1. Subbasin Assessment – Watershed Characterization

1.1 Introduction

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to §303 of the CWA, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list (a "§303(d) list") of impaired waters. Currently this list must be published every two years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. (In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.)

This document addresses the water bodies in the Salmon Falls Creek Subbasin that have been placed on Idaho's current §303(d) list. Also included is a summary of the water body assessment outcomes for the unlisted water bodies assessed for the integrated report and 303(d) listing cycle.

The overall purpose of the subbasin assessment (SBA) and TMDL is to characterize and document pollutant loads within the Salmon Falls Creek Subbasin. The first portion of this document, the SBA, is partitioned into four major sections: watershed characterization, water quality concerns and status, pollutant source inventory, and a summary of past and present pollution control efforts (Sections 1 – 4). This information will then be used to determine the pollutant(s) of concern and to develop a TMDL for each of these pollutants of concern for the Salmon Falls Creek Subbasin (Section 5).

In 1972, Congress passed the Federal Water Pollution Control Act, more commonly called the Clean Water Act. The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Water Environment Federation 1987, p. 9). The act and the programs it has generated have changed over the years and continue to change, as experience and perceptions of water quality have changed.

The CWA has been amended 15 times, most significantly in 1977, 1981, and 1987. One of the goals of the 1977 amendment was protecting and managing waters to insure "swimmable and fishable" conditions. This goal, along with a 1972 goal to restore and maintain chemical, physical, and biological integrity, relates water quality with more than just chemistry.

Some conditions that impair water quality do not receive TMDLs. The EPA considers certain unnatural conditions, such as flow alteration, a lack of flow, or habitat alteration, that are not the result of the discharge of specific pollutants as “pollution.” TMDLs are not required under the CWA for water bodies impaired by pollution, but not by specific pollutants. A TMDL is only required when a pollutant can be identified. However, often a stream will be found to be impaired by several pollutants as well as pollution. In those cases the best management practices (BMP) used to complete the required load reductions for the specified pollutants will likely also address the effects of pollution. In most circumstances, the BMPs for many pollutants and pollution are one and the same. In effect creating the desired effect of restoring beneficial uses impaired by pollution. In those cases, a de facto TMDL for pollution is then created by the TMDLs for specific pollutants.

However, in some rare cases, such as Cedar Creek, flow alteration is the only factor impairing the beneficial uses. In these circumstances the stream is retained on the 303(d) list until such time as pollution can be addressed or a Use Attainability Analysis can be completed.

Idaho adopts water quality standards to protect public health and welfare, enhance the quality of water, and protect biological integrity. A water quality standard defines the goals of a water body by designating the use or uses for the water, setting criteria necessary to protect those uses, and preventing degradation of water quality through antidegradation provisions.

The state may assign or designate beneficial uses for particular Idaho water bodies to support. These beneficial uses are identified in the Idaho water quality standards and include the following:

- Aquatic life support – cold water, seasonal cold water, warm water, salmonid spawning, modified

- Contact recreation – primary (swimming), secondary (fishing or boating)

- Water supply – domestic, agricultural, industrial

- Wildlife habitats, aesthetics

The Idaho legislature designates uses for water bodies. Industrial water supply, wildlife habitat, and aesthetics are designated beneficial uses for all water bodies in the state. If a water body is unclassified, then cold water and primary contact recreation are the default designated uses when water bodies are assessed.

In the Salmon Falls Creek Subbasin, only four assessment units or stream segments have been so designated. These designated assessment units include: Salmon Falls Creek from Nevada/Idaho border to Salmon Falls Creek Reservoir; Salmon Falls Creek Reservoir; and Salmon Falls Creek from Salmon Falls Creek Reservoir to the Snake River (two assessment units). The remainder of the water bodies within the Salmon Falls Creek Subbasin are unclassified.

A SBA entails analyzing and integrating multiple types of water body data, such as biological, physical/chemical, and landscape data to address several objectives:

- Determine the degree of designated beneficial use support of the water body (i.e., attaining or not attaining water quality standards).

- Determine the degree of achievement of biological integrity.

- Compile descriptive information about the water body, particularly the identity and location of pollutant sources.

- When water bodies are not attaining water quality standards, determine the causes and extent of the impairment.

1.2 Physical and Biological Characteristics

The characterization of the Salmon Falls Creek Subbasin (Figure 3) will be based on its physical and biological features and how they interplay with ecoregional and hydrological traits. The Salmon Falls Creek Subbasin is complex in its characterization, principally due to a plurality of land types within the Idaho portion of the subbasin. There are highly accessible areas where agricultural, pastureland, and row crop activities dominate the land use. Adjacent to these lands, and predominating the subbasin, are the low mountainous and sage-steppe areas from which the majority of water in the subbasin comes and rangeland land use activities dominate.

Additionally, there are many sources of water in the subbasin. Much of the water for the smaller streams (e.g. Cottonwood Creek and Big Creek) comes from snowpack and rainfall in the mountain ranges in the eastern portion of the subbasin. However, many of the smaller feeder streams along the western portion of the subbasin arise from springs (e.g. China Creek, and House Creek).

To further complicate the analysis, some of the streams within the subbasin gain a portion of their water from thermal sources (e.g. Hot Creek, Salmon Falls Creek, and Shoshone Creek) and hydrological modifications have essentially dewatered at least two of the streams located within the subbasin. Both Cedar Creek and Salmon Falls Creek have been disconnected from their natural headwaters and must rely on seep water or springs to regenerate any significant flow below their respective dams. In the case of Cedar Creek, these water sources do not exist and the stream has been dry since the construction of the dam in 1912. Unlike Cedar Creek, Salmon Falls Creek (built in 1906) gains water throughout the lower portion of its watershed from water seeping around the dam and from numerous springs and irrigation returns.

Adding to the subbasin complexity is the issue of nonpoint source pollution within the watersheds. Many factors influence the type and rate of nonpoint source pollution, such as soil characteristics, climate, vegetation, and topography, as well as land use and population centers.

Land use in the subbasin is predominantly rangeland (89 percent). Irrigated agriculture also exists in the lower elevation, northern portion of the subbasin where water is either pumped from the ground or diverted from Salmon Falls Creek Reservoir or Cedar Creek Reservoir. The subbasin is somewhat unique in that (in the Idaho portion) the major population centers impacting the basin are outside of the subbasin. The cities and towns of Twin Falls, Rogerson, and Hollister are where the majority of landowners, recreationists, and land managers reside. Within the Idaho portion of the subbasin most of the row crop agricultural areas are near the community of Castleford. Other communities within the subbasin include Jackpot and Contact, Nevada.

The subbasin contains three different water sources. The first of these is runoff from the snowpack and other precipitation events in the mountainous region to the south and west. The second is the Salmon Falls/Rock Creek Aquifer below the northern portion of the subbasin (Crosthwaite 1969). Salmon Falls Creek is the southern-most border between the Eastern Snake River Plain Aquifer and the Western Snake River Plain Aquifer (Garabedian 1992). The final source is a geothermal aquifer layer that feeds several geothermal springs along the ecoregional boundary. These sources affect water quality to varying degrees. Water from the geothermal aquifer may affect water quality significantly in some portions of the subbasin, Hot Creek in particular.

The subbasin land forms, vegetation, topography, and precipitation can be defined by two ecoregions. The predominant ecoregion of the subbasin is the Northern Basin and Range. The Northern Basin and Range ecoregion is predominantly sage-steppe-juniper mountain lands. Most of the surface streams are intermittent or ephemeral in nature due to low annual precipitation and high seasonal evaporation. Consequently, limited riparian habitat exists within the subbasin. Those streams that remain perennial usually form from spring sources in the more mountainous regions of the subbasin. Along these stream courses some riparian habitats persist.

Sediment, nutrients, and temperature were the most common listed pollutants in the subbasin in 2004. These pollutants were listed on the most of the 2004 §303(d) listed Assessment Units within the subbasin (Figure 4). Other listed pollutants and stressors (pollution) included flow alteration, bacteria, organic enrichment, and mercury. The SBA portion of the SBA-TMDL determines the current amount of a particular pollutant in each of the watersheds of the §303(d) listed assessment units. The SBA also determines what impact to the beneficial uses each pollutant may have.

Climate

The Salmon Falls Creek Subbasin begins in the mountains and highlands located along the southern and western boundaries of the subbasin and reaches northward to the lowlands of the Snake River Basin/High Desert ecoregion in the northern edges of the subbasin. The pronounced differences in climate from the mountains to the Snake River Plain are due to the elevation difference across the subbasin. Precipitation varies from 10.1 (in)/year in the lower elevations at Castleford to 20.9 to 38.2 in/year on the mountain summits (See Appendix A for unit conversion factors).

Using the Koeppen system of climate classification (Figure 5), the majority of the subbasin is considered cold steppes (Bsk) with localized areas of Humid Continental areas with precipitation being evenly distributed and warm short summers (Dfb) to precipitation concentrated during the winter with warm short summers (Dsb) (See http://www.met.tamu.edu/class/metr324/Slide56-57.pdf for more detail in determining Koeppen climate classification.)

Three climate stations (Jackpot NV 264016, Hollister, ID 104295, and Castleford ID 101551) from the Western Regional Climate Center (www.wrcc.dri.edu 2004) are available near the subbasin to characterize the watershed. Because the majority of the climate stations are outside of the subbasin, there are few data sets available to characterize the bulk of the subbasin. As noted, nearly all the perennial flow in this watershed comes from the mountainous areas of the subbasin, which do not have climate station data.

The town of Jackpot NV is in the southern portion of the subbasin near the Idaho border. The town is at approximately 5,248 feet (ft) in elevation. The climate is arid with an annual precipitation of less than 9.8 inches. Approximately 40 percent of the precipitation falls in the spring (March to May). The average snow depth in the winter months is 1 inch, except in January, which averages approximately 2 inches. This indicates that precipitation in the form of snow does not accumulate to provide for a spring snowmelt runoff in the lower southern portions of the subbasin. The wettest months of the year are April, May, and June (1.1, 2.0, and 1.4 inches respectively), while the driest months are December (0.5 in) February (0.4 in), and July (0.4 in). However, for the remainder of the year, outside of the wettest and driest three, average precipitation is near 0.6 inch per month. The monthly average precipitation is approximately 0.8 inch a month due in part to the relatively moist average conditions in May. The average annual maximum temperature for the Jackpot area is 60.4 °F, with the average annual minimum temperatures of 32.4 °F.

The town of Hollister is approximately 27 miles (km) north of the NV/ID border in the Snake River Basin Ecoregion. Hollister lies at 4,513 ft elevation. It is an arid climate, with an annual mean precipitation of just under 10.1 inches. Approximately 30 percent of the precipitation falls in the spring (March to May) and approximately 20 percent falls during each of the other seasons. The average snow depth in the winter months is effectively zero. This indicates that precipitation in the form of snow does not accumulate to provide for a spring snowmelt runoff in the lower middle portions of the subbasin. The wettest months of the year are January, May, and June (1.0, 1.4, and 1.2 inches respectively), while the driest months are February (0.6 inch), July (0.5 inch), and August (0.5 inch). Annual average monthly precipitation is 0.8 inch per month. The average annual maximum temperature for the Hollister area is 94.8 °F, with the average annual minimum temperatures of 34.9 °F.

The town of Castleford is in the northern portion of the subbasin, it is also located in the Bsk cold steppe climate area, and is well within the Snake River Basin Ecoregion. Castleford lies at 3,864 ft elevation. It is an arid climate, with an annual mean precipitation of just under 10.1 inches. Typical of cold steppe climates, most of the precipitation that falls in the Castleford area falls in the winter while the summer months are some of driest. Approximately 30 percent of the precipitation falls in the spring (March to May) and another 30 percent falls during the winter months. The average snow depth in the winter months is 0.7 inch. This indicates that precipitation in the form of snow may accumulate to provide for some spring snowmelt runoff in the northern portions of the subbasin. The wettest months of the year are January, May, and December (1.2, 1.2, and 1.1 inches respectively), while the driest months are July (0.2 inch), August (0.4 inch), and September (0.5 inch). Annual average monthly precipitation is 0.8 inch per month. The average annual maximum temperature for the Castleford area is 62.4 °F, with the average annual minimum temperatures of 35.4 °F.

Four SNOTEL sites can be used to determine snow pack and to make runoff predictions for the water-year. Two of these sites are in Idaho and are Wilson Creek located at 7,120 feet in the North Fork of Salmon Falls Creek Watershed and Magic Mountain at 6,880 feet in the Rock Creek Watershed of the Upper Snake-Rock Creek Subbasin and also includes the watershed of Shoshone Creek in the Salmon Falls Creek Subbasin.

The Nevada SNOTEL sites include Pole Creek Ranger Station at 8,330 feet in the Canyon Creek Watershed of the Salmon Falls Creek Subbasin, Draw Creek at 7,200 feet in the South Fork of Salmon Falls Creek Watershed of the Salmon Falls Creek Subbasin. Information from these SNOTEL sites can be found at http://www.wcc.nrcs.usda.gov/snotel/Nevada/nevada.html and http://www.wcc.nrcs.usda.gov/snotel/Idaho/idaho.html.

Monthly and yearly averages from the four sites are presented in Tables 4 and 5.

Table 4. Monthly Average Precipitation (inches).

MONTH	WILSON CREEK	MAGIC MOUNTAIN	POLE CREEK	DRAW CREEK	MONTHLY AVERAGE
1	3.16	4.13	2.00	2.67	2.99
2	2.54	3.55	1.88	2.24	2.55
3	2.73	3.56	2.37	1.90	2.64
4	4.03	3.62	2.30	1.58	2.88
5	2.89	3.17	2.62	1.80	2.62
6	1.94	1.73	1.67	1.07	1.60
7	0.66	0.82	1.03	0.68	0.80
8	0.64	0.74	0.77	0.50	0.66
9	0.97	1.05	1.03	0.67	0.93
10	1.34	1.75	1.17	1.06	1.33
11	2.92	4.10	2.15	2.63	2.95
12	3.08	4.58	2.15	2.38	3.05

Table 5. Annual Average SNOTEL Precipitation (inches).

YEAR	WILSON CREEK	MAGIC MOUNTAIN	POLE CREEK	DRAW CREEK
1981				18.7
1982		31.4		28.9
1983		36.7		30.3
1984		51	23.7	28.5
1985		41	16.9	19.5
1986		29.1	19.3	21.3
1987		33.7	16.1	19.3
1988		25.9	18.4	18.8
1989		34	15.2	16.5
1990		22	18.1	20.6
1991	28.8	29.6	16.5	21.6
1992	20.6	25.1	17	16.4
1993	29.9	32.4	18.5	20.4
1994	26.8	31.8	15.6	21.4
1995	33.5	40.2	22.8	26.2
1996	30.8	43.9	28	24.1
1997	28.1	30.3	18.2	21.2
1998	30.5	41.1	26.4	27.6
1999	24.1	28.4	17.8	18
2000	25.8	30.3	18.7	16.6
2001	23.3	30	21.1	16.6

YEAR	WILSON CREEK	MAGIC MOUNTAIN	POLE CREEK	DRAW CREEK
2002	22.2	24.1	14.3	16.6
2003	25.5	29.1	20.3	17.7
Annual Average	26.92	32.78	20.91	19.15

It is apparent from these tables that appreciably more precipitation falls in the mountains than in the lowland where the weather stations are located. Also notable is that more precipitation falls in the mountains of Idaho than those in the Nevada region. As a result, the streams fed by the Cassia Mountains should provide for more perennial streams such as Big Creek, Cottonwood Creek and Shoshone Creek. Were as, the streams from the Nevada portion should be expected to be intermittent or ephemeral if they rely solely on runoff from precipitation falling in the mountains. Examples of these would be Player Creek, Cottonwood Creek (a tributary stream of Salmon Falls Creek not Shoshone Creek, located solely in Nevada), Corral Creek, and Whiskey Slough.

Subbasin Characteristics

Water in the Salmon Falls Creek Subbasin moves through a variety of pathways. Generally, the natural hydrology of an area is the result of its climactic regime, topography, and geology. Topography seems to play the most significant role in determining the location of perennial water within the subbasin as the other two factors are fairly uniform throughout the subbasin. Most of the perennial streams have some origin in the mountainous areas of the subbasin. Mountainous areas are located principally in the southwest portion and southeastern portions of the subbasin (Figure 6). In the southwestern portion the Browns Bench (China and House assessment units), the Bad Lands in Nevada, and Granite Range also in Nevada (Salmon Falls and North Fork of Salmon Falls assessment units) provide snowpack and groundwater for much of the perennial watersheds. The mountainous region to the southeast serves as the headwater areas of Big Creek, Hot Creek and Shoshone Creek assessment units. In general, the Salmon Falls Creek and Shoshone Creek routes dominate the subbasin. Except for these two major drainages, most of the surface channels are intermittent or ephemeral tributaries.

Stream Characteristics

The EPA reach file identifies numerous streams as perennial within the subbasin. Further investigations, ground-truthing, and cross-referencing with United States Geological Service (USGS) topographic maps were required to determine if a stream is currently perennial. The reach file identified thirty streams as perennial including the ones assessed in this document that are contained in the various assessment units on the §303(d) list. Some of these streams will be included in assessment units assessed in upcoming years. Future iterations of the SBA-TMDL will include new streams not meeting their beneficial uses. Many of the remaining streams have had Beneficial Use Reconnaissance Program (BURP) data collected on them. Updated assessment guidance is available in the Water Body Assessment Guidance II (WBAG II) (Grafe et al. 2002), and will be used on these streams with BURP data collected in years following the SBA-TMDL initiation. These streams with BURP data will be assessed for the next §303(d) list. Table 6 contains a list all subbasin "perennial" streams from the NHD database and a determination if they actually have perennial water through DEQ personnel observations. This list is for those interested parties that might have data on these streams. The BURP data and any other data gathered on these streams will be used to assess streams and rivers for future §303(d) lists. Subsequently, those streams added to the §303(d) list would be included in future iterations of the Salmon Falls Creek SBA-TMDL.

The geology of the subbasin exerts its most dominant control of the hydrology of the subbasin through the interplay with groundwater. Seasonally, ground water plays an unknown but significant role in the hydrology of several streams and rivers of the subbasin. Discussions of the hydrology of each stream will follow much later in this document.

Table 6. Streams under consideration as perennial streams.

Stream Name	Observed Status	Boundaries
Big Creek	Perennial	Headwaters to Mouth
Browns Creek	Intermittent	Headwaters to Mouth
Cedar Creek	Perennial	Headwaters to Reservoir
Cedar Creek	Intermittent	Reservoir to Mouth
China Creek	Perennial	Headwaters to Mouth
Corral Creek	Intermittent	Headwaters to Mouth
Cottonwood Creek	Perennial	Headwaters to Mouth
Devil Creek	Intermittent	Headwaters to Mouth
Diamond Creek	Unknown	Headwaters to Mouth
Eagle Spring Creek	Unknown	Headwaters to Mouth
Electric Spring Creek	Unknown	Headwaters to Mouth
Hanna's Creek	Perennial	Headwaters to Mouth
Hot Creek	Perennial	Headwaters to Mouth
House Creek	Perennial	Headwaters to Mouth

Stream Name	Observed Status	Boundaries
Jack Creek	Unknown	Headwaters to Mouth
Langford Flat Creek	Intermittent	Headwaters to Mouth
Little House Creek	Perennial	Headwaters to Mouth
Lost Creek	Unknown	Headwaters to Mouth
Middle Fork Hanna's Creek	Perennial	Headwaters to Hanna's Fork
Middle Fork Shoshone Creek	Perennial	Headwaters to Shoshone Creek
Mule Creek	Unknown	Headwaters to Mouth
North Fork Salmon Falls Creek	Perennial	Headwaters to Salmon Falls Creek
Player Creek	Perennial	Player Spring to China Creek
Player Creek	Intermittent	Headwaters to Player Spring
Pole Camp Creek	Intermittent	Headwaters to Shoshone Creek
Salmon Falls Creek	Perennial	Headwaters to Reservoir
Salmon Falls Creek	Perennial	Reservoir to Mouth
Shoshone Creek	Perennial	Headwaters to State Line
South Fork Hanna's Creek	Unknown	Headwaters to Hanna's Fork
South Fork Shoshone Creek	Perennial	Headwaters to Salmon Falls Creek
Twin Springs	Perennial	Headwaters to Mouth
West Fork Devil Creek	Unknown	Headwaters to Mouth
Wilson Creek	Unknown	Headwaters to Mouth

Salmon Falls Creek Reservoir supplies water for irrigation in the northern portions of the subbasin and to areas outside of the subbasin. The reservoir discharges into a main canal, which then splits into two feeder canals, one on the east side of the valley and one on the west side. Data is available from the USGS on discharge from the reservoir through the canal since 1922. From this data, DEQ estimates that during the irrigation season about 345 ft^3/s on average are diverted from the reservoir during the irrigation season. Monthly and daily discharge rates vary throughout the irrigation season. Typically, peak discharge is in July and averages 386 ft^3/s.

Cedar Creek Reservoir also supplies irrigation water to the Northern portion of the subbasin and surrounding areas. The reservoir discharges into Cedar Creek and uses the existing creek channel for 4 miles. At that point the water is siphoned into the Cedar Mesa Canal and routed to the Cedar Mesa Reservoir prior to delivery to the irrigated farmlands near Castleford. Discharge information for Cedar Creek Reservoir is estimated to average approximately 80 ft^3/s during the irrigation season.

Ground water

Ground water in the Salmon Falls Creek Subbasin is an important aspect of the water quality and quantity of some streams. Typically, the spring fed streams lie within the boundary layers of the various volcanic periods, such as between the Banbury and Idavada volcanic layers. For example, in the China Creek area, springs and dissolved materials in the ground water have a great impact on water quality. In this system it is chiefly total phosphorus (TP) from groundwater which affects water quality. However, for the most part springs are limited in the subbasin. Additionally, some of the springs within the area are warm or hot springs (arising from the Idavada volcanic layer) which may influence stream temperatures although, the impact from these geothermal sources is unknown at this time. The Salmon Falls Creek-Rock Creek Aquifer (part of the Eastern Snake River Plain Aquifer) lies beneath the northern portion of the subbasin (Figure 7). The elevation of ground water in the Salmon Falls area was estimated to be near 1,036 to 3,040 feet (ft) above sea level in 1993 (Bendixson 1993). Wells in the Twin Falls subarea range in depth from 62 to 1,289 ft. In the Rogerson area, water table depth of several wells ranged between 259-499 ft. However, for most wells in the area, pumping lifts are ordinarily near 400 ft (Young and Newton 1989). The specific capacity of wells studied in the Blue Gulch area of the subbasin within the Salmon Falls Creek-Rock Creek aquifer was estimated at 34-290 gallons per minute per foot (gpm/ft) of drawdown (Chapman and Ralston 1970). In some areas of the aquifer the transmissivity can be very high, such as in the Quaternary basalts. However, in fine-grained sediments and older tertiary rhyolite the transmissivity is much lower. These factors indicate that time of travel in the lower Salmon Falls Creek-Rock Creek area can be very short while in the upper rhyolitic volcanics and sedimentary alluvium areas, time of ground water travel is much longer. Furthermore, typical water movement in the area is from recharge areas in the mountains down gradient north west towards the Snake River. The Salmon Falls Creek Canyon forms a ground water movement barrier that prevents water movement East/West within the aquifer.

Some ground water level monitoring was done in the Salmon Falls Creek-Rock Creek area (1960 to 1993) as a result of the Blue Gulch area being listed as a critical Groundwater area (see Bendixon 1993). Most of the monitored wells in the subbasin show a seasonally steady decrease in ground water level up to the mid 1980s. This indicates that over the period of record to 1980s, that ground water withdrawals exceeded recharge. However, most wells in the study area have shown steady increases following this period. In general Bendixson (1993) estimated that ground water declines of up to 29.5 ft had occurred between 1960 and the mid 1980s. Following the establishment of large tracts of farmlands in the Conservation Reserve Program (≈80 percent of the Blue Gulch area) in the 1980s groundwater levels have increased to near predrafting conditions (Bendixon 1993). In the aquifer system analysis done by Chapman and Ralston (1970), they estimated that 34,000 acre/feet per year was discharged from the system via underflow and from irrigation withdrawals. This estimate was made during somewhat substantial groundwater level declines in the study area. While during the recharge years Bendixon (1993) refined those estimates to be closer to 18,500 acre-feet per year to ground water pumping and 7,300 acre-feet discharged to Salmon Falls Creek. In addition, it was estimated that between 10,000 and 35,000 acre-feet per year would recharge the area from precipitation events in the spring and winter, entering the aquifer through the fractured basalt beds of the local ephemeral stream systems. Ralston and Chapman (1970) indicated that a minimal amount is lost due to low evapotranspiration in the non-irrigated lands of the area base solely on the depth to groundwater in the area.

Soils/Geology/K-Factor

Local soils can be conceptualized as four soil provinces: the clayey and loamy soils of volcanic areas, the loamy soils of the fluvial canyons, the highly stratified alluvial soils of the area near the farming center of Castleford, and the alpine glacial soils of the Cassia Mountain province.

The average slope provides a gauge of potential soil erosion, or risk erodibility. GIS shapefiles indicate that slopes of the subbasin are generally low (1.2-5.6 percent) on the agricultural plains, moderately steeper in the areas forming the watersheds surrounding the stream networks in the Shoshone Basin (5.7-12.4 percent), and slopes increase appreciably as one approaches the bordering mountain ranges and into Nevada. The slopes are fairly steep in the Nevada Portion of the Subbasin, ranging from 22-45.9 percent (Figure 8). The overall percentage of the subbasin within five slope classes are presented in Table 7.

Table 7. Percent of Subbasin within Five Slope Classes.

SLOPE CLASS	PERCENT OF SUBBASIN AREA
1 to 2 percent	22.37
2 to 5 percent	33.55
5 to 10 percent	32.25
10 to 22 percent	11.15
22 to 46 percent	0.68

The “K-factor” is the soil erodibility factor in the Universal Soil Loss Equation (Wischmeier and Smith 1965). The factor is comprised of four soil properties: texture, organic matter content, soil structure, and permeability. The K-factor values range from 1.0 (most erosive) to 0 (nearly non-erosive). K-factors for the Salmon Falls Creek Subbasin were calculated from the STATSGO soil information and range from 0.08 in the Salmon Falls Creek Canyon bottom, 0.34 in the Brown’s Bench area, to a high of 0.42 in the eastern hills of the Cassia Mountains bordering the Shoshone Basin. Those portions of the subbasin in Nevada range from 0.2 to 0.32, while the agricultural lands of the subbasin range from 0.19 to 0.32. This indicates that the soils in the subbasin are relatively stable with the highest K-factor at nearly the bottom third between highly erodible and nonerosive. Soils on the flat slope of the plains and agricultural areas have the low to moderately erodible soils. The K-factors range from 0.1 to 0.26 on the soils of the main rangeland areas, such as in the Salmon Falls Reservoir area and Shoshone Basin. Table 8 shows the percentage of the subbasin within five K-factor classes. Figure 9 presents the area weighted K-factors of the Salmon Falls Creek Subbasin soils.

Table 8. Percentage of Subbasin within Five K-factor Classes.

K-FACTOR CLASSES	PERCENTAGE OF SUBBASIN AREA
0.08 to 0.15	1.8
0.15 to 0.22	27.50
0.22 to 0.29	31.68
0.29 to 0.36	32.22
0.36 to 0.43	6.80

In general, the K-factors indicate that the rangelands have low soil erosion potentials. Because of this, the amount of sediment from rangelands entering streams is also low. Due to the low erosion potential from the uplands, the Salmon Falls Creek Subbasin Assessment and following Total Maximum Daily Loads (TMDL) will focus on valley bottom and channel sources of sediment for those streams on the 1998 §303(d) list with sediment as a pollutant.

The overall geologic structure of the area is within the southern extent of the Northern Basin and Range ecoregion. The Basin and Range is an area of faulted metamorphic and sedimentary rocks uplifted into mountains, separated by basins deeply filled with alluvium and colluvium (Figure 10). In addition, areas of the Salmon Falls Creek Subbasin that lie within the Northern Basin and Range contain granitic intrusions in scattered locations chiefly in Nevada. Also prominent in the ecoregion, beside the volcanic geology common to southern Idaho, are the Pliocene and Miocene lake and stream deposits through which Salmon Falls, and House Creeks flow (Figure 11).

The Snake River Basin/High Desert ecoregion crosscuts the Salmon Falls Creek Subbasin in the north. Locally thick deposits of loess (wind-blown silt) overlie these rocks, particularly in the volcanic Snake River Plain (Alt and Hyndman 1989). The Snake River Plain is a deep, wide, structural basin filled with a veneer of volcanic basalt deposits overlying rhyolite. The rocks in the Snake River Plain decrease in age, from west to east, due to the migration of a magma source that has migrated to present-day Yellowstone National Park.

Table 9. Geologic Description for Select Formations.

Formation	Salmon Falls Creek Subbasin Geologic Descriptions	Percent of Subbasin
Tpb	Pliocene and upper Miocene Basalt	33.1
Tpf	Pliocene and upper Miocene felsic volcanic rocks	21.9
QTb	Quaternary Basalt	10.0
Qplg	Volcanic breccias, tuffs, and volcanic rocks older than Tertiary age	7.8
Jgr	Quaternary to Tertiary-age volcanic flows Rhyolite	4.8
Tr3	Tertiary tuffacious rocks and sediments	3.0
Qa	Quaternary alluvial deposits	3.0
QTs	Pleistocene and Pliocene stream and Lake Deposits	1.1
Tt3	Pleistocene glacial outwash	1.0
Ts3	Intrusive and metamorphic rocks	0.9

*GIS coverage changes at state lines due to different state descriptions for geological types. Various agencies are working to have the descriptions the same for all areas.

The geomorphology of the subbasin can be divided into six geological subsections (Figure 10). Within each of these subsections, locally distinct geological formations can be found. The majority of the subbasin (92.0 percent including the Nevada portions) lies within the Volcanic plateau lands subsection. Each geological subsection contributes sediment to the streams in various volumes. From Figures 6 and 7 it can be seen that the volcanic plateau subsection likely does not contribute significant sediment loads to the streams and rivers as its slopes are usually less than 5 percent and it is below Salmon Falls Creek Reservoir. Therefore, only three geological subsections play any factor in water quality in the Salmon Falls Creek Subbasin.

For a more detailed view of the geology of the Salmon Falls Creek Subbasin that may affect water quality, see Figure 11 and Table 9.

Topography

The region is cartographically covered by 1:24,000-scale and higher USGS topographic quadrangle maps. The total vertical relief in the area is 6,737 ft, from an elevation of 3,431 ft at the Snake River to 10,168 ft at Gods Pocket Peak Nevada in the Jarbidge Mountains. Slopes in the agricultural and most grazing areas are quite gentle (less than 5 percent) with considerably steeper slopes in the foothills and mountains (5-46 percent) (Figure 8).

The topography is an expression of the geologic structure and historical glacial and volcanic processes. Chiefly the faulted, linear mountain chains of the Northern Basin and Range ecoregion, which are bordered by the Snake River Plain to the north are the basis for most of the topography. The mountainous areas of the subbasin can be generally broken into several provinces. The first of these are high volcanic/glacial mountains in the Jarbidge area. Second is the western edge of the Cassia Mountains locally known as the South Hills from which spring sources dominate and form Big Creek and Cottonwood Creek. Third are the granitic intrusions located in Nevada near Contact. The final province would be the basalts and quaternary detritus, which form the fertile agricultural Snake River Plain area (Figure 10).

The Salmon Falls Creek and Shoshone Creek streams bisect the subbasin North-South in the case of Salmon Falls Creek and East-West in the case of Shoshone Creek. Each flow through large open valleys or basins before entering into deeply incised canyons in the volcanic plateau region of the subbasin. Alluvial terraces rise above these streams along their courses through the open basins.

The Salmon Falls Creek Subbasin covers approximately 2,103 square miles (mi^2) in total area. Nearly 871 mi^2, or 41 percent of the subbasin, lies within the state of Idaho. The elevation range within the Idaho portion of the subbasin is from 3,431 to 7,829 ft. Overall, the subbasin has a northeast aspect. The stream channels and mainstem rivers follow a dendritic drainage pattern throughout the subbasin as a result of the topography.

Vegetation

The Salmon Falls Creek Subbasin is predominantly within the Northern Basin and Range ecological region (97.46 percent of the subbasin) as described by Omernik and Gallant (1986) and Omernik (1986), with limited Snake River Basin/High Desert to the north. These two ecoregions are further divided into ecozones (Figure 12).

Basin and Wyoming Sagebrush is the dominant vegetation type throughout the region (over 54 percent of the Idaho portion of the subbasin). Other shrub brush communities such as Mountain big sage, rabbitbrush, and bitterbrush combine to make up over 90 percent of the Idaho portion of the subbasin. Streamside vegetation is generally the same as the surrounding regional vegetation due to the intermittent or ephemeral nature of most streams. Where perennial flow does occur, dense stands of sedges and forbs line the riparian zone. In perennial streams with moderate annual flow, woody vegetation consists of alder, willow, cottonwood, clematis, rose, and mock orange.

Most of the Northern Basin and Range ecoregion is used as rangeland. Where access by livestock is concentrated loss or reduction of streamside vegetation is severe, causing stream bank erosion and sedimentation. Water withdrawal for pasture irrigation or stock water can result in completely dry channels downstream from diversions.

Variability in the makeup of natural vegetation in the Salmon Falls Creek Subbasin is minimal. Shrubland vegetation predominate the entire subbasin (90.73 percent in the Idaho portion) with limited riparian vegetation (0.63 percent of the Idaho portion of the subbasin) in the mainstem streams and rivers. Following the construction of irrigation canals and irrigation return drains, some of the natural sage-grass areas have been changed to support agricultural crops, pasture grasses, hay, and riparian vegetation (Figure 13 and Table 10), which cover approximately 5.77 percent of the Idaho portion of the subbasin.

Fish and Wildlife

Within the Salmon Falls Creek Subbasin, several state and federal agencies list species of special concern; candidate species; or endangered, threatened, and sensitive species. The United States Fish and Wildlife Service (USFWS) is the main (non-anadromous, nonmarine species) listing agency. The USFWS lists 24 animals and 4 plants as endangered, threatened, or as candidate species within the state of Idaho (http://ecos.fws.gov/tess_public/StateListingAndOccurrence.do?state=ID). However, in Twin Falls County there are only seven endangered or threatened species (Table 11). Of these species, five are aquatic and one, the Bald Eagle, frequents aquatic habitats. The aquatic animals are Snake River snails, which are found only in the mainstem of the Snake River and as such may be greatly influenced by activities within the Salmon Falls Creek Subbasin. Decreases in the sediment and nutrient delivery from the Salmon Falls Creek Subbasin should positively impact the snails of the Snake River system. In addition to the downstream effects of improving water quality on the listed snails, other federally listed or candidate plants and animals that may be influenced by the Subbasin Assessment (SBA) or TMDL are the spotted frog (*Rana luteiventris*) and potentially slickspot peppergrass (*Spiranthes diluvalis*). The slickspot peppergrass has the potential to be found in bare slickspot soils within Wyoming sagebrush habitat and has been found in nearby Owyhee County. The spotted frog is an aquatic animal found in and near streams, lakes, marshes, and ponds. The spotted frog frequents these aquatic habitats in mixed coniferous forests, subalpine forests, grasslands, and sage and rabbitbrush shrublands (Stebbins 1985). Management decisions, because of the SBA-TMDL, will need to address these two species. Management decisions because of the SBA-TMDL may affect upland species as well. These will need to be addressed in any implementation plans developed by state and federal land management agencies.

Table 10. Vegetation Cover Classes.

Covertype
Agricultural Land
Alpine Meadow
Aquatic Bed
Aspen
Basin and Wyoming Big Sagebrush
Bitterbrush
Broadleaf Dominated Riparian
Curlleaf Mountain Mahogany
Deep Marsh
Disturbed, High
Disturbed, Low
Douglas fir
Douglas fir, Grand fir
Douglas fir, Lodgepole Pine
Exposed Rock
Foothills Grassland
Forb Dominated Riparian
Grand Fir
Herbaceous Burn
Herbaceous Clearcut
High Intensity Urban
Lava
Lodgepole Pine
Low Intensity Urban
Low Sagebrush
Maple
Mixed Barren Land
Mixed Needleleaf, Broadleaf Forest
Mixed Subalpine Forest
Mixed Xeric Forest
Montane Parkland, Subalpine Meadow
Mountain Big Sagebrush
Mountain Low Sagebrush
Mud Flat
Needleleaf Dominated Riparian
Perennial Grass Slope
Perennial Grassland
Pinyon Pine, Juniper
Ponderosa Pine
Rabbitbrush
Saltdesert Scrub
Sand Dune
Shallow Marsh
Shrub Dominated Riparian
Shrub Steppe Annual Grass Forb
Subalpine Fir
Subalpine fir, Whitebark Pine
Subalpine Pine
Utah Juniper
Vegetated Lava
Vegetated Sand Dune
Warm Mesic Shrubs
Water
Western Juniper
Wet Meadow

The Idaho Department of Fish and Game (IDFG) maintains a statewide list of species of special concern. Many of the species on this list are duplicates of those listed by the USFWS and other federal agencies. However, the list does not contain plant species.

Table 11 displays the federally listed threatened, endangered, and federal species of special concern found within the Salmon Falls Creek Subbasin. A list of the Idaho Department of Fish and Game's species of special concern can be found at http://fishandgame.idaho.gov/cms/tech/CDC/cwcs_pdf/appendix%20b.pdf

Table 11. Threatened, endangered, and other species of federal concern in the Salmon Falls Creek Subbasin.

Species Common Name	Scientific Name	Comments
Bald Eagle	*Haliaeetus leucocephalus*	First protected in 1966 by the Endangered Species Preservation Act. Listed in 1973 under the Endangered Species Act. Down listed from endangered to threatened in 1995. Removed from the list of threatened and endangered species on June 28, 2007.
Banbury Spring Limpet	*Lanx sp*	Listed as endangered in 1992.
Bliss Rapids Snail	*Taylorconcha serpenticola*	Listed as threatened in 1992.
Canada Lynx	*Lynx canadensis*	Proposed for listing as threatened.
Gray Wolf	*Canus lupus*	Currently listed as endangered.
slickspot peppergrass	*Lepidium papilliferum*	Proposed for listing as endangered.
Snake River Physa Snail	*Physa natricina*	Listed as endangered in 1992.
Spotted Frog	*Rana lateiventris*	Considered the Great Basin sub-populations of the Columbian spotted frog. Determined that listing was warranted 1993. Currently a candidate species.

Fisheries

There are many species of fishes in the streams and reservoirs of the Salmon Falls Creek Subbasin (Table 12). The various fish species found within the basin include, rainbow trout, brown trout, brook trout, cutthroat trout, cutthroat/rainbow trout hybrid, kokanee salmon, sculpin species, shiners, long nose dace, speckled dace, and sucker species such as Utah, mountain, and blue head suckers.

Table 12. Fish species and pollution tolerance in the Salmon Falls Creek Subbasin

Species	Scientific name	Tolerance to pollution
rainbow trout	*Oncorhynchus mykiss*	II
brown trout	*Salmo trutta*	MI
kokanee salmon	*Oncorhynchus nerka*	II
sculpin	*Cottus sp.*	
Utah sucker	*Catostomus ardens*	TT
mountain sucker	*Catostomus platyrhychus*	MT
shiners	*Richardsonius sp.*	
longnose dace	*Rhinichthys cataractae*	MI
specked dace	*Rhinichthys osculus*	MI
walleye	*Stizostedion vitreum*	MT
black crappie	*Pomoxis nigromaculatus*	
smallmouth bass	*Micropterus dolomieu*	
northern pikeminnow	*Ptychocheilus oregonensis*	II
mountain whitefish	*Prosopium williamsoni*	

From: 1996 Water Body Assessment Guidance, A Stream to Standard Process (DEQ 1996)
Tolerance Value: II = Highly intolerant, MI = Moderately intolerant, MT = Moderately tolerant, TT = High tolerant

In addition, DEQ has recently developed a fish index for assessing water bodies for upcoming §303d lists. The stream fish index (SFI) is part of the Water Body Assessment Guidance, second edition (WBAG II) (Grafe et al. 2002) document, and uses the fish community to determine the support status of cold water aquatic life. The individual metrics within the index are slightly different depending upon which ecoregion the stream falls within. For the rangeland type streams, the metrics used were percent cold water individuals, Jaccard's community similarity coefficient, percent omnivores and herbivores, percent cyprinids as longnose dace, percent of fish with abnormalities, and catch per unit effort.

Macroinvertebrates

DEQ has developed two multi-metric indices for macroinvertebrate communities over the past decade. Both share many of the same metrics as well as metrics unique to each. The first of these was developed in 1996 as part of the original WBAG. It was called the Macroinvertebrate Biotic Index (MBI), and was intended to be used as an indicator of stream health (DEQ 1996).

Following the development of WBAG II, a new multi-metric tool was used to assess the aquatic life beneficial uses of wadeable streams in Idaho (Grafe et al. 2002). DEQ staff and Tetra Tech, a private consulting firm often employed by the EPA, developed the new tool. The new macroinvertebrate tool is called the Stream Macroinvertebrate Index (SMI). Within the index nine metrics are used: total taxa, Ephemeroptera taxa, Plecoptera taxa, Trichoptera taxa, percent Plecoptera, Hilsenhoff Biotic Index, percent five dominant taxa, scraper taxa, and clinger taxa. Further descriptions of scoring and breakpoint determinations can be found in WBAG II (Grafe et al. 2002). Theoretically, the SMI yields scores that range from 0 to 100. Break points used to assign rating conditions were based on reference conditions found in desert basin streams. These break points and condition ratings allow DEQ to integrate the scores from other indices into one final score for a given stream. The condition ratings range from 0, the minimum threshold, to 3, the maximum rating a stream can receive. The condition ratings from all indices used in an assessment are averaged to determine the final assessment outcome. For the desert basin ecoregions a SMI score greater than or equal to 51 yields a condition rating value of 3. For scores less than 33 a condition rating value of 0 is given. In General, if a stream receives an average condition rating of 2 or more it would be considered fully supporting its beneficial uses.

For the Salmon Falls Creek SBA, DEQ assessed the macroinvertebrate communities using both multi-metric indices in conjunction with other biological communities and water chemistry. These other data sources will augment any perceived shortcomings of the MBI and SMI in assessing the status of aquatic life beneficial uses in streams in the Salmon Falls Creek Subbasin. Moreover, the use of the macroinvertebrate community will lend further weight to fishery and water chemistry assessments made in previous and following sections. The assessment of the macroinvertebrate information will be based on the WBAG II and the best professional judgment of DEQ staff involved with the collection and assessment of this type of data and as corroborating information from other sources.

Aquatic Vegetation

Throughout the spring and summer of 2006, DEQ conducted water quality monitoring on the §303(d) listed assessment units within the Salmon Falls Creek Subbasin. During these monitoring events, DEQ made other water quality observations. These included the number and type of fishes observed and the approximate dates the various streams in the subbasin went dry. In addition to these observations, DEQ has noted the distribution of aquatic plants in the streams. Most locations are completely devoid of aquatic plant mats that would indicate excessive aquatic growths due to excess nutrients. In other locations the aquatic plants are localized and do not cover large portions of the streambeds. In addition, DEQ has not received any complaints concerning aquatic vegetation within the subbasin.

1.3 Cultural Characteristics

The cultural characteristics of the Salmon Falls Creek Subbasin have changed only slightly over the past century since the area was first settled by cattlemen in the late 1800s. The area's first European inhabitants arrived in the middle to late 1860s. Prior to that, the area was a major crossroads for the Shoshone and Piaute Indians traveling through southern Idaho and Northern Nevada. Brown's Bench may have been a significant source for quality tool stone. Ignimbrite quarries have been located in the area and the stone is supposed to have been used by native Americans from considerable distances away (http://www.centerfirstamericans.com/mt.php?a=50). Early visitors included trappers searching for new beaver trapping areas. Ramsey Cook traveled through the area in 1811 followed by Peter Ogden's Hudson Bay Trappers in 1826. Neither group stayed long as there was not sufficient beaver in the area (Idaho State Historical Society 1981).

Following the early establishment of coach and mail lines between Salt Lake City, Utah and The Dalles, Oregon in 1864 was the establishment of the Camp Reed in Shoshone Basin (Varley 2004). The Army was charged with searching for marauding Indians, who were thought to be stealing livestock and horses from the stage lines. By 1866, Camp Reed was abandoned.

A short gold rush along the Snake River, from Minidoka to below the Thousand Springs area, brought yet more people to the area in the 1870s (Varley 2004). As the gold was isolated to gravel bars within the river, and of such fine particle size, many abandoned their efforts. Those with some remaining capital began buying up ranches along the streams in the Salmon Falls, Shoshone Basin, and Twin Falls areas.

The largest operator at the time was Andrew Harrel, who trailed over 3,000 head of cattle into the region. In subsequent years, he added more livestock to his herd. These huge cattle operations ran in the area between Goose Creek to the East, the Bruneau River to the West, and the Snake River to the North. For the most part, the cattle were turned out to the range in the spring and collected at various points for shipment and sale in the late fall. As such, it was the beginning of the widespread degradation of water quality throughout the region as there was little control of the cattle along the riparian areas.

Large free-range operations thrived until the late 1890s, when several harsh winters drove many out of business. Included were the notorious ranchers in the Browns Bench area, who, wanting a rail line spur from the Delaplain area in Nevada, hired Chinese laborers to build the spur. Upon completion of the line, the ranchers did not have the money to pay for the construction. When the laborers came to the ranchers for their pay, the laborers were hung in the area of China Creek, hence the name of this creek in the Salmon Falls Creek Subbasin.

In the following years, several hundred people were living in the area, homesteading, farming, and ranching. Meanwhile, water projects, such as the Milner Dam and the Minidoka Dam were beginning to be built in surrounding communities. These large water projects assured the surrounding areas of a steady supply of water in areas where water was limited. Consequently, the communities flourished.

In 1909, developers from the east decided to build a dam in the Salmon Falls area. The idea of a steady flow of water was appealing, and it was estimated that the dam would provide water for 120,000 to 150,000 acres of land (Idaho State Historical Society 1981). However, the water quantity stored by the dam did not live up to its original billing. In 1911, only 19,000 acres were irrigated, causing many to abandon their farms while the remaining farmers bought up the shares and learned to conserve water. By 1918, only 35,000 acres of the originaly-estimated 150,000 acres were being watered with Salmon River Canal water (Idaho State Historical Society 1981).

By the 1920s, with a rail line from Twin Falls to Rogerson, the development of a highway system in the area, and increased reliance on automobiles, the small farming towns of Berger, Amsterdam, and Hollister began to fade away. Only very small communities exist in Rogerson and Hollister today. Population estimates in 2005 are as follows: Hollister, ID 236; Castleford, ID 277; Rogerson, ID 230 (www.city-data.com); Jackpot, NV 1,281 (http://gov.state.nv.us/pr/2004/PDF/PR-attachment.pdf). Cattle ranching and farming remain the way of life for most of the subbasin residents in Idaho, while the gaming industry is the major employer in the Jackpot, Nevada area.

Land Use

As seen in Figure 14 and Table 13, approximately 85 percent of the lands within the subbasin are classified as rangelands. 5.28 percent of the remaining lands are in the open agricultural areas, which are classified as irrigated agriculture. In addition, 9.35 percent of the subbasin is classified as forested, of which most is used as rangeland. The remaining 0.43 percent of the subbasin consists of urban area, wetlands, bare rock, etc. The urban areas are scattered in the agricultural areas and are made up of many small town sites that range in size from Jackpot (population 1,281) to Berger (population 1-10).

Table 13. Land Use in the Salmon Falls Creek Subbasin (Idaho Portion Only).

LAND USE TYPE	AREA, MILES^2	PERCENT OF TOTAL AREA
Range	1,787	84.94
Forest	197	9.35
Irrigated Agriculture	111	5.28
Urban	0.8	0.03
Other	8.2	0.43
Total	2,103	100.00

Highway 93 is the main road through the subbasin. This highway bisects the subbasin and heads north/south through the central portion of the subbasin. The only other paved roads in the subbasin are those that connect Highway 93 with the small towns in and around the area, such as the Three Creek Road, as well as the section roads leading to the Snake River and other communities from Castleford. The remainder of the subbasin is covered with numerous dirt and gravel roads, most of which are not maintained (Figure 15).

The subbasin contains portions of Twin Falls County, Idaho; Owyhee County, Idaho; and Elko County, Nevada (Figures 16-17 and Table 14). Privately owned lands (17.62 percent of the entire subbasin) are essentially the same lands that are used for agriculture. The majority of the remainder (80.21 percent of the subbasin) is managed by the federal government—United States Bureau of Land Management (BLM) 71.48 percent and USFS 8.73 percent. Scattered state endowment lands (sections 16 and 36), under the management of each state’s respective department of lands comprise 1.90 percent of the subbasin, of which almost all belongs to the State of Idaho (Table 15). Nevada’s current policy regarding endowment lands has been to sell these lands to private landowners. As a result, approximately 27 acres of Nevada state lands exist within the subbasin.

Table 14. County area of the subbasin.

County	Area, Miles^2	Percent of Total Area
Elko County Nevada	1,232	58.57
Twin Falls County Idaho	802	38.14
Owyhee County Idaho	69	3.29
Total	2,103	100.00

Table 15. Land ownership in the Salmon Falls Creek Subbasin.

Land Owner	area (acres)	Area (Miles^2)	Percent
BLM Nevada	603,925	953	45.32
BLM Idaho	348,549	550	26.16
USFS Idaho	44,239	70	3.32
USFS Nevada	44,275	67	3.17
Wilderness USFS Nevada	29,788	47	2.24
Private Idaho	130,252	206	9.77
Private Nevada	104,555	165	7.85
State Land Idaho	25,271	40	1.90
State Land Nevada	27	0.04	0.00
Reservoirs	3,645	5.9	0.27
Military	8	0.01	0.00
Total	1,334,534	2103	100.00

The 2005 population estimate for Twin Falls County was 69,419 (www.idoc.state.id.us 2006) and it was 64,349 in 2000. The majority of the county population lives outside of the subbasin. For example, the population of several of the cities near the subbasin (Twin Falls, Buhl, and Filer) was 44,413 in 2005. Most of the towns in the subbasin and their populations have been listed previously within the SBA. The underlying foundation for economic activity in the area is agriculture, which consists of ranching and farming.

Recreation is an important water-related industry of the Salmon Falls Creek Reservoir and Cedar Creek Reservoir, although water delivery for irrigation is the principle use for these reservoirs' waters. These impoundments provide for recreational experiences throughout the year, most notably fishing for trout and walleye. In addition to fishing, personal watercraft use and water skiing occur on a limited basis on both water bodies.

History and Economics

The principal economic activity within the Salmon Falls Creek Subbasin is agriculture. In the lower portion of the subbasin, below Salmon Falls Creek Reservoir, row crop agriculture dominates. Potatoes, sugar beets, corn, and hay are the primary crops. A potato processing plant is located in the nearby Twin Falls area, as is a sugar processing plant, and, there are numerous dairies located within the area that require a steady stream of feed. Consequently, the farmers find a ready market for their products. In recent years, more large industrial dairies and cheese plants have begun to locate in the south-central Idaho region increasing the demand for hay and corn.

In the upper portion of the subbasin, cattle and sheep ranching are the dominant economic activities. However, recreation plays a significant role as well. Hunting and fishing opportunities bring many people into the subbasin throughout the year.

In some areas of the subbasin, hydrologic modifications to the tributaries and mainstem rivers have been extensive. Salmon Falls Creek Reservoir was started in 1906 and virtually dewatered Salmon Falls Creek below the dam once the dam was completed. However, many springs and seepage through the fractured basalts restore much of the river to a perennial water body as the stream proceeds to the confluence with the Snake River. Similar dewatering of the Cedar Creek system occurs below the dam as well. Specifically, most of Cedar Creek is dry below the Cedar Mesa Canal siphon throughout the year. Cedar Creek Reservoir was initiated in December of 1907 with land sales and construction to begin later that year (Twinfallspubliclibrary.org 2006).

Many other streams are also diverted for agricultural purposes and are dry for significant portions of the year. Furthermore, most of the water bodies have control structures or pumps fully capable of removing all the water from the stream. However, most of these structures and pumps are the result of water rights that predate the CWA and will be considered as part of the subbasin characteristics in any water quality plan (see IDAPA 58.01.02.050.01).