. Completed BMPs in the Northern Middle Bear Subbasin

BMP	Amount	Units	Estimated Cost	Program
Fence	39,260	Ft.	$78,520	EQIP
Use Exclusion	42	Ac.	$1,481	EQIP/CCRP
Streambank Protection	5,101	Ft.	$306,060	EQIP
Pasture/Hayland Protection	159	Ac.	$15,850	EQIP
Trough	9	No.	$9,000	EQIP
Pipeline	6,421	Ft.	$14,576	EQIP
Prescribed Grazing	334	Ac.	$1,668	EQIP
Structure for Water Control	15	No.	$30,000	EQIP
Pest Management	1,192	Ac.	$35,760	EQIP
Pumping Plant	3	No.	$8,300	EQIP
Well	1	No.	$5,000	EQIP
Irrigation Water Control	44,190	Ft.	$441,900	EQIP/CCRP
Sprinkler System	199	Ac.	$1,092	EQIP
Channel Vegetation	2	Ac.	$6,000	EQIP
IWM	611	Ac.	$3,055	EQIP
Spring Development	2	No.	$4,700	EQIP
Heavy use Protection	2	No.	$800	EQIP
Herbaceous Vegetation	23	Ac.	$6,930	EQIP
Waste Storage Facility	3	No.	$60,000	EQIP
Nutrient Management	160	Ac.	$800	EQIP
Windbreak	13,513	Ft.	$13,513	EQIP/CCRP
Trickle Irrigation	5	No.	$7,500	EQIP/CCRP
Mulching	13,513	Ft.	$330	EQIP/CCRP
Upland Wildlife Habitat	5	Ac.	$27	EQIP/CCRP
CRP	10,595	Ac.	$6,007,365	CRP
TOTAL:			$7,060,227	

WATER QUALITY PROBLEMS

Beneficial Uses

Table 5 lists the beneficial uses for impaired streams located in the Northern Middle Bear subbasin. This information was taken from the Bear River Basin/Malad Subbasin Assessment and TMDL (IDEQ, 2006).

Table 5. Beneficial Uses for §303(d) Stream Segments in the Northern Middle Bear Subbasin.

Water Body	Boundaries	WQLS #	Beneficial Uses
Bear River	Alexander Dam to Oneida Res.	2236,2235,2233	CWAL,SS,PCR,SCR AWS,IWS,WH, Ae
Cottonwood Creek	Tributary 4 miles to the Bear River	2245	CWAL,AWS,IWS,WH,Ae,SCR
Densmore Creek	Headwaters to the Bear River	2249	CWAL,AWS,IWS,WH,Ae,SCR
Whiskey Creek	Headwaters to Bear River	2248	CWAL AWS,IWS,WH,Ae,SCR
Williams Creek	RF Williams Creek to Bear River	2246	CWAL,SS,AWS,IWS,WH,Ae,SCR
CWAL-Cold Water Aquatic Life, SS-Salmonid Spawning, PCR-Primary Contact Recreation, SCR-Secondary Contact Recreation, DWS-Domestic Water Supply, AWS-Agricultural Water Supply, IWS-Industrial Water Supply, WH-Wildlife Habitat, Ae-Aesthetics			

Pollutants

Listed below in Table 6 are the affected streams in the Northern Middle Bear subbasin. These streams are used for agricultural production and for other uses such as primary and secondary recreation. The table also describes the listed pollutants for each stream as well as the reduction needed to restore beneficial uses to these streams. These reductions are taken from the Bear River Basin/Malad Subbasin Assessment and TMDL (IDEQ, 2006).

Table 6. Identified Pollutants and Required Reductions for Impaired Streams

Water Body	§303(d) Listed Pollutants	Required Reduction to meet TMDL
Bear River	Nutrients	68,359 lbs TP per yr
	Sediment	44,875 lbs TSS per yr
Cottonwood Creek	Nutrients	2,266 lbs TP per yr
	Sediment	1,057,066 lbs TSS per yr
Densmore Creek	Nutrients	311 lbs TP per yr total
	Sediment	187,829 lbs TSS per yr
Whiskey Creek	Nutrients	1,870 lbs TP per yr
	Sediment	296,343 lbs TSS per yr
Williams Creek	Nutrients	736 lbs TP per yr
	Sediment	210,350 lbs TSS per yr

Water Quality Monitoring

IASCD and ISDA recently completed a water quality monitoring project on eight streams in the Northern and Southern Middle Bear subbasins: Densmore, Whiskey, Williams, Cottonwood, Battle, Deep, Fivemile, and Weston Creeks (Jenkins 2007). *Battle, Deep, Fivemile, and Weston Creeks will be discussed further in the Southern Middle Bear TMDL;* they are only listed here to show what streams were sampled in the monitoring process. The goal of the monitoring was to quantify pollutant concentrations in the streams to help the Franklin and Caribou Districts prioritize areas for BMP implementation. Water quality samples were collected from 2005 to 2006 and were analyzed for suspended sediment, phosphorus, and nitrogen.

Jenkins (2007) stated that "the results of the monitoring indicated that six of the eight streams experienced elevated pollutant levels, especially during spring runoff events. Exceptions to this were Williams and Cottonwood Creeks where pollutant concentrations remained low despite some seasonal fluctuations." Water quality monitoring on both of these streams was discontinued because data indicated that pollutant concentrations were not a problem.

For Densmore Creek, the percentage target exceedance was 41 percent for suspended sediment, 76 percent for phosphorus, and 100 percent for nitrogen. Jenkins (2007) suggested that Densmore Creek should be considered a moderate to high priority for water quality improvements", because sediment and nutrients are likely being transported from surrounding cropland and rangeland. The lower portion of Densmore Creek goes dry towards the end of the summer.

Whiskey Creek rarely exceeded the suspended sediment target, but this creek should still be monitored for fine sediment deposition. Whiskey Creek exceeded the nitrogen target every sampling event, however nitrogen is naturally occurring at the springhead.

Water quality monitoring on the mainstem Bear River has been conducted by the IDEQ, Ecosystems Research Institute (ERI), and Utah State University (USU). Prior to writing the Bear Basin TMDL, ERI collected data at ten river sites in the Northern Middle Bear subbasin. IDEQ has continued monitoring on a quarterly basis as part of a tri-state effort that will be conducted through 2011. A number of water quality studies were conducted in the subbasin by USU (Clyde 1953, Sorenson et al. 1984, 1986). These studies indicated that elevated sediment and nutrient loads in the Bear River below Oneida Narrows Reservoir were largely due to tributary inputs. Limited tributary data have been collected by ERI and IDEQ in the Middle Bear subbasin (Jenkins, A., 2007).

AGRICULTURAL WATER QUALITY INVENTORY AND EVALUATION

Riparian

In 2007 and 2008, IASCD and ISCC staff conducted riparian assessments on private agricultural lands along §303(d) listed streams in the Northern Middle Bear subbasin including Densmore, Cottonwood, Williams, and Whiskey creeks, as well as the portion of the Bear River from Alexander Reservoir to Oneida Narrows.

The tools used to assess stream reaches included the NRCS Stream Visual Assessment Protocol (SVAP) and Rosgen Stream Classification. The reaches were delineated using soils, geology, slope,

sinuosity, vegetation, hydrology, roads, valley type, land ownership, and land use using GIS layers, NAIP aerial imagery, and USGS topographic maps.

Bear River

The upper portion of the Bear River that runs through the northern end of the subbasin is extremely regulated by the power companies. The water is diverted through a flume near the Grace Dam to the Cove Power Plant, and because of this diversion Black Canyon is nearly barren of water. The water that does travel through the Black Canyon channel is delivered by natural springs which empty their contents directly into the river channel. However, beginning in the spring of 2008, Pacific Corp. is scheduled to begin releasing the water which would normally travel through the flume, back into the river channel. The reason for this large release of water is for recreational purposes. These scheduled releases are to occur over the course of 16 different weekends beginning in May and ending in July. This portion of the river runs through an area lined with large basaltic rocks and was given a fair to good rating using SVAP.

The middle portion of the Bear River has grazed pasture lands nearly its entire length below the power plant. The river meanders through several low-lying meadows in an incised channel. In most instances livestock have direct access to the river. It is estimated that 25 to 30 percent of the banks have erosion problems. There is a lack of woody species along the Bear River. Most of the vegetation is reed canary grass, an invasive species. This section of the Bear River ranged from poor to fair condition using the SVAP.

The lower portion of the Bear River which empties into the Oneida Narrows Reservoir is lined with willows and other woody species. The banks do show signs of erosion and livestock have direct access to the river. This portion of the river was found to be in fair condition based on SVAP.

Cottonwood Creek

Cottonwood Creek is an intermittent stream. After high runoff events and during the irrigation season, the lower portion of Cottonwood Creek goes dry. The upper portion of the creek is covered with a diverse species of trees and willows and there is a large beaver complex. The middle portion of the creek is covered with cottonwoods and quaking aspen trees. The lower portion is lined with cottonwood trees. The stream bed is rocky and offers great fish habitat when there is water running through it. Livestock have access to the creek, but the banks appear to be in good condition.

Densmore Creek

Densmore Creek is also an intermittent stream. After high runoff events and during the agricultural watering season, it goes dry. Nearly all of the water is used for agricultural irrigation of crops and watering of livestock. The upper end of the creek runs through a deep mountain valley and the stream is severely incised. Because of the incised stream channel there is no flood plain. Grazing livestock have direct access to the stream nearly the entire extent of the stream. Quaking aspen trees and willows line the creek along the upper portion of the stream.

The middle portion of Densmore is lined with sagebrush and other woody species and the channel is lined with rock. Livestock have direct access to the stream, and there are some eroding banks. There is approximately a 400 foot drop in elevation from the top to the bottom of this reach. Because of the high velocity of the water there is approximately 1,400 feet of eroding banks.

The lower portion of Densmore runs through meadows and grazing livestock have direct access to the stream. There is a lack of willows and trees, and there are signs of erosion. Densmore Creek ranked fair on the SVAP. The creek bottom is lined with gravel as the stream runs through this reach. Also, the gradient of the stream is very flat.

Whiskey Creek

This is a spring fed creek and almost from its onset it runs through the state fish hatchery. Below the hatchery the stream has large amounts of sediment covering the streambed. There are a few hawthorns and willows which line the creek in the upper section. The banks are fenced off in the upper portion and livestock presence is minimal. The banks are in good condition.

The middle portion of Whiskey Creek runs through rangeland until it flows under Highway 34. There are lots of sedges and rushes that grow along its banks. Grazing livestock have direct access to the stream in this portion, but the banks appear to be in good condition.

The lower portion of the creek consists mainly of waterfalls. After the stream flows under Highway 34 it drops dramatically in elevation and the water falls are deeply incised. The stream enters the Bear River almost directly from the waterfalls. Whiskey Creek ranked good on the SVAP.

Williams Creek

The upper portion of this creek is heavily vegetated with willows and maples. There is a large beaver complex which stays full of water all year round. The water is clear and the banks are stable. Grazing livestock do have direct access to the stream. The middle portion of this creek is similar to the upper. There is a diverse community of plant species and the stream channel is rocky. The water is clear and flows all year round.

The lower portion of the stream is considered to be in fair condition. There is a lack of woody species and the banks are not as stable as those in the upper and middle sections. Grazing livestock have direct access to the stream. However, the impacts of grazing livestock have had minimal impacts on the stream banks throughout this reach.

When Williams Creek was monitored it was determined by IASCD to have the best water quality of any of the streams sampled in either the Northern or Southern Middle Bear subbasins. This stream is in good condition and is being petitioned by IDEQ to be removed from the §303(d) list. No TMDL was written for this stream.

Resource Concerns

Existing grazing management may not meet NRCS resource quality criteria or landowner objectives. Facilitation practices may be needed for riparian area improvement and livestock distribution. These concerns include plant productivity, health and vigor; streambank erosion; noxious and invasive plants; plant establishment and growth; inadequate domestic stock water; inadequate quantity/quality of feed/forage for domestic animals; and inadequate cover/shelter for wildlife. All resource concerns will be evaluated on a site-specific basis according to NRCS' Conservation Planning Process.

Suggested BMPs for Riparian Areas in the Northern Middle Bear Subbasin

The most common riparian problem is the lack of proper distribution of livestock grazing. The second most prolific problem is the lack of livestock watering facilities, which worsens the distribution problem. Drought periods and wildfires can cause problems with resulting forage shortages. The following list of BMPs are a few that could be recommended for riparian areas in the Northern Middle Bear subbasin: Prescribed Grazing (528); Watering Facility (614); Water Well (642); Pumping Plant (533); Streambank and Shoreline Protection (580); Spring Development (574); Pipeline (516); Fence (382); and Pest Management (595); Use Exclusion (472).

Pasture

Pasture ranges from low, wet meadows to rolling hills which border the valleys. Livestock utilization is during early spring and late fall, with a rest period in the summer. Fencing of property boundaries is generally an existing practice. Soils are deep with wetland inclusions with slopes from 0 to 10 percent. Vegetation ranges from native grass, sedge, and rush complexes in the wet meadows to improved forage species such as timothy, bromegrass, orchard grass, and clover in the uplands. Occasionally, these may be cut once during the summer as wild hay.

Cropland

One of the major BMPs that seemed to be consistent throughout the subbasin was the implementation of water and sediment control basins in highly erodible areas. The water and sediment control basins help to deal with the problem of gully erosion (NRCS, 2007). Water and sediment control basins have typically been used in areas which are not in permanent vegetative cover. These control methods for runoff events have proven to be a very effective solution, especially in places of high erosion and vulnerability to water related soil loss. Using water and sediment control basins will continue to be an option in the future to protect these highly erodible lands.

Dry Cropland

Dry cropland makes up the majority of the critical acres in the subbasin. Dry cropland is located along the valley margins on slopes ranging from 3 to 12 percent. Elevations along the valley margins range from 4,000 to 5,500 feet which shortens the growing season to about 120 days on average. Precipitation ranges from 10 to 14 inches per year, making this very marginal for producing crops without irrigation. To accommodate for this, most landowners have a winter small grain, fallow rotation. Tillage practices are fall disk, spring chisel with sweeps, summer chisel with sweeps, drill in the fall, and followed by the harvest. Some landowners are trying an annual small grain. This has had mixed results due to the lower yields and increase in weeds. Tillage practices with an annual grain rotation are fall disk, spring disk, drill, and then harvest.

Typical soils are silt loams with a soil loss tolerance (T) rating of 5 and an erosion factor of 0.43. Sheet and rill erosion are a problem due to the steep slopes. Steeper slopes have ephemeral and classic gully erosion. Dry cropland that has been converted to permanent vegetation or placed in the Conservation Reserve Program (CRP), applies to all slopes, soil types, and precipitation rages. Wildlife habitat and gully erosion are still a concern in areas that had very severe erosion before the conversion of permanent cover. There are approximately 10,595 acres of CRP in the subbasin. Nearly $6,007,365 has been spent over the lifespan of the CRP contracts in the subbasin.

Irrigated Cropland

Irrigated cropland is located along the lower valley margins and in the valley bottoms. Slopes range from 0 to 8 percent with steeper slopes sprinkler irrigated and some of the slopes surface irrigated. Soils are loamy sand and finer with T values 3 to 5. Precipitation ranges from 8 to 12 inches with a growing season of 100 to 120 days. Crops grown are alfalfa, small grain, potato, silage, and grain corn. Crop rotations have 5 years alfalfa and 1 to 3 years small grain, corn, and potato.

Dry Hayland

Dry hayland is located on 8 to 12 percent slopes. Soils are deep with variable textures. Fertilizers and pesticides are periodically applied. One cutting of introduced grass, alfalfa, or clover is typical with rotations lasting up to 10 years. Dry hayland is typically cut one time in the early summer, and then it allowed re-grow for fall feed. Cattle or other livestock are generally brought in to graze the ground from the mountains in the fall. Big game species are present in winter and early spring. Forage harvest management is usually an existing practice.

Irrigated Hayland

Irrigated hayland is found on 0 to 7 percent slopes. Precipitation is 12 inches or less per year and the growing season is approximately 100 to 120 days long. Small grains and alfalfa hay are grown in rotation with alfalfa and typically maintained for 4 to 6 years. Grazing of crop aftermath may occur. Due to the colder temperatures and shorter growing seasons in the subbasin, many producers are unable to grow more than three cuttings of hay. Therefore it is s common practice to allow the hay to grow as much as possible after the third cutting and then bring in grazing livestock.

Rangeland

Resource Setting

Rangeland vegetation consists of sagebrush and perennial grasses. Precipitation is 16 inches and greater, most of which falls as snow in winter and early spring. Elevations are from 4,500 to 7,500 feet. Topography consists of steep slopes and high mountain valleys. Soils are loamy to gravelly. Frost free period ranges from 80 to 120 days. Fencing is generally an existing practice.

Management/Rotation

Livestock are contained on private pastures while calving typically during the months of February, March, and the beginning of April. After calving, pairs are turned out onto other private pastures and cropland; and are either feed on alfalfa or graze pastures and crop aftermath as the snow melts until the 1st of June. Around the 1st of June, livestock are moved out to the higher ranges where they stay until the end of October or early November. In November, livestock are brought back to graze the crop aftermath. In December, managers/operators move livestock back to private pastures and graze until the snow flies, after which they start feeding alfalfa hay and other supplements.

Rangeland Assessment

We utilized our Rangeland WQI worksheets on four common resource areas in the Central Rocky, Wasatch, and Uinta Mountains. These rangeland assessments covered about 56,603 acres of private rangeland in the Northern Middle Bear subbasin including four resource types: Partly Forested Mountains, Semi-arid Bear Hills, High Mountains, and Semi-arid Foothills. Rangeland Water Quality Indicators were derived from the Water Quality Indicators Guide (WQIG) and allowed us to

evaluate and score the condition of eight factors on rangelands to determine water quality impacts and to rate the area in excellent, good, fair, or poor condition.

Current Condition

Approximately 40 percent of the private rangeland assessed in the Northern Middle Bear subbasin is in fair condition and has minimal impact on the water quality in the Bear River, Cottonwood Creek, Densmore Creek, Whiskey Creek, and Williams Creek. According to the results of the WQI, some sheet and rill erosion and classic gullies are evident on gravelly loam soils. Runoff potential is high on moderate to steep terrain on south facing slopes. North facing slopes have a lower runoff potential. Depending upon valley type and the location of the stream within that valley, natural vegetation buffers vary in width between 50 and 200 feet. Current grazing management results in 50 to 70 percent grass/shrub cover, creates few bare areas, and on dry years may exceed carrying capacity at different times of the year. Grazing animals have unlimited access to creeks and springs with minimal sources of livestock watering facilities. Animal productivity and health has no apparent issues under current management schemes.

Water Quality Impacts

The erosion potential is considerable because of the moderate to steep sloping gravelly loam soils, with rills and gullies during early summer. The majority of this sediment loss is associated with rill and gully erosion and is most evident on south facing slopes. Additional water quality impacts include sediment, nutrients, and bacteria from the unlimited livestock access to creeks and to springs for livestock watering.

Resource Concerns

Facilitation practices may be needed for range improvement and livestock distribution. These concerns include plant productivity, health and vigor; noxious and invasive plants; plant establishment and growth; inadequate domestic stock water; inadequate quantity/quality of feed and forage for domestic animals; and inadequate cover/shelter for wildlife. All resource concerns will be evaluated on a site-specific basis in accordance with NRCS' Conservation Planning Process.

Suggested BMPs on Rangelands in the Northern Middle Bear Subbasin

The most common rangeland problem is the lack of proper distribution of livestock grazing. The second most prolific problem is the lack of livestock watering facilities, which worsens the distribution problem. Drought and wildfires can cause problems resulting in forage shortages. Moreover, federal grazing allotment policy can create problems because additional private grazing must be secured or animals must stay longer on private rangelands. Consequently, the following BMPs are needed for rangelands in the Northern Middle Bear subbasin: Prescribed Grazing (528); Watering Facility (614); Water Well (642); Pumping Plant (533); Spring Development (574); Pipeline (516); Range Planting (550); Prescribed Burning (338); Brush Management (314); Fence (382); and Pest Management (595).

Threatened and Endangered Species

The only threatened and endangered species which might be found in the Northern Middle Bear subbasin is the Canada lynx (*Lynx canadensis*). The Northern Middle Bear subbasin contains no candidate or proposed species (NRCS, 1999). The US Fish and Wildlife Service (USFWS) are concerned about the population status and long-term viability of certain plants and animals in the Northern Middle Bear subbasin, which have no status under the Endangered Species Act. The

species of concern include: long-legged myotis (*Myotis volans*), pygmy rabbit (*Brachylagus idahoensis*), northern goshawk (*Accipiter gentiles*), Columbian sharp-tailed grouse (*Tympanchus phasianellus columbianus*), western burrowing owl (*Speotyto cunicularia hypugaea*), and the Bonneville cutthroat trout (*Oncorhynchus clarki utah*) (NRCS, 2007).

Bonneville Cutthroat Trout (BCT)

The Bear River is home to BCT. These trout migrate upstream to spawn in the early spring. Several different agencies including Idaho Department of Fish and Game (IDFG), Environmental Coordinating Committee (ECC), and Trout Unlimited along with others have donated monies and time to implement BMPs to improve stream channel conditions and stabilize shorelines to better the living conditions of these fish, which are considered a species of concern.

The BCT is a subspecies of cutthroat trout native to the Bonneville basin of Utah, Nevada, Idaho, and Wyoming. The desiccation of ancient Lake Bonneville restricted BCT to headwater streams and lakes within the subbasin. Human activities such as water development, agricultural development, energy development, mining, timber harvesting, grazing, over fishing, and the introduction of nonnative species have impacted BCT populations. The tenuous status of the remaining populations and their habitat has led to conservation efforts at the Federal, State, and local levels.

Animal Feeding Operations and Dairies

The Idaho Legislature enacted Idaho law, *I.C. §37-401, Title 37, Chapter 4, Sanitary Inspections of Dairy Products* which requires sanitary inspections and nutrient management plans for all dairy farms. Existing dairy farms were required to submit a nutrient management plan for approval to ISDA on or before July 1, 2001. Any new dairy farms are required to have an approved nutrient management plan before issuance of a milk permit. ISDA promulgated rules (IDAPA 02.04.14.000 et seq.) for dairy waste and they were adopted in 1997. Table 7 shows that there are currently 4 dairies in the subbasin ranging in size from 25 to 500 head (ISDA, 2007).

The Idaho Legislature passed Idaho law, *I.C. §22-4906, Title 22, Chapter 49, Beef Cattle Environmental Control Ac*, in 2000. ISDA promulgated rules (IDAPA 02.04.15.000 et seq.) which became effective in September 2000. Beef cattle animal feed operations are required to submit a nutrient management plan to ISDA for approval no later than January 1, 2005. ISDA, ISCC, and IASCD conducted a preliminary inventory and identified approximately one potential site with animal feed operations, corrals or pens within the subbasin.

Table 7. AFOs in the Northern Middle Bear Subbasin. (Smith, S., Banks, C., & Wakely, M., 2007)

Operation Type	Number of Facilities	Number of Head
Dairy	4	25 to 500
Feedlots	1	25 to 1,000

TREATMENT

Treatment Units (TU)

The following Treatment Units (TUs) describe areas in the Northern Middle Bear subbasin with similar land uses, soils, productivity, resource concerns, and treatment needs. These TUs not only provide a method for delineating and describing land use, but are also used to evaluate land use impacts to water quality and in the formulation of alternatives for solving water quality problems. BMPs to improve water quality are suggested for each treatment unit.

Critical Acres

ISCC and IASCD personnel spent time assessing lands and speaking with landowners in the Northern Middle Bear subbasin to determine areas of agricultural lands which contribute excessive amounts of pollutants to water bodies defined as "critical areas". These critical areas will be used for determining BMP implementation. Critical areas are prioritized for treatment based on their location to a water body of concern and the potential for pollutant transport and delivery to the receiving water body. Critical areas are those areas in which treatment is considered necessary to address resource concerns affecting water quality.

The subbasin is divided into four TUs: riparian, cropland, rangeland, and animal facilities, that have similar land uses, soils, productivity, resource concerns and treatment needs. The subwatershed amount that falls under each of the treatment units is provided in Table 8.

Table 8. Treatment Units in the Northern Middle Bear Subbasin

	TU 1	TU 2	TU 3	TU 4
Subwatershed	Riparian Acres	Cropland Acres	Rangeland Acres	Animal Facilities (No.)
Bear River	2,896	55,063	45,801	3
Cottonwood Creek	44	3,196	4,618	1
Densmore Creek	62	1,173	4,258	0
Whiskey Creek	26	1,174	0	1
Williams Creek	27	227	713	0
TOTAL:	3,055	60,833	55,390	5

Recommended BMPs and Estimated Costs

BMPs appropriate for the reduction of agricultural impacts to water quality in the Northern Middle Bear subbasin and their installation costs are listed below in Table 9. Individual conservation planning with willing landowners will determine the most appropriate BMPs to install on a case by case basis. The information included in Table 9 provides an estimate only of the BMPs recommended for critical acres in the subbasin and their approximate costs. A more precise estimate of quantities of each BMP recommended to install will be determined at the time of conservation planning for a particular landowner.

Table 9. Estimated Cost of BMPS in the Northern Middle Bear Subbasin

Treatment Unit	Best Management Practice	Unit Type	Unit Cost	Unit Amount	Total Funds
TU1 Stream Channels & Riparian	Channel Vegetation	acre	$2,100	191	$401,100
	Conservation Cover	acre	$60	192	$11,520
	Critical Area Planting	acre	$250	114	$28,500
	Fence, 4-wire	foot	$2	30,518	$61,036
	Heavy Use Area Protection	acre	$50	22	$1,100
	Pest Management	acre	$20	382	$7,640
	Prescribed Grazing	acre	$5	761	$3,805
	Riparian Forest Buffer	acre	$185	192	$35,520
	Stream Bank Protection	foot	$20	3,052	$61,040
	Stream Channel Stabilization	foot	$35	1,221	$42,735
	Tree/Shrub Establishment	acre	$290	152	$44,080
	Use Exclusion (Riparian)	acre	$100	192	$19,200
				Subtotal	$717,276
TU2 Croplands	Contour Farming	acre	$3	22,811	$68,433
	Conservation Crop Rotation	acre	$2	22,811	$45,622
	Field Border	acre	$88	4,563	$401,544
	Critical Area Planting	acre	$200	1,521	$304,200
	Deep Tillage	acre	$16	22,811	$364,976
	Drip Irrigation	each	$2	31,680	$63,360
	Nutrient Management	acre	$3	30,414	$91,242
	Pasture & Hayland Planting	acre	$100	15,209	$1,520,900
	Pest Management	acre	$20	7,604	$152,080
	Residue Management	acre	$20	15,209	$304,180
	Water & Sediment Control Basin	each	$800	609	$487,200
	Windbreak/Shelterbelt	foot	$4	31,680	$126,720
				Subtotal	$3,930,457
TU3 Rangelands	Brush Management	acre	$30	6,923	$207,690
	Fence, 4-wire	foot	$2	121,844	$243,688
	Pest Management	acre	$20	4,153	$83,060
	Pipeline, PE 100 psi, 2.0"	foot	$2	152,306	$304,612
	Prescribed Grazing	acre	$3	13,846	$41,538
	Pumping plant for Water Control	each	$5,000	21	$105,000
	Range Planting	acre	$80	6,923	$553,840
	Spring Development	each	$2,400	28	$67,200
	Structure For Water Control	each	$3,000	2	$6,000
	Water Well	each	$8,250	13	$107,250
	Watering Facility	each	$1,150	115	$132,250
				Subtotal	$1,852,128
TU4 Animal Facility	Corral Fence	foot	$15	21,000	$315,000
	Nutrient Management	acre	$3	280	$840
	Pipeline	foot	$2	14,000	$28,000
	Pumping Plant for Water Facility	each	$3,000	14	$42,000
	Water Well	each	$8,250	14	$115,500
	Waste Storage Facility	each	$20,000	14	$280,000
				Subtotal	$781,340
				Total	$7,281,201

IMPLEMENTATION

The following implementation alternatives were developed on TUs for consideration:

1. No action
2. Land treatment with non-structural BMPs on crop and rangelands
3. Land treatment with structural and non-structural BMPs on crop and rangelands
4. Riparian and stream channel restoration
5. Animal facilities/waste management

Description of Alternatives

Alternative 1 – No action

This alternative continues the existing conservation programs without additional project activities. Current problems would continue to negatively impact beneficial uses.

Alternative 2 – Land treatment with non-structural BMPs on crop and rangelands

This alternative would reduce accelerated sheet and rill erosion and gully erosion. This would improve water quality and reduce pollutant loading to the §303(d) stream segments in the Northern Middle Bear subbasin. Beneficial uses may be improved with this alternative which includes voluntary landowner participation.

Alternative 3 – Land treatment with structural and non-structural BMPs on crop and rangelands

This alternative would reduce accelerated sheet and rill erosion and gully erosion. It is anticipated that this alternative will reduce soil erosion. This would improve water quality and reduce pollutant loading to the §303(d) streams in subbasin. Beneficial uses would be improved or achieved with implementation of this alternative. This alternative includes voluntary landowner participation.

Alternative 4 – Riparian and stream channel restoration

This alternative would reduce stream erosion. This alternative would improve water quality, riparian vegetation, aquatic habitat and fish passage in the subbasin. Beneficial uses would be improved with implementation of this alternative. This alternative includes voluntary landowner participation.

Alternative 5 – Animal Facilities/Waste Management

This alternative would reduce sediment and nutrient runoff from animal facilities. This would improve water quality and reduce pollutant loading to the §303(d) streams in subbasin. This alternative includes voluntary and mandatory landowner participation.

Implementation Priority

Both the Caribou SCD and Franklin SWCD determined a ranking priority for BMP alternatives. The districts came to a unanimous decision that they would focus on the alternatives in the following order: 1st priority is Alternative four, 2nd priority is Alternative five, 3rd priority is Alternative three, 4th priority is Alternative two, and they chose to rule out Alternative one, which calls for no action to be taken in regards to implementing BMPs and conserving natural resources. Table 10 is a list of anticipated deadlines for the development of conservation plans and contracts, BMP designs, installation of BMPs, administration, and maintenance of BMPs, as well as final reports for installed and completed projects.

Table 10. Estimated Timeline for TMDL Agricultural Implementation

Task	Output	Milestone
Develop conservation plans and contracts	Completed contract agreements	2012
Finalize BMP designs	Completed BMP plans and designs	2015
Design and install approved BMPs	Certify BMP installations	2018
Track BMP installation	Implementation progress report	2022
Evaluate BMP & project effectiveness	Complete project effectiveness report	2025

FUNDING

Financial and technical assistance for installation of BMPs is needed to ensure success of this implementation plan. The Caribou SCD and the Franklin SWCD will actively pursue multiple potential funding sources to implement water quality improvements on private agricultural and grazing lands. These sources include (but are not limited to):

(WQPA) The Water Quality Program for Agriculture;
(RCRDP) The Resource Conservation and Rangeland Development Loan Program;
(CIG) Conservation Improvement Grants;
(SRF) State Revolving Loan Funds are all administered by the ISCC to implement agricultural BMPs or to purchase equipment to increase conservation. http://www.scc.state.id.us/programs.htm

(CWA) Clean Water Act §319 Subgrants are EPA funds that are allocated to the State of Idaho. The IDEQ has primacy to administer the Clean Water Act §319 Nonpoint Source Management Program. Funds focus on projects to improve water quality, and are usually related to the TMDL process. http://www.deq.state.id.us/

(PL-566) The Watershed Protection and Flood Prevention Act (PL 83-566) authorized NRCS to cooperate with States and local agencies to carry out works of improvement for soil conservation and for other purposes including flood prevention; conservation, development, utilization and disposal of water; and conservation and proper utilization of land. http://www.nrcs.usda.gov/programs/watershed/

(AMA) Agricultural Management Assistance provides cost-share assistance to agricultural producers for constructing or improving water management structures or irrigation structures; planting trees for windbreaks or to improve water quality; and mitigating risk through production diversification or resource conservation practices, including soil erosion control, integrated pest management, or transition to organic farming. http://www.nrcs.usda.gov/programs/ama/

(CRP) Conservation Reserve Program is a voluntary program for agricultural landowners. Through CRP, you can receive annual rental payments and cost-share assistance to establish long-term, resource conserving covers on eligible farmland. http://www.fsa.usda.gov

(CTA) Conservation Technical Assistance provides free technical assistance to help farmers and ranchers identify and solve natural resource problems on their farms and ranches. This might come as advice and counsel, through the design and implementation of a practice or treatment, or as part of

an active conservation plan. This is provided through your local Conservation District and NRCS. http://www.nrcs.usda.gov/programs/cta/

(CCPI) Cooperative Conservation Partnership Initiative is a voluntary program established to foster conservation partnerships that focus technical and financial resources on conservation priorities in watersheds and airsheds of special significance. http://www.nrcs.usda.gov/programs/ccpi/index.html

(EQIP) Environmental Quality Incentives Program offers cost-share and incentive payments and technical help to assist eligible participants in installing or implementing structural and management practices on eligible agricultural land. http://www.nrcs.usda.gov/programs/eqip/

(WRP) Wetlands Reserve Program is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. Easements and restoration payments are offered as part of the program. http://www.nrcs.usda.gov/programs/wrp/

(WHIP) Wildlife Habitat Incentives Program is a voluntary program for people who want to develop and improve wildlife habitat primarily on private land. Cost-share payments for construction or re-establishment of wetlands may be included. http://www.nrcs.usda.gov/programs/whip/

(GRP) Grassland Reserve Program is a voluntary program offering landowners the opportunity to protect, restore, and enhance grasslands on their property. http://www.nrcs.usda.gov/programs/GRP/

(CSP) Conservation Security Program is a voluntary program that rewards the Nation's premier farm and ranch land conservationists who meet the highest standards of conservation environmental management. http://www.nrcs.usda.gov/programs/csp/

(GLCI) Grazing Land Conservation Initiative provides high quality technical assistance on privately owned grazing lands on a voluntary basis and to increase the awareness of the importance of grazing land resources. http://www.glci.org/

(CPGL) Conservation of Private Grazing Land initiative will ensure that technical, educational, and related assistance is provided to those who own private grazing lands. http://www.nrcs.usda.gov/programs/cpgl/

(EWP) Emergency Watershed Protection Program is to undertake emergency measures, including the purchase of flood plain easements, for runoff retardation and soil erosion prevention to safeguard lives and property from floods, drought, and the products of erosion on any watershed whenever fire, flood or any other natural occurrence is causing or has caused a sudden impairment of the watershed. http://www.nrcs.usda.gov/programs/ewp/

Many of these programs can be used in combination with each other to implement BMPs.

OUTREACH

The conservation partnership (Caribou SCD, Franklin SWCD, ISCC, USDA/NRCS, FSA, U of I Extension Service, ISDA, and county officials) will use their combined resources to provide information to agricultural landowners and operators within the Northern Middle Bear subbasin. A local outreach plan can be developed by the conservation partnership. Newspaper articles, district newsletters, watershed and project tours, landowner meetings, and one-on-one personal contact would be used as outreach tools. Outreach efforts will:

- Provide information about the TMDL process
- Supply water quality monitoring results
- Accelerate the development of conservation plans and program participation
- Distribute progress reports
- Enhance technology transfer related to BMP implementation
- Increase public understanding of agriculture's contribution to conserve and enhance natural resources
- Improve public appreciation of agriculture's commitment to meeting the TMDL challenge
- Organize an informational tour bringing together irrigation districts, soil conservation districts, and others
- Identify and encourage the use of BMPs for recreation activities on the subbasin

MONITORING AND EVALUATION

Field Level

At the field level, annual status reviews will be conducted to insure that the contract is on schedule, and that BMPs are being installed according to standards and specifications. BMP effectiveness monitoring will be conducted on installed projects to determine installation adequacy, operation consistency and maintenance, and the relative effectiveness of implemented BMPs in reducing water quality impacts. This monitoring will also measure the effectiveness of BMPs in controlling agricultural nonpoint-source pollution. These BMP effectiveness evaluations will be conducted according to the protocols outlined in the ISCC's Agriculture Pollution Abatement Plan (APAP) and ISCC's Field Guide for Evaluating BMP Effectiveness (ISCC, 2003).

The Revised Universal Soil Loss Equation (RUSLE) and Surface Irrigation Soil Loss (SISL) Equation are used to predict sheet and rill erosion on non-irrigated and irrigated lands. The Alutin Method, Imhoff Cones, and direct-volume measurements are used to determine sheet and rill irrigation-induced and gully erosion. SVAP and Stream Erosion Condition Inventory (SECI) are used to assess aquatic habitat, streambank erosion, and lateral recession rates. The Idaho One Plan's CAFO/AFO Assessment Worksheet is used to evaluate livestock waste, feeding, storage, and application areas. The WQIG is utilized to assess nitrogen, phosphorus, sediment, and bacteria contamination from agricultural land.

Subbasin Level

At the subbasin level, there are many governmental and private groups involved with water quality monitoring. The IDEQ uses the Beneficial Use Reconnaissance Protocol (BURP) to collect and measure key water quality variables that aid in determining the beneficial use support status of

Idaho's water bodies. The determination will tell if a water body is in compliance with water quality standards and criteria. In addition, IDEQ will be conducting five-year TMDL reviews.

Annual reviews for funded projects will be conducted to insure the project is kept on schedule. With many projects being implemented across the state, ISCC developed a software program to track the costs and other details of each BMP installed. This program can show what has been installed by project, by watershed level, by subbasin level, and by state level. These project and program reviews will insure that TMDL implementation remains on schedule and on target. Monitoring BMPs and projects will be the key to a successful application of the adaptive watershed planning and implementation process.

REFERENCES

[CSCD] Caribou Soil Conservation District. 2007. Five Year Plan. Caribou Soil Conservation District. Soda Springs, Idaho.

[FSWCD] Franklin Soil and Water Conservation District. 2007. Five Year Plan. Franklin Soil and Water Conservation District. Preston, Idaho.

[IDEQ] Idaho Department of Environmental Quality. 2006. Bear River Basin/Malad Subbasin Assessment and Total Maximum Daily Load Plan. Idaho Department of Environmental Quality. Pocatello, Idaho.

[IDEQ] Division of Environmental Quality. 1998. 1998 §303(d) list. State of Idaho, Division of Environmental Quality. Pocatello, Idaho.

[IDEQ] Idaho Department of Environmental Quality. 1999. Beneficial use reconnaissance project: work plan for wade-able streams. Idaho Department of Environmental Quality, Boise, Idaho.

IDEQ and ISCC. 2003. *Idaho Agricultural Best Management Practices*. Boise Idaho: Resource Unlimited Inc.

[ISDA] Idaho State Department of Agriculture. 2000. The Idaho Beef Cattle Environmental Control Memorandum of Understanding, 7pp. ISDA. Boise, Idaho.

[ISDA] Idaho State Department of Agriculture. 2000. Beef Cattle Animal Feeding Operation Program, 3pp. ISDA. Boise, Idaho.

[IDWR] Idaho Department of Water Resources. 2000. Idaho GIS Data website. http://www.idwr.state.id.us/gisdata/gis_data.htm.

Resource Planning Unlimited, Inc. 2003. Idaho Agriculture Pollution Abatement Plan. Idaho Department of Environmental Quality and Idaho Soil Conservation Commission. Boise, Idaho.

Jenkins, A. 2007. Middle Bear Subbasin. Water Quality Monitoring Report, ARJ-MB-07. Idaho Association of Soil Conservation Districts. Pocatello, Idaho.

Smith, S., Banks, C., and Wakely, M. 2007. Field Inventory and Contacts of AFOs/CAFOs. Northern Middle Bear Subbasin. Soda Springs, Idaho.

Sorenson, D.L., C.W. Ariss, P Ludrigen, S Erbel, W.J. Greeney, V.D. Adams. 1984. Water Quality Management Studies for Water Resources Development in the Bear River Basin: Second Progress Report. Utah Water Research Laboratory, Utah State University, Logan Utah.

Sorenson, D.L., C. Caupp, W.J. Grenney. S Eberl, J.J. Messer, P. Ludrigsen, C.W. Ariss. 1986. Water Quality Management Studies of Water Resources Development in the Bear River Basin. Utah Water Research Laboratory Utah State University. Logan, Utah.

USDA, [NRCS] Natural Resource Conservation Service. 2008. Threatened and Endangered Species, NRCS EFOTG, Section 1. http://www.nrcs.usda.gov/technical/efotg/

USDA, [NRCS] Natural Resource Conservation Service. 2008. Conservation Management Systems, NRCS EFOTG, Section 3. http://www.nrcs.usda.gov/technical/efotg/

USDA, [NRCS] Natural Resource Conservation Service. 2008. NRCS Geospatial Data Gateway http://datagateway.nrcs.usda.gov/

USDA, [NRCS] Natural Resource Conservation Service. 2007. Middle Bear-16010202, Rapid Watershed Assessment. Natural Resource Conservation Service. Boise, Idaho.

USDA, [NRCS] Natural Resource Conservation Service. 2004. NRCS CRA Report. ftp://ftp-fc.sc.egov.usda.gov/ID/technical/pdffiles/IdahoCRAReport.pdf.

USDA, [NRCS] Natural Resource Conservation Service. 2003. National Range and Pasture Handbook, Grazing Lands Technology Institute. http://www.glti.nrcs.usda.gov/technical/publications/nrph.html.

USDA, [NRCS] Natural Resource Conservation Service. 1989. Water Quality Indicators Guide. http://www.id.nrcs.usda.gov/technical/wq_indicators_guide.html.

USGS. Data calculated from 24,000-scale stream hydrography and orthophoto quadrangles.