

Journey through the Bear River Watershed



Journey through the Bear River Watershed

A watershed-specific activity guide for grades 6-12



Co-published by Project WET (Water Education for Teachers) and Utah State University Water Quality Extension



Acknowledgment page

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Introduction

The Journey through the Bear River Watershed activity guide is composed of three main parts. Part 1 contains introductory material. Part 2 includes a description of the components of a watershed, an overview of the Bear River watershed, a more detailed narrative describing the Bear River from its headwaters to its outlet, and a discussion of several water resource management issues in the watershed. (Most the information included in this section is focused on the Bear River itself. Additional information on some of the river's tributaries can be found in the Watershed Descriptions link at <http://bearriverinfo.org>.) Part 3 includes four activities for grades 6-12, which are designed to help educators teach students about the Bear River Watershed. Each of these lessons has been adapted from activities in *Discover a Watershed: the Colorado* (Project WET International, 2005). Part 4 consists of the appendices, including cross-referenced charts that correlate each activity to Idaho, Utah, and Wyoming state standards, a glossary, and a bibliography.

The material in this activity guide will help foster a deeper understanding of the watershed, its physical properties, who lives in it, and how human activities affect different components of the watershed. Through the information and lessons provided in this guide, we hope to inspire students and teachers to take a greater interest in their local watershed and apply what they learn from the different activities to make a difference through their personal actions and future roles as members and leaders of their community.

Activity Summaries

This guide includes a set of lesson plans that provide engaging activities for teachers to integrate into their own curricular plans throughout the year. The lesson plans are detailed and correlated to state core standards. Each lesson is written to leave teachers room for innovation and enhancement. Each lesson plan has a similar format:

- **Subject Areas** (a list of subject areas that the activity covers)
- **Activity Time** (the time it takes to prepare for and complete the activity. Because the activities were written for multiple grades, the time in which it takes to complete the activities will vary by grade. This is indicated by the range of time listed in each activity.)
- **Setting** (location in which the activity should be completed)
- **Purpose**
- **Summary**
- **Objectives**
- **Materials**
- **Teacher Background**
- **Procedure** (detailed instructions to help teachers prepare for and conduct the activities and include the following sub-sections: *Teacher Preparation, Warm Up, The Activity, Wrap Up, Resources, e-links*)
- **Student and Teacher Resources Pages**

Summaries:

Define Your Watershed

Students learn to identify their local watershed on a map and the different components of their watershed, including its mainstem, tributaries, headwaters, and boundary. Watershed-related terms are introduced and defined.

How's it Flowing?

Students analyze water quantity and quality as they track instream flows and sediments in the Bear River.

Hunting for Habitats

Students learn about ecological communities and apply this knowledge by matching plant and animal species with different habitats and ecosystems in the Bear River Watershed.

First Come, First Served

Students role-play various scenarios of competing water users as they learn about water rights and the principles of how water is “allocated” or divided among users.

How to Use This Guide

Many activities require maps and other related materials. Color copies of various maps, supplemental activity pages (such as student worksheets and maps), a PowerPoint presentation to assist teaching the activities, and additional photos of the watershed are available on the Supplemental CD that accompanies the activity guide.

For the most complete learning experience for students, we suggest that these activities be used in conjunction with Stream Side Science, a set of lessons focused on water quality and watershed science. Though the activities in Stream Side Science are correlated to Utah's 9th grade earth system science core standards, the activities are appropriate for students in grade 6 and above. Please see the Suggested Lesson Plan that integrates the lessons in this guide with the lessons in Stream Side Science. Each lesson in this guide also includes tips on how to link it with lessons in Stream Side Science. For more information and to obtain a copy of Stream Side Science, please visit the USU Water Quality Extension website. Follow the Education Resources link at <http://extension.usu.edu/waterquality/>. Or, contact USU Water Quality Extension at 435-797-2580.

The Bear River Watershed Information System website is a valuable resource for educators and others interested in this watershed (<http://bearriverinfo.org>). The site includes links to additional photos of the Bear River Watershed, an interactive GIS mapping tool, specific watershed descriptions and links to data, links to research projects and the people involved in the projects, a digital library, a calendar with upcoming events and meetings in the Bear River Watershed, and a searchable resource guide that has contact information for managers, agencies, organizations, etc.

Suggested Lesson Plan

Topic covered	Suggested Order of Activities	Resource for Activity*	Time in which to complete each activity (minutes)**
Introduction to the Bear River Watershed (geography – in particular watershed delineation, using maps)	<ul style="list-style-type: none"> Define Your Watershed Optional Reading Assignment (The watershed description in Part 2 of the activity guide, including the historical timeline) 	JTBRW JTBRW	30-45 30
Water quantity (math skills and history – pertaining to water storage and flow, history of water diversions)	<ul style="list-style-type: none"> Where’s the Water? Many Happy Return Flows (Part 1) 	SSS JTBRW	30-45 30-45
Water quality (math skill and science – pertaining to , physical properties of water, water chemistry, aquatic ecology, wetland functions, pollution)	<ul style="list-style-type: none"> Many Happy Return Flows (Part 2) What’s in the Water? Who’s in the Water? Missing Macroinvertebrates Wetlands vs. Stream Macroinvertebrates Nitrogen Cycle When Things Heat Up 	JTBRW SSS SSS SSS SSS SSS SSS	30-45 90 70 70 100 50 70
Habitat and ecosystems (science – pertaining to biodiversity, local plant and animal species, ecosystem functions)	<ul style="list-style-type: none"> Hunting for Habitats Riparian Review That’s Predictable 	JTBRW SSS SSS	60-90 70 30 + 2 weeks
Water Rights (history and social studies– pertaining to irrigation water management, water users, allocation of water in the west)	<ul style="list-style-type: none"> First Come, First Served 	JTBRW	30-45
Water Management (social studies – pertaining to western water management with diverse water users)	<ul style="list-style-type: none"> Water Management Biodiversity Debate 	SSS SSS	Varies 50

* JTBRW=Journey through the Bear River Watershed

SSS= Stream Side Science

Total time to complete the 4 activities in Journey through the Bear River Watershed ONLY as a unit: **approximately 1 week.

Total time to complete the 4 activities in Journey through the Bear River Watershed AND 11 activities in Stream Side Science: **approximately 2-3 weeks.**

Common Units of Water Measurement

Definitions

Concentration: the amount (mass) of a material in a given volume of water; commonly used to describe the mass of a pollutant in a volume of water.

Volume: the amount of space an object occupies; commonly used to describe storage capacity of a reservoir or the amount of water in a stream; for example, 1 acre-foot is the volume of water that would cover 1 acre to a depth of 1 foot.

Flow rate: a measure of the volume of water moving past a given point in a given period of time; for example, 1 cubic foot per second (cfs) is the amount of water that would flow in a stream one foot wide by one foot deep and moving at a rate of one foot every second.

Area: the size of a geographic feature measured in a particular unit; commonly used to describe surface area, such as the drainage area of a watershed.

Conversion Table

Measure	Commonly used unit		
Concentration	1 milligram per liter (mg/l)	=	1 part per million (ppm) = 1,000 parts per billion (ppb)
Volume	1 acre-foot (af) (i.e., the volume that would cover one acre with one foot of water) NOTE: This is the average amount of water that a family of 4 in the US uses each year.	=	326,000 gallons = 44,000 cubic feet (ft ³) = 1230 cubic meter (m ³)
Flow rate	1 cubic foot/second (cfs)	=	7 gallons/second (gps) = 450 gallons/minute (gpm) = 646,000 gallons/day (gpd) = 0.028 cubic meters/second (cms)
Area	1 square mile (mi ²)	=	640 acres = 260 hectares (ha) = 2.6 square-kilometers (km ²)

Maps

- a) **Rivers and Streams** – includes over 500 miles of perennial streams and rivers, lakes and a few impounded waters (reservoirs) in the Bear River watershed.....**viii**

- b) **Dams** – includes 12 dams in the watershed, with a combined storage capacity of less than 200,000 acre-feet (less than 10% of the total storage capacity in the watershed.) Including Bear Lake, which has a storage capacity of about 1.3 million acre-feet, the total storage capacity in the watershed is about 1.4 million acre-feet.....**ix**

- c) **Populated Places** – includes 52 incorporated cities and towns in the Bear River watershed with a combined population of about 140,000.....**x**

- d) **Land Ownership** – includes the US Fish and Wildlife Service, the US Forest Service, the Bureau of Land Management, the State of Utah, and private land owners. Most land (54% or about 2.7 million acres) in the watershed is owned by private landowners**xi**

- e) **Land Use** – includes agriculture, rangeland, forest, and urban uses. The majority of the land in the watershed (2.6 million acres, or about 60% of the total area of the watershed) is used as rangeland**xii**

- f) **Annual Average Precipitation** – includes annual average precipitation throughout the watershed in inches per year. The annual average precipitation in the entire watershed is 21.4 inches, with a minimum of 9 inches per year (falling at the lower elevations) and a maximum of 59 inches per year (falling at the higher elevations)**xiii**

Bear River Watershed Human History Timeline

- **8,000 to 14,000 years ago:** Paleo-Indian big game-hunters, with Clovis (11,500 to 12,500 B.P), Folsom (10,500 to 11,000 B.P), and Plano (8,000 to 10,500 B.P) cultures, lived in what is now Idaho.
- **Pre- European Settlement:** Shoshone, Bannock, and Ute Native American Indians inhabited the Bear River Watershed.
- **1811-1812:** Bear Lake was discovered by the early explorers and trappers, but was still within the boundaries of land claimed by the Spanish.
- **1819:** All land north of the 42nd Parallel (the line of latitude that now forms the northern boundary between Utah and Idaho) was ceded to the United States, bisecting Bear Lake. The Northern half became part of the Oregon Territory while the southern half remained Spanish land.
- **1821:** Mexico won its independence from Spain and the southern half of Bear Lake became a Mexican possession.
- **1833-34:** Bear Lake was explored by US Army Capt. E. de Bonneville who claimed that "the lake abounds with trout and other small fish".
- **1842-43:** Numerous explorers and adventurers traveled through the Bear Lake Valley, including John C. Fremont, Kit Carson, Bill Sublett, Jedediah Smith, and Jim Bridger.
- **1841:** The first wagon train marked the beginning of the migration of settlers to this area of the West.
- **1843:** The Oregon Trail began and cut through Bear Lake Valley, bringing thousands of emigrants through the watershed.
- **1847:** The Mormon Trail ended in Utah.
- **1842-57:** Bear Lake's first resident, Thomas "Peg Leg" Smith, established a trading post on the Bear River.
- **1849:** US constitutional convention proposed the State of Deseret, which encompassed the entire Great Basin.
- **1850:** On September 9, the Utah Territory was established. The Organic Act established the 42nd Parallel as the northern boundary of Utah Territory.
- **1851:** The first permanent European-American settlements were established when Mormons moved north from the Salt Lake City area and settled in what are now Willard and Brigham City.
- **1854:** The Malad River Valley was settled by European-Americans to raise horses and hay for Ben Holliday Stage Lines. Soon these settlers left due to conflicts with the Native Americans.
- **1856:** First settlement in Cache Valley at Wellsville.
- **1860:** Idaho's oldest town, Franklin, was founded just north of the Utah border. Mormon settlers in Franklin County began to irrigate land and plant potatoes.
- **1862:** The Homestead Act was passed and offered settlers 160 acres of land in exchange for a minor filing fee and a promise to reside on the land and improve it.
- **1863:** On March 3rd the Idaho Territory is created.
 - Mormon settlers established Paris, Utah, the first settlement in Bear Lake Valley. They thought they were settling within the Utah Territory, but instead were on Shoshone land. Charles C. Rich and Chief Washakie of the Shoshone Indians reached a cooperative, peaceful agreement that the settlers would be allowed in all parts of the valley except the Southern end of the lake.
 - The Bear River Massacre near Franklin, Idaho occurred, killing of more than 300 Shoshone, making this the most costly Indian defeat in Western US history.

- **1864:** During the spring, an additional 700 Mormon settlers established the towns of Bloomington, Fish Haven, Liberty, Montpelier, Ovid, and St. Charles.
 - By the summer of 1864, businesses in Montpelier were trading with travelers traversing the Oregon Trail.
 - The Malad River Valley was re-settled.
- **1868:** Frontier railroad camp was established in Evanston, Wyoming for workers on the Union Pacific Railroad.
- **1869:**
 - May 10: The first transcontinental railroad was completed with the ceremonial driving of the Golden Spike at Promontory, Utah, about 32 miles west of Brigham City, near the northern end of the Great Salt Lake.
 - Butch Cassidy robbed the bank in Montpelier.
 - First non-Mormon church was built in Utah (Church of the Good Samaritan) in Corinne.
- **1871:** The survey done by the US Geological Survey reestablished that Bear Lake is half in Utah and half in Idaho.
- **1874:** First railroad line was constructed in Idaho, from Utah to Franklin.
- **1889:** One of the first stream-gaging stations in the US was established at Collinston
- **1898:** The Utah Sugar Company and the Telluride Power Company proposed to divert the Bear River into Bear Lake for water storage.
- **1907:** Bear River Project was authorized to provide hydroelectric power generation and irrigation.
- **1911:** The Dingle Canal and the Outlet Canal to and from Bear Lake were completed.
- **1918:** Construction of the Stewart Dam was completed, allowing the Bear River to be diverted to Bear Lake.
- **1946:** Congress consented to the formation of a tri-state negotiation to settle Bear River water disputes between the upper basin Wyoming users and the downstream users in Idaho and Utah.
- **1958:** 12 years of negotiations resulted in the Bear River Compact and the formation of the Bear River Commission.
- **1973:** The Bear Lake Regional Commission was formed.
- **1983:** Above average snowfall led to severe flooding in northern Utah, destroying part of the Bear River Migratory Bird Refuge. Flows near Corinne, Utah, peaked at 9750 cfs on June 4.
- **1984:** High Uintas Wilderness Area was established.
- **1986-92:** Because of an extended drought and continual removal of water from Bear Lake primarily for irrigation, the level of Bear Lake fell 19 feet.
- **1991:** Bear River Development Act was signed, which ensured that 220,000 acre-feet of Bear River water can be put towards new uses, as defined by the Bear River Compact.
- **1994:** The summer of 1994 is one of the driest water years on record.
- **1999-2004:** Most of the watershed experienced another extended drought, putting strains on local users of water.
- **2005:** A wet winter and several large storm events in the spring caused flooding in the southern part of Cache Valley in Utah. Water levels in Bear Lake started to increase again after several years of drought.

This timeline is based on information from the following sources: Bear Lake Watch <http://www.bearlakewatch.com/>, Idaho State Historical Society <http://www.idahohistory.net/dateline.html>, Idaho State History Summary <http://www.u-s-history.com>, Idaho State History <http://www.shgresources.com/id/history/>, History of Evanston <http://www.evanstonwy.org/tourism/history-evanston.asp>, Utah State History to Go <http://historytogo.utah.gov/firstpeople.html>

Part 2: Journey through the Watershed

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Watershed Basics

No matter where you are on a landscape, you are in a watershed. John Wesley Powell, a scientist and geographer who first explored the Colorado River, defined a watershed as “an area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community.”



Basic Watershed (Image by USDA NRCS)

We define a watershed as a geographic area of land that collects water, stores water, and releases water. A watershed is also known as a drainage or basin. In a watershed, the water and the materials carried by the water (such as sediment, organic matter, and dissolved materials) collect in a common water body, or outlet, such as a larger stream or river, pond, lake, or ocean. The stream or river that carries water to the watershed’s final outlet point is called its mainstem. The length and volume of the mainstem is determined by climate, geology, geography and other factors. The mainstem can be as small as a creek, such as a creek running through your backyard, or as large as the Mississippi River.

Watersheds are nested systems and include smaller watersheds called sub-basins or sub-watersheds. The boundary between any two watersheds is called a divide. A network of rivers, streams, channels, storm drains, and wetlands, is also part of a watershed. How water moves or travels through a watershed is determined by many factors including soil type, topography, geologic base, and the type of vegetation in the watershed.

Because all water in a watershed collects at a single outlet, all activities throughout the watershed can influence water downstream. Human influences, such as urban development, agricultural practices, grazing, forestry, industry, mining, the placement of dams and reservoirs, recreation, and daily human activities involving water, such as washing a car, can all impact the health of a watershed and the quality of the water collecting in the watershed. Since all waterways in a watershed are connected, actions in one specific area of a watershed may affect the conditions downstream.

Overview of the Bear River Watershed



Bear River Watershed (Adapted from bearriverinfo.org)

The Bear River is the largest river that flows into an inland sea (Great Salt Lake) in the western hemisphere. The Bear River travels a total of 500 miles along its path and is shaped like a horseshoe. It originates in the Uinta Mountains in Utah at an elevation of approximately 11,000 feet, travels through parts of Wyoming and Idaho until it returns to Utah, entering the Great Salt Lake only 90 miles northwest of where it started. Along its path, the river drops almost 7,000 feet in elevation and drains approximately 7,600 square miles. This drainage area is referred to as the Bear River Watershed.

The water in the Bear River is essential for humans and also supports diverse ecosystems. The river's headwaters begin in high elevation conifer forests and snow-covered mountain slopes that provide habitat for elk, black bear, pika, and marmots. High shrubland, sage-covered grasslands, and pasturelands make up the middle section of the watershed through Wyoming and support pronghorn antelope, sage grouse, and many predatory and migratory birds. Most of the land in Idaho and Utah that the river travels through, such as lands in the Bear Lake, Gentile, Gem and Cache Valleys, is utilized for raising livestock or irrigated for agriculture. In the final section of its journey, the Bear River travels through the vast open landscape of the Great Salt Lake valley in northern Utah, which is also used for agriculture and raising livestock. The river supplies water to thousands of acres of wetlands along its path, which in turn support nesting and feeding habitat for thousands of migratory birds and other animals.

In addition to supporting abundant wildlife, the water in the Bear River and its tributaries supports various commercial activities such as irrigated agriculture, raising livestock, and producing hydroelectric power, all of which help to sustain the 140,000 people who live in the basin, with the highest concentration of people living in Cache Valley. Complex systems of canals and aqueducts carry water from the Bear River and its storage reservoirs (four of which are on the Bear River itself) to different users within the basin for irrigation of croplands and livestock. Water is also distributed and used for industrial purposes, such as mining and manufacturing.

The Bear River delivers an average of 1.2 million acre-feet of water to the Great Salt Lake annually, which accounts for over half of the total surface water that flows into the lake every year. In the next fifty years, about one-fifth of this water will be diverted to locations outside the Bear River Basin, specifically to the communities along the Wasatch Front in Utah for municipal and industrial use.

The Bear River's Journey



Uinta Mountains

The Bear River originates on the north slope of the Uinta Mountains in the High Uintas Wilderness Area. High mountain snowmelt and water from natural springs trickle down through the vast conifer forests found in the area to form its headwaters. Alpine meadows and lakes are also common in this area, with ridges that divide the wilderness into scenic smaller sub-watersheds interspersed with glacial moraines. The small mountain streams are cold, clear, and pristine and provide ideal breeding grounds for one of the watersheds most important native species, the Bonneville cutthroat trout. These small streams, such as West Fork, Hayden Fork, Stillwater Fork, and East Fork, eventually join together to form the Bear River.

The forested areas at the headwaters and in other parts of the basin are part of a critical wildlife corridor for species migration in the western United States. These forested areas offer the only major link between the ecosystems in the northern Rocky and the southern Rocky Mountains.

Special Places:

High Uintas Wilderness Area

The headwaters of the Bear River begin here, near Yard Peak. During the winter, snowfall can exceed 450 inches. This area is 460,000 acres and is the largest wilderness area in Utah. Elevations range from 8,000 feet to 13,528 feet.



(Photo by US Forest Service)

Special Places: Rocky Mountain Wildlife Corridor

This corridor travels from Colorado north through Utah and into Montana. The Uinta Mountains and parts of the Wasatch-Cache National Forest in the Bear River Watershed are part of this critical wildlife corridor. The Bear Lake/Logan Canyon section is the narrowest point in the entire corridor and thus of added importance. Elk, pictured to the right, are example of a species that uses this corridor.



The river travels north out of the high conifer-covered slopes of the Uintas and into narrow valleys in Utah to Woodruff Narrows Reservoir in Wyoming, which is used for recreation and storage. Below the reservoir, the river continues north through an open valley. As the river travels from the Uinta Mountains through these areas, land uses begin to change. The mountains give way to wide valleys that have been converted to pastureland and are used for grazing and agriculture. Oil and gas exploration are also expanding in this part of the basin. Remaining portions of undisturbed lands in these areas are covered by low shrubs, sagebrush and grass. As land uses change, so does water quality. Water at the headwaters is pristine, but the river picks up sediment, nutrients, and other pollutants along its journey. Sediment and high levels of nutrients, specifically phosphorus, remain the main water quality concerns throughout the entire Bear River Watershed.



Bear River in low gradient lands in Wyoming

The shrublands in this part of the basin provide good habitat for wildlife, such as elk, mule deer, antelope, bald eagle, rabbit, badger, bobcat, black bear, cougars, coyote, red-tailed hawk, goshawk, grouse, and pheasants. The edges of the rivers and streams provide good habitat for a variety of birds and mammals. Near Woodruff, Utah, the Woodruff Cooperative Wildlife Management Area protects lands for grazing, but also protects habitat for wildlife species.

Quick Fact:

Native Americans named the Bear River "Quee-ya-paw" for a tobacco root that grew along its banks. Trappers called it "Bear River" because of the many bears that frequented the area.

Source: Wyoming State Parks and Historic Sites: Bear River State Park (<http://wyoparks.state.wy.us/BRslide.htm>)



Special Places: Woodruff Cooperative Wildlife Management Area

The Woodruff Cooperative Wildlife Management Area, located in northern Utah near the Utah-Wyoming state line provides protected habitat and is managed by the Utah Division of Wildlife Resources and the Bureau of Land Management (BLM). This is a 4000 acre, high-desert site with sage and grassland habitat that supports sage grouse, golden eagle, antelope, mule deer, and elk.



Bear River below Pixley Dam

As the Bear River travels north from Woodruff Narrows Reservoir, it crosses the Utah-Wyoming border two times and collects water from many tributaries, including Sulphur Creek and Big Creek in Wyoming, before it reaches a small diversion structure, Pixley Dam, near Sage Creek Junction.

Below Pixley Dam, the Bear River continues north through low gradient sagebrush lands and grasslands towards the town of Cokeville in Wyoming, through the Cokeville Meadows National Wildlife Refuge, and then finally into Idaho.



Bear River near Cokeville

Special Places: Cokeville Meadows National Wildlife Refuge

This refuge was established in 1993 and is located south of Cokeville, Wyoming. It is centered on a 20-mile reach of the Bear River and includes wetlands and uplands. The wetlands within the refuge provide excellent habitat for a variety of migratory and resident wildlife species, supporting one of the highest densities of nesting waterfowl in Wyoming.

North of the refuge and the town of Cokeville, Smith's Fork River joins the mainstem. The Smith's Fork is the second largest tributary to the Bear River in the entire basin, draining about 172,800 acres. It supplies a substantial amount of water to the Bear River and causes flows within the mainstem to almost double. Once in Idaho, the Bear River is met by another large tributary, the Thomas Fork, which supplies additional water to the mainstem.

Below the confluence with Thomas Fork in Idaho, the river continues to travel northwest until it reaches Stewart Dam, where water is diverted to Bear Lake. During the hundreds of thousands of years that Bear Lake has been in existence, the Bear River has apparently been connected to the lake multiple times during high water periods; however, during the past 11,000 years, the river has not connected to Bear Lake. In 1911, a canal was constructed that now diverts almost all flow in the Bear River south at Stewart Dam through Mud Lake and the Bear Lake National Wildlife Refuge into Bear Lake. The diversion raised the water level in Bear Lake as much as 21.5 feet, allowing an average of 245,000 acre-feet of water to be stored annually for irrigation purposes downstream. (See "*Bear Lake: Storage Development and Water Levels*" in the Special Issue Section.)

Special Species: Bonneville Cutthroat Trout

The stretch of the Bear River between Smith's Fork and Thomas Fork and the tributaries themselves make up some of the most important aquatic habitat for the Bonneville cutthroat trout (BCT) in the entire Bear River watershed. The section of the Bear River between Smith's Fork and Thomas Fork links these tributary populations and constitutes what is likely the last connected large river habitat available to BCT. This section also supports some of the most genetically pure species of the BCT in its native range. However, habitat loss, migration barriers, and potential reservoir development on Smith's Fork threaten the native BCT populations in this reach of the river. Several different groups, such as Trout Unlimited and Wyoming Game and Fish, are involved in maintaining and restoring migration corridors for the fish in Thomas Fork and Smith's Fork.



During the summer, water for irrigation is returned to the Bear River through the Lifton Pumping Station to the Bear River. The agreements outlined in the tri-state Bear River Compact, signed in 1958, control when and how much water is released from Bear Lake, and allow lake levels to fluctuate up to 21.5 feet annually.

Quick Fact:

In the summer, the majority of the irrigation water used by Utahns who work and live in north Rich County is released from Bear Lake.



The lake supports a large population of lake trout, an introduced sport fish, and four species of fish that are found nowhere else in the world: the Bonneville cisco, Bonneville whitefish, Bear Lake whitefish, and Bear Lake sculpin. Bear Lake also has a strain of the Bonneville cutthroat trout that evolved in Bear Lake.

Special Places: Geologic History of Bear Lake

Historically, the Bear River was a tributary of the Snake River. About 140,000 years ago, lava flows near present-day Soda Springs, Idaho blocked the Bear River channel and diverted the river to the south into the Great Basin. Erosion of the lava dam probably allowed the Bear River to eventually drain oceanward again; however, about 35,000 years ago, another volcanic debris slide cut off this



Bear Lake

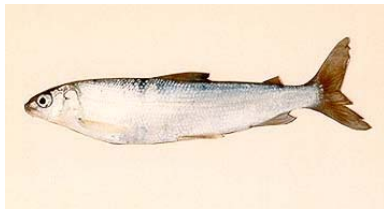
northerly route and deflected the river to the south, resulting in its current almost circular route to the Great Salt Lake. Some time after that, Bear Lake formed, which scientists believe was due to landslides damming the north end of the valley near present-day Georgetown, Idaho. The Bear River then flowed into this lake, creating beaches and other shoreline features 25 feet to 200 feet above today's lake level.

Special Species: Fish and Ostracod Species in Bear Lake

Bear Lake supports four endemic species (meaning that they are found no where else in the world) of fish: the Bonneville cisco, Bonneville whitefish, Bear Lake whitefish, and Bear Lake sculpin, as well as a strain of the Bonneville cutthroat trout (BCT) that evolved in Bear Lake. This BCT was originally called "bluenose" because the head of the fish was a brilliant azure color. Because the BCT in Bear Lake spawn in streams connecting to the Lake during May and June, certain streams are closed to fishing at that time to allow the fish to spawn naturally or to be trapped by Utah Division of Wildlife Resources for propagation of their eggs in a fish hatchery.

The lake also supports a large population of Lake trout. The fish was initially stocked in Bear Lake in the 1930s as a sport fish, and are still stocked today. Because of the combination of cold temperatures and limited food resources (i.e., smaller foraging fish) in Bear Lake, lake trout rarely weigh over 20 pounds which is half of what they weigh in ecosystems with more available food resources.

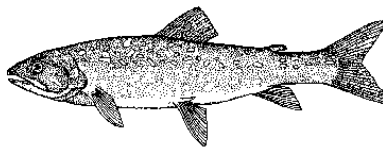
Several endemic ostracods (tiny, swimming, crustaceans with clam-like shells) have been identified from fossils, but no living specimens have been found in Bear Lake. These "missing" ostracod species may have become extinct after the Bear River diversion started in 1912, or may continue to occupy very small habitats today.



Bear Lake Whitefish



Bonneville Cutthroat Trout



Lake Trout

Special Places: Bear Lake National Wildlife Refuge

The Bear Lake National Wildlife Refuge provides the largest acreage of wetland habitat in the Bear Lake area. It is located on the north end of Bear Lake and includes 19,000 acres of marsh, open water, and grasslands. The marsh is drawn down severely in the late summer to be used for agriculture and is covered with ice in the winter. This refuge is particularly important as a nesting area for white-faced ibis, Canada geese and redhead ducks. It also provides a nesting, resting and feeding area for other ducks, greater sandhill cranes, and a variety of water and shorebirds. The refuge supports a white-faced Ibis colony of 5,000 birds, which is one of the largest in the west.





Bear River near Georgetown

Water released from Bear Lake travels through Mud Lake back to the Bear's original river channel about seven miles from where water is first diverted to Bear Lake. Downstream from this junction, the river passes through lands used mostly for grazing and irrigated agriculture and receives water from several additional tributaries, such as Montpelier Creek and Eightmile Creek. The river travels about 100 miles northwest to Alexander Reservoir near the town of Soda Springs, Idaho. This reservoir is used to store water for irrigation, recreation, and also to generate hydroelectric power when water is released through Alexander Dam (also known as Soda Dam).



Alexander Dam (courtesy www.UntraveledRoad.com)

Below the dam, the river makes a hair-pin turn around Sheep Rock (also known as Soda Point) and heads south. About 1.5 miles beyond this point is one of the major diversions on the river, the Last Chance Canal.

Special Places: Last Chance Canal

Last Chance Canal is one of the oldest and most impressive diversion canals in the entire watershed. Completed in the early 1900s, the Last Chance Canal diverts 60,000 acre-feet of water (about one-tenth of the river's annual flow at this point) from the Bear River every year to Gentile Valley and is considered a remarkable engineering feat of its time. This canal is part of an extensive network of irrigation canals created by settlers of this region which have allowed agriculture to occur in this arid basin.



Last Chance Canal, Gorge and Bridge
(Photo © 1999 A. Crane)

Below the canal diversion, the river continues south towards Grace, Idaho. Just above Black Canyon, almost all of the water in the river is diverted at Grace Dam into an aqueduct and delivered to the Grace Power Plant for power production. The water is then returned to its original river channel just below Black Canyon at Cove Dam.

Special Places: Black Canyon

Black Canyon is an impressive basalt formation that often takes visitors by surprise when they first see it. The canyon appears almost from nowhere as an astonishingly deep, narrow gorge cutting straight through solid lava rock. The waters of the Bear River were diverted from the canyon in early 1900s and routed through Grace Power Plant. The canyon is now fed mostly by seeps in the basalt. Its clear waters, deep pools and gentle terraces make Black Canyon a favorite spot for trout fishermen.



Bear River through Black Canyon

As part of the hydroelectric relicensing agreement for Grace and Cove dams, beginning in 2008, PacifiCorp will provide scheduled releases of whitewater flows into Black Canyon during the spring and early summer of each year to improve recreation opportunities in the canyon. (See “Hydroelectric Power in the Bear River Watershed” in the Special Issues section.)



Bear River in Gentile Valley

Below Black Canyon, the river continues south through the wide and relatively flat Gem and Gentile Valleys in Idaho. Irrigated agriculture, grazing, and dairy production are the primary land uses in this area, and are supported by water from fifteen different lakes and reservoirs scattered throughout this part of the watershed. These reservoirs also provide recreation opportunities. Once at Oneida Reservoir, Bear River water is stored for irrigation and hydroelectric power generation. Just below the reservoir, the river travels through Oneida Narrows, one of the more popular canoeing, kayaking and fishing sections of the Bear River because of the steep grade and narrow channel of the river in this location. The river continues south below the Narrows into Cache Valley passing Preston, Idaho, before it returns once again to Utah.



Bear River at the Oneida Narrows

Bounded by the dramatic Bear River Range on the east side of the Cache Valley and by the Bannock and Malad Ranges on the valley's west side, the Bear River travels through lands used for dairy production, cropland, and other agricultural-related activities. Just below the Idaho-Utah state line, the Bear receives water from the Cub River which contributes water from lands in Idaho and portions of Utah, including the Mt. Naomi Wilderness Area.

Special Places: Mt. Naomi Wilderness Area

Mt. Naomi Wilderness Area provides wonderful recreational opportunities in the high mountains on the east side of the Cache Valley in Utah. The wilderness area is 44,964 acres and rises to 9,974 feet, at the summit of Mount Naomi. The western side of the wilderness consists of deep and scenic canyons, which open up into large meadows that are carpeted with wildflowers in the summer. The alpine scenery of this wilderness is considered some of the most spectacular in the Rockies, with unique floral species and an abundance of wildlife, including moose, elk, deer, and beaver.

Below the confluence with the Cub, the Bear River travels through the flat valley and eventually enters the shallow wetlands complex of Cutler Reservoir. The river's flow approximately doubles in this reservoir due to inputs from three large tributaries that drain the south-central portion of the watershed. The Logan River originates in the Bear River Range and passes through the city of Logan and outlying agricultural areas. It converges with the Blacksmith Fork near the southeast end of Cutler Reservoir. The Blacksmith Fork, which also begins high up in the Bear River Range, drains the lands south of the Logan River. The entire Logan River drainage area, including the Blacksmith Fork, drain 374,000 acres of land east and southeast of Cutler Reservoir, and together contribute the largest volume of water of any tributary to the Bear River in the entire Bear River Watershed. The third tributary, Little Bear River, collects waters from 182,000 acres south of Cutler Reservoir, most of which is forested land or land used for agriculture. Two important reservoirs are located on this river, Hyrum Dam and Porcupine Dam, which provide irrigation storage and recreation opportunities.

Quick Fact: Cache Valley is the most populated area in the entire Bear River Basin and is home to 100,000 of the total 140,000 people living in the basin. About half of Cache Valley is geographically in Idaho, but 80% of its people live in Utah. The largest cities are Smithfield, North Logan, and Logan.



Cutler Reservoir looking towards Mt. Logan

Special Places: Hardware Ranch Wildlife Management Area

This 19,000-acre area is a unique spot in Blacksmith Fork Canyon for elk and other terrestrial game species and served as a center for elk research. Although the area is maintained for elk habitat, deer, moose, ruffed grouse, cottontail rabbits, and wild turkey are also hunted in the management area. The refuge also contains 15 miles of fishable streams.

Special Places: Cutler Reservoir and Marsh

Cutler Marsh, a large wetland area surrounding the shallow Cutler Reservoir, supports many song birds, birds of prey, upland birds, and water fowl, including the American bittern, white-faced ibis, snowy egret, cattle egret, great blue heron, northern harrier, common yellowthroat, American white pelican, and sandhill crane.

Though the waters are turbid, Cutler Reservoir's shallow, warmwater environment is very productive and supports a diverse and abundant fish assemblage, including walleyes, black crappies, channel catfish, common carp, and black bullheads. Green sunfish, bluegill sunfish, largemouth bass, and smallmouth bass, rainbow trout, and brown trout are also found in Cutler, but not in great numbers. The Utah sucker is the only native fish found in the reservoir at this time.



Quick Fact:

The second coldest temperature ever recorded in the continental United States of -69°F , occurred in this watershed in Logan Canyon near Peter Sinks on February 1, 1985.



Bear River leaving Cutler Dam, looking southeast

Water leaves Cache Valley at Cutler Dam through a small, narrow canyon at the very northern tip of the Wellsville Mountains. From the dam, the Bear River enters Box Elder County in the Great Salt Lake valley and travels about 45 miles through grassland and pastureland. The Malad River converges with the Bear River about 45 miles below Cutler Dam, near the town of

Tremonton. This river drains the entire northwestern portion of the watershed (about 10% of the entire watershed). Below this confluence, the river travels 20 more miles until it reaches its final destination, the Bear River Migratory Bird Refuge and Willard Bay located on the Great Salt Lake. The Bear River remains the Great Salt Lake's most important tributary, contributing over half of the total surface flow entering the Great Salt Lake each year. The large volume of freshwater from the Bear River helps to maintain temperatures, salinity, and water levels in the lake.



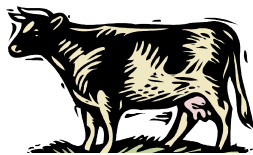
Bear River near the Bear River Migratory Bird Refuge, looking east

Special Places: Bear River Migratory Bird Refuge

Located at the northern tip of the Great Salt Lake and 15 miles west of Brigham City, the Bear River Migratory Bird Refuge includes 74,000 acres of marshes, uplands, mudflats, and open water and attracts thousands of migratory ducks, swans, geese, shorebirds, and other fowl. Since 1990, many efforts to restore the refuge have addressed the damage to the visitor's center and the habitat caused by flooding of the refuge in 1983.

Quick Fact:

Lands bordering the Bear River between the Cutler Dam and the Great Salt Lake support more than 104,000 head of cattle.



Quick Fact:

Box Elder County is named after the abundant number of Box Elder trees that grow in this part of the Great Basin.

Because of its ample flows, the Bear River sustains life within and outside its boundaries in this arid region of the Great Basin, making it a river of ecological, cultural, and economic importance. From its headwaters to its outlet, the watershed encompasses unique geologic and ecologic features and supports a plethora of different ecosystems and landscapes. As a result, it is one of the most beautiful watersheds in the intermountain west.

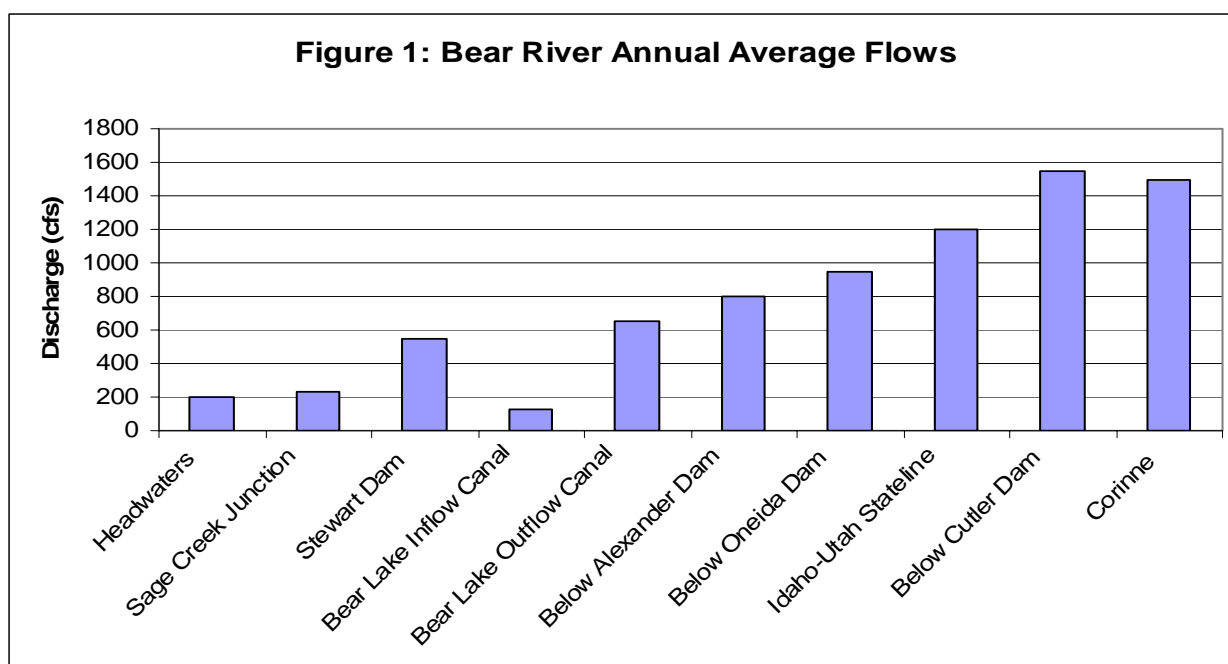


Bear River as it approaches the Great Salt Lake looking south

Special Water Issues

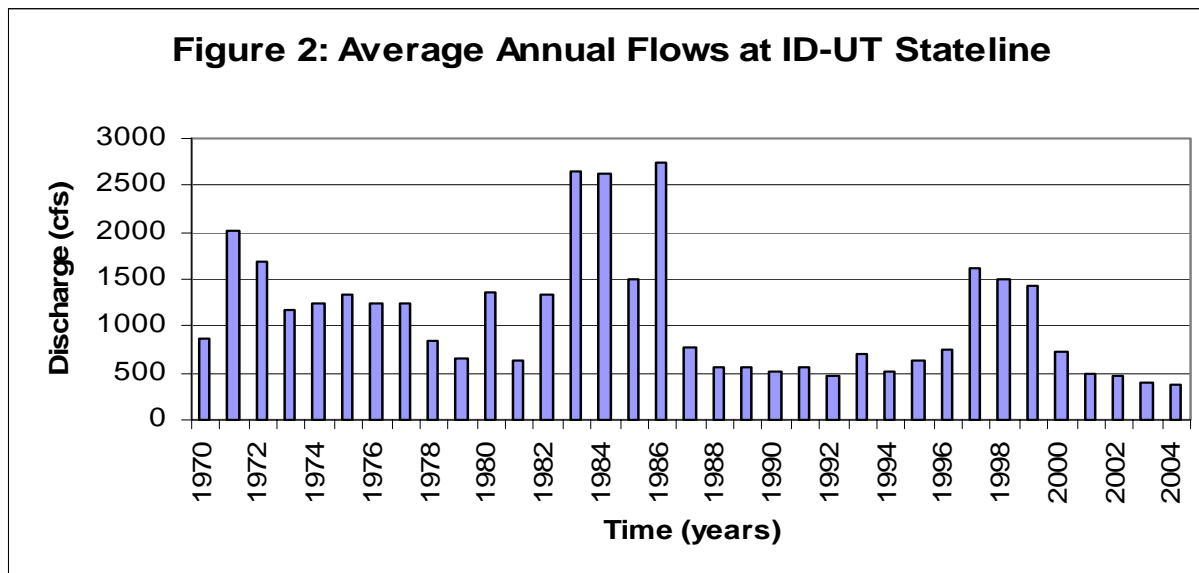
Water Use and Diversions in the Bear River Watershed

The amount of water in the Bear River and its tributaries varies both seasonally and between years. Snowmelt runoff results in high flows in the early spring, and the low “base flows” that naturally occur during the rest of the year are often modified because of irrigation diversions, or releases from upstream dams. Year to year variation in snow fall in the mountains can result in enormous variability between years in total flow in the river. For example, daily flows in the Bear River at the Idaho-Utah stateline average 1200 cfs (see Figure 1), but recorded annual average flows at this location have ranged from a low of 380 cfs in 2004 to a high of 2743 cfs in 1986 (see Figure 2).



Source: Data adapted from Figure 3 in the Bear River Basin State Water Plan (Utah Division of Water Resources, 2004)

Based on average flows, the water of the Bear River is divided and diverted to meet the needs of its users. Most diverted water is used for irrigating agricultural lands. When water is withdrawn from the Bear River system, the amount applied towards different uses varies by state, with Utah using the most water and Wyoming using the least. How much water is allocated and thus diverted in each state is based on agreements in the Bear River Compact. (For more information on how the water in the river is regulated and stored, see the *Bear River Compact and Bear River Development in Utah* section below.)



Source: USGS Daily-Streamflow Data for IS-UT Stateline stream gage (http://nwis.waterdata.usgs.gov/nwis/discharge/?site_no=10092700)

The largest diversions in the entire basin are the Last Chance Canal in Idaho, West Cache Canal in Idaho, the Bear River Canal Company's West Side and East Side canals in Utah, and the Bear River Migratory Bird Refuge in Utah. (For approximate diversion locations and amounts in the basin, refer to the Utah State Water Plan: Bear River Basin at the following website: <http://www.water.utah.gov/planning/SWP/bear/bearRiver-1A.pdf>.)

Bear River Compact and Bear River Development in Utah

Dividing the water in the Bear River among different users within the three different states has been a challenge since water was first diverted in the mid-1800s. The Bear River Compact, signed by federal lawmakers and made effective in 1958, is an agreement between Utah, Wyoming and Idaho, and designates how the waters of the river are to be allocated or divided among the three states. The Compact apportions the waters of the Bear River and its tributaries above Bear Lake among the three states, as well as establishes and limits additional storage rights. It also establishes Bear Lake as a storage reservoir for late summer irrigation and to supply users who hold water rights downstream from Bear Lake. Over time, the Compact has been amended to change the amount of water to be stored in Bear Lake and during the relicensing of hydropower plants.

To administer and enforce the provisions in the Compact, an interstate administrative agency known as the Bear River Commission was created. The Commission is composed of nine commissioners, three commissioners representing each of the three states. There is one additional commissioner who serves as a neutral chairman and does not vote. The role of the Commission is to administer and enforce the provisions of the compact.

Currently, less than half (about 40%) of the total flow of the Bear River is allocated and controlled under the Bear River Compact. Taking into consideration current uses and existing water rights in all three states, only a portion of the non-allocated water in the Bear River (i.e., water that is not “assigned” to or “owned” by any one user) can be put to new uses. In Utah, for example, there is an average annual flow of about 275,000 acre-feet left in the Bear River that can be put toward new uses.

Utah sees this unallocated water in the Bear River as an untapped water source. After years of study, the Bear River Development Act was passed in 1991 by the Utah State Legislature. This plan allocates 220,000 acre-feet of the 275,000 acre-feet of non-allocated water in Utah. Part of the plan includes:

1. connecting the Bear River to a pipeline and/or canal to Willard Bay;
2. constructing a conveyance and treatment facility to deliver water from Willard Bay to the Wasatch Front, including the Jordan Valley and Weber Basin Water Conservancy Districts;
3. building a new dam or enlarging existing dams in the Bear River Watershed.

Utah’s Bear River Development Act Allocations (in acre-feet)	
Bear River Water Conservancy District	60,000
Jordan Valley Water Conservancy District	50,000
Weber Basin Water Conservancy District	50,000
Cache County	60,000
Total	220,000

Source: Utah Division of Water Resources, 1999.

As of February 2006, the Utah House of Representatives passed a bill (HR45) that allows pre-construction work--such as design, engineering and acquisition of land & rights-of-way--to begin on portions of activities outlined in the Bear River Development Act, before financing is secured. This bill was signed by Utah’s Governor Huntsman on March 10, 2006.

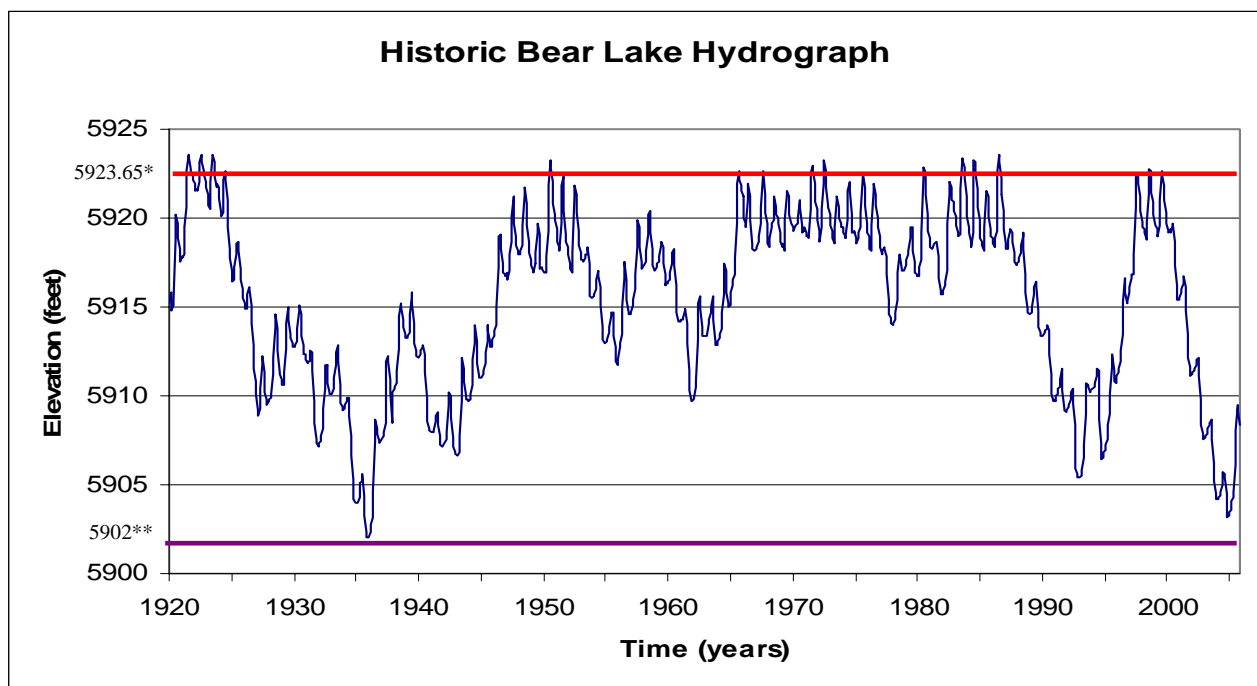
Bear Lake: Storage Development and Water Levels

Because the primary use of water in the Bear River Watershed is for irrigation, the river has been managed to ensure the delivery of irrigation water to various users. To guarantee a dependable supply of irrigation water especially for late-season irrigation, water managers decided to make Bear Lake a storage reservoir.

In 1898, diverting water from Bear River to Bear Lake was considered a viable solution to overly abundant natural flows in the early summer followed by late summer low flows, inadequate for irrigation. In 1902, Telluride Power Company (later called Utah Power and Light) constructed inlet and outlet canals in an effort to divert Bear River water into the lake for later release during the agricultural growing season. The Lifton Pumping Station, located at the north end of the lake, was constructed in 1914 to pump water from Bear Lake into the outlet canal. These modifications to the natural river system have created an active storage capacity of about 1.3

million acre-feet in Bear Lake, which is about 93% of the total storage capacity in the watershed, making Bear Lake the largest storage reservoir in the watershed. The next largest reservoir, Woodruff Narrows Reservoir, has half of Bear Lake's storage capacity at 573,000 acre-feet.

Bear Lake's water levels change as a result of diversions to and from the lake, which affects irrigators, property owners and recreationists. The water levels are measured based on the elevation of the top of the lake and are controlled by the agreements outlined in the Bear River Compact. Based on the agreement in the Bear River Compact, only the top 21.5 feet of the lake are allowed to fluctuate. In 2004, Bear Lake reached its lowest level in 70 years at more than 18 feet below what is considered full or normal by water managers. However, a wet winter in 2004-2005 caused the lake levels to start to rise again.



Source: Utah Division of Water Resources, 2005.

*Normal (or full)

** Historic Low (occurred in fall 1935)

Hydroelectric Power in the Bear River Watershed

Throughout the watershed, the Bear River is used to generate hydroelectric power. The most concentrated area of hydroelectric power development is between Alexander Reservoir and Cutler Reservoir, which are all administered by PacifiCorp Electric Company (now called Rocky Mountain Power). Authorized in 1907, construction of these dams along the Bear River began in 1909 and was completed in 1927. Currently, five dams generate hydroelectric power (see the *Dams Map* in Part 1):

- Soda Dam – a 103-foot-high concrete dam at Alexander Reservoir, with a total capacity of 14 megawatts per year.
- Grace Dam – a 51-foot-high timber dam near the town of Grace, with a total capacity of 33 megawatts per year.
- Cove Dam – a 26-foot-high concrete dam near Grace Power Plant, with a total capacity of 7.5 megawatts per year.
- Oneida Dam – a 111-foot-high concrete dam at Oneida Reservoir, with a total capacity of 30 megawatts per year.
- Cutler Dam- a 109-foot-high concrete dam on the west side of Cutler Reservoir, with a total capacity of 29 megawatts per year.

Quick Fact: The average US household uses about 10,655 kilowatt hours (kWh) of electricity per year. (One megawatt is 1000 kilowatts.)



Alexander Dam

These dams are nonfederal hydroelectric projects, but operate under licenses issued by the Federal Energy Regulatory Commission (FERC). Dam licenses extend for 30 years, and at the end of the period, the dam can either be relicensed or decommissioned. All of the dams listed above currently are re-licensed to operate until 2033, with the exception of Cove Dam which is scheduled to be decommissioned starting in October of 2006, and Cutler Dam, whose license will expire in 2024. The removal of Cove Dam will open six extra miles of river upstream of the dam for Bonneville cutthroat trout to spawn and migrate upstream through Black Canyon.

Hydroelectric dams and reservoirs on the Bear River also provide opportunities for recreation, such as water skiing, canoeing, kayaking, and fishing. A settlement agreement signed on August 28, 2002 and PacifiCorp's license issued by the FERC on December 23, 2003 includes several measures to enhance whitewater recreation near the project facilities. Some of these enhancements include:

- Providing put-in and take-out facilities near the Grace and Oneida dams for use by whitewater recreationists;
- Providing scheduled releases of whitewater flows into Black Canyon during the spring and early summer of each year (beginning in 2008);
- Providing streamflow information and scheduled whitewater releases on a website and hotline so that the public can better plan their recreational experience.

Water Quality in the Bear River



Cub River, a tributary to the Bear River

water originates as pristine snow melt high in the Uinta Mountains. We expect water in such areas to be cold, relatively clear, to have low concentrations of dissolved salts and nutrients, and to be able to maintain cold water fish populations. (Cold water fish, such as trout or salmon, prefer water temperature ranges between 45-65 degrees F, whereas warm water fish, such as bass or bluegill, prefer water temperatures between 65-85 degrees F). As a river grows, broadens, and moves into lower gradient lands with different natural soils, the natural condition of the river changes. It becomes wider, warmer, and carries some dissolved salts, nutrients, and sediments that it picks up along its path. Contrary to the headwaters, water at the end of the Bear River's journey has probably never been able to support a cold water fishery, but does support a healthy population of warm water fish, and other organisms dependent on slow, meandering rivers and wetlands.

The challenge is to differentiate a river's natural condition from the polluted condition that occurs when excess materials enter the river. These pollutants can affect the living organisms that naturally occur in the river, or may affect the other uses of the water that its natural conditions would have supported, such as irrigation of crops, recreation, and more.

Human activities which may affect a river's water quality include changes in the land uses, direct discharges of pollutants to the water body, and changes in the volume or seasonal pattern of the river's flow. Agricultural development, urbanization, forestry, road building, and mining are all activities which can result in excess pollutants running off into the river's waters, such as sediments and nutrients. When runoff collects pollutants from a variety of sources on a landscape, this is referred to as "nonpoint" source pollution. On the other hand, "point" source pollution comes from one particular source such as a

There is no simple definition of "clean water" that applies to all water bodies in the United States. This is because the local conditions of a stream, lake or river determine the natural temperature, pH, dissolved oxygen, concentrations of nutrients, sediments and other naturally occurring materials in the water.

Because of changes in the landscape, water in the Bear River at the end of its journey at the Great Salt Lake has always been quite different from the water at its headwaters. The river's



Sprinkler systems irrigate alfalfa in Cache Valley, Utah (Photo by USDA NRCS)

sewage pipe. Point sources of pollution to the Bear River are mostly comprised of discharge from municipal treatment plants, although several industries such as fish hatcheries also discharge waste directly into the river. Reservoirs in the Bear River and agricultural diversions result in modified flow patterns. Water is withdrawn for irrigation uses, flows are modified for hydroelectric generation, and reservoirs may impact water quality through warming the surface waters, allowing sediments to drop out, providing conditions for nutrient rich water to feed excess algae, and other effects.



Runoff carrying sediments from non-point sources pollution from a parking lot

The main water quality concerns in the Bear River Watershed include excess sediments and nutrients. Sediments enter the river from agricultural fields, construction activities, roads and logging. Poor stream bank conditions also result in mass slumping of bank soil into the river. Loss of riparian vegetation along the river has also led to reduced shading and higher water temperatures than may not have occurred naturally. Excess suspended and settled sediments have various consequences. For example, excess sediments can harm stream organisms by clogging the gills of fish or aquatic

insects and reduce the amount of oxygen they can take up from the water, impair fish spawning, and decrease the amount of light available for photosynthesis by submerged aquatic vegetation, reducing stream productivity. Sediments can also fill in reservoirs reducing storage capacity, and clog irrigation pipes.

Nutrients, another pollutant, enter the river from agricultural and urban activities, from deposits of phosphorus containing minerals in the watershed, and from fisheries and municipal discharges. In high concentrations, excess nutrients in aquatic systems can be toxic to individuals and ecosystems. Too much phosphorus or nitrogen in a lake or pond, for example, can lead to excess algae or plant growth that is out of balance with the natural forces of decay and renewal. When these mats of algae or plants die, they sink to the bottom where oxygen is used as this organic matter decomposes. As a result, the fish and other organisms that live in the cool, deep waters may no longer be able to survive, upsetting the balance of the ecosystem and reducing fishing population for human recreation.



Eroding stream bank (Photo by USDA NRCS)

One of the challenges in the Bear River is to coordinate water quality management between the three states. Water quality managers in each state are addressing problems by identifying the

different sources of pollution and implementing activities to help reduce the amount of pollution entering the rivers and streams, such as reducing bank erosion by improving riparian habitat,



Mountain pond and wetland

reducing runoff from animal feeding operations, and restricting livestock from grazing on streambanks or directly in the streams.

Organizations such as the Bear River Water Quality Taskforce (BRWQTF), which was formed in 1993, serves as an advisory committee to the Bear River Commission to help facilitate the management of this

multi-state watershed. In addition, other federal and state agencies are active in improving water quality in the Bear River.

(For more information regarding total maximum daily load (TMDL) reports, restoration efforts to improve water quality, and other projects in the watershed, visit the Bear River Watershed Information System at bearriverinfo.org.)