

Chapter 3

Description of the Study Area

Karl Taboga, James Stafford and
Paul Taucher

This study examines groundwater resources that underlie the Bear River drainage basin in Wyoming as well as areas in Idaho and Utah that are tributary to the Wyoming part of this basin (**Fig. 3-1**). The Bear River Basin covers approximately 1,494 square miles (0.95 million acres) or 1.5 percent of Wyoming's surface area. The tributary watershed in southeastern Idaho is small, about 18 square miles (0.01 million acres). Approximately 1,112 square miles (0.71 million acres) of tributary watershed are located in northeastern Utah. In Wyoming, the Bear River Basin includes 23 percent of Uinta County and 24 percent of Lincoln County. In Utah, the tributary watershed covers 15 percent of Summit and 75 percent of Rich counties. Unless specific references are made to the Utah and Idaho tributary areas, it can be assumed that references to the Bear River Basin in this memorandum include only the Wyoming portion of the watershed defined above.

Although, the Bear River Basin encompasses about 1.5 percent of Wyoming's total surface area, it serves as home to approximately 14,500 people or about 2.4 percent of the state's current population (2010 census). The Bear River Basin contains three incorporated municipalities (Evanston, Cokeville, and Bear River); a U.S. Census Designated Place (CDP), Taylor; approximately 2000 people live in rural areas. The index map in **Figure 3-1** shows townships, major roads, and incorporated municipalities within the Bear River Basin.

3.1 Physiography, landforms, topography, and surface drainage

The Bear River drainage basin is located almost entirely within the Middle Rocky Mountain Physiographic Province; a small part of the basin falls within the Wyoming Basin Province just to the east and northeast of the point where the river crosses Wyoming's southern border. Major drainages, reservoirs, and physiographic features of the Bear River Basin are shown on **Figure 3-2**. A map of the physiographic provinces of Wyoming can be found on the WSGS website at <http://www.wsgs.uwyo.edu/Research/Geology/images/Final/Elevations.pdf>.

The overall physiography of the Bear River Basin consists of a deeply eroded geologic foundation composed of arcuate belts of strike ridges and valleys. This system of belts, known as the Thrust, or Overthrust, Belt of eastern Idaho, northern Utah and western Wyoming was formed over 70 million years during the Sevier Orogeny (125 – 55 million years ago (Ma)). During that time, rocks of Paleozoic and Mesozoic age were pushed eastward along low angle, imbricated (overlapping), westward-dipping thrust faults. This resulted in the formation of five thrust systems (**Fig. 4-1**). The extent of the Bear River drainage basin examined in this study (**Fig. 3-1**) encompasses portions of all five Sevier thrust systems. The Wyoming portion of the Bear River Basin includes the three eastern-most thrust systems: the Crawford, the Absaroka, and the Darby.

Following the thrust systems, a phase of geologic extension started in the late Eocene, about 35 - 40 Ma, and continues to the present. The extension formed numerous normal faults that shape the foundation of the Bear River valley and its tributary drainages. During the Sevier Orogeny and the more recent period of geologic extension, erosion, mass wasting, and fluvial processes wore down the highlands and deposited sediments in the valleys. These processes, combined with concurrent and continued faulting, resulted in the present physiography characterized by north-south trending mountain ranges with alternating valleys of variable areal scale and elevation. In Wyoming, elevations in the Bear River Basin range from 6,055 feet above mean sea level where the Bear River crosses the Wyoming-Idaho state line to 10,761 feet at Mount Isabel (Wyoming Water Development Office (WWDO), 2012). Detailed discussions of the geography of the Bear River Basin are provided in the 2011 Bear River Basin Plan (WWDO, 2012) and can be accessed at <http://waterplan.state.wy.us/plan/bear/2011/finalrept/finalplan.html>.

Surface drainage in the Bear River Basin is controlled by topography. Perennial streams receive a large percentage of their source waters from overland flow associated with snowmelt and rainfall that originate in semi-humid and

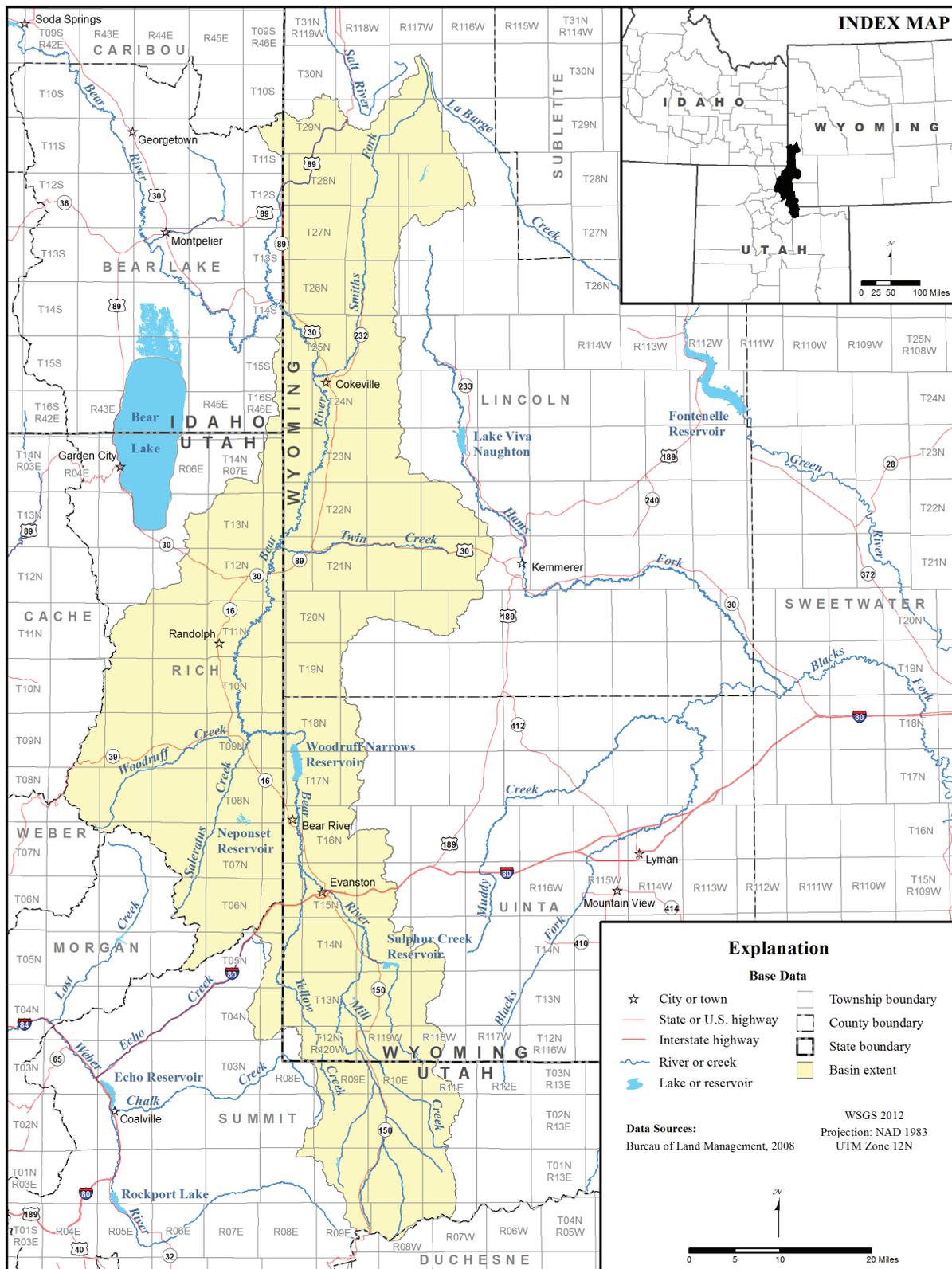


Figure 3-1. Municipality, road, township, and range index map, Bear River Basin.

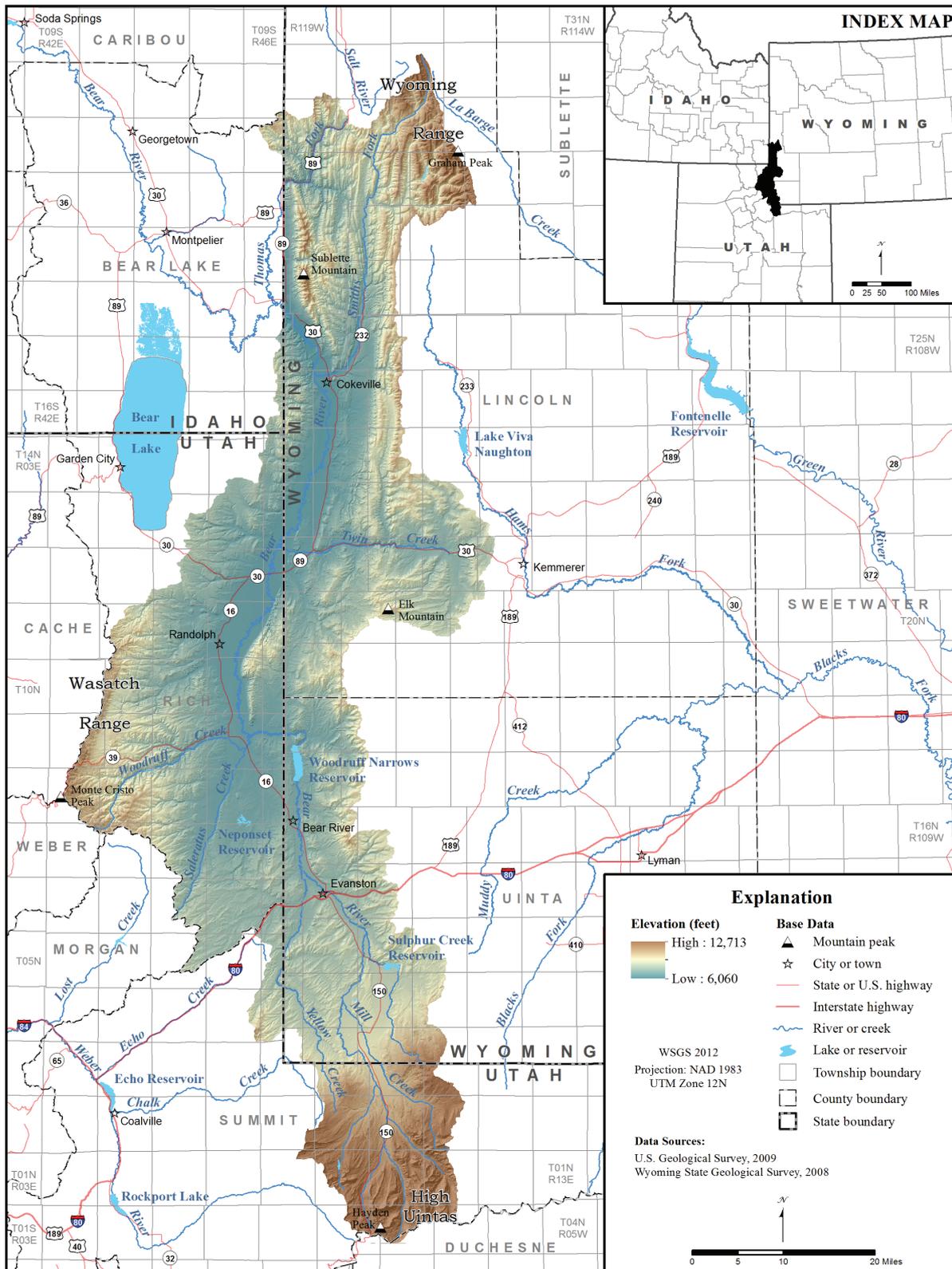


Figure 3-2. Physiographic features, drainages, and bodies of water, Bear River Basin.

humid mountainous headwater regions and from persistent baseflow (WWDO, 2012). Most ephemeral flow occurs in response to springtime snowmelt and to intense, short duration rainfall events characteristic of transient convective thunderstorms. Streamflows are also affected by vegetation, temperature, manmade diversions, and complex interconnections with groundwater.

Major drainages, reservoirs, and physiographic features of the Bear River Basin are shown on **Figure 3-2** and **Plate 1**. The basin encompasses the Bear River and its headwater drainage system. The Bear River is the major tributary to the Great Salt Lake. The mainstem of the Bear River begins at the confluence of Hayden Fork and Stillwater Fork in Summit County, Utah. Primary tributaries that confluence with the Bear River in Wyoming include Sulphur, Bridger, and Twin creeks and Thomas and Smith's forks. Woodruff Creek and Saleratus Creek are Utah tributaries to the Bear River. The distal divides of these drainages define the limits of the Bear River Basin study area.

3.2 Climate, precipitation, and vegetation

Climate within the Bear River Basin is primarily a function of elevation, to a lesser degree latitude and topography. Climate types range from semi-arid continental within the basin interiors, to humid-alpine in the bordering mountains. The mountain ranges capture much of the atmospheric moisture through orographic uplift, increasing annual precipitation in the mountainous regions while substantially decreasing precipitation in the basin interiors. Temperature varies by season from well below 0°F in the winter to more than 100°F in the summer. Annual precipitation increases with surface elevation (**Fig. 3-3**) and can exceed 40 inches a year in the high mountain headwater areas near Smith's Fork; average annual precipitation for the entire basin is 21 inches (PRISM, 2013). Most precipitation within the basin occurs as snowfall during the winter and early spring and as convective thunderstorms during late spring and summer months (Ahern and others, 1981).

The distribution of the diverse vegetation within the Bear River Basin is strongly influenced by elevation, soil type, exposure, and precipitation. In Wyoming, the dominant habitat system is sagebrush steppe/ shrubland, where the dominant vegetation consists of mixed prairie grasses and shrubs (primarily sagebrush). Other widespread habitat types include forest and woodland, agriculture – pasture hay, grasslands, and riparian areas (U.S Fish and Wildlife Service, 2013) Cottonwood and Russian olive trees are found along rangeland drainages where elevated soil moisture levels are maintained by perennial or frequent ephemeral streamflows. Fertile bottomlands along the perennial streams have been converted to irrigated cropland. Major crop producing areas are located along the Bear River mainstem, Sulphur and Mill creeks, and Thomas and Smith's forks (Forsgren and Associates, 2001). The abundance of grasses, shrubs, a variety of woodland trees (primarily conifers), and other species generally increases with altitude and increased annual precipitation up to timberline, above which vegetation is alpine tundra species of lichens, low shrubs, and grasses. A map illustrating the general distribution of vegetation types in the Bear River Basin is provided online in the U.S Fish and Wildlife Service website at <http://www.fws.gov/mountain-prairie/planning/lpp/ut/brr/brr.html>.

3.3 Population distribution, land use, and land ownership

U.S. Census Bureau data does not provide high resolution population numbers by river basin. Reasonable estimates can be made, however, by processing the most recent census data (U.S. Census Bureau, 2010) for Wyoming counties and municipalities. Using this approach, it is estimated that the 2010 population of the Bear River Basin was approximately 14,500 with about 86 percent residing in cities and towns, and rural populations accounting for the remainder. Every community within the Bear River Basin is located along or within a few miles of the river. While the Bear River Basin encompasses approximately 1.5 percent of the land in Wyoming, in 2010 it contained about 2.4 percent of the state's

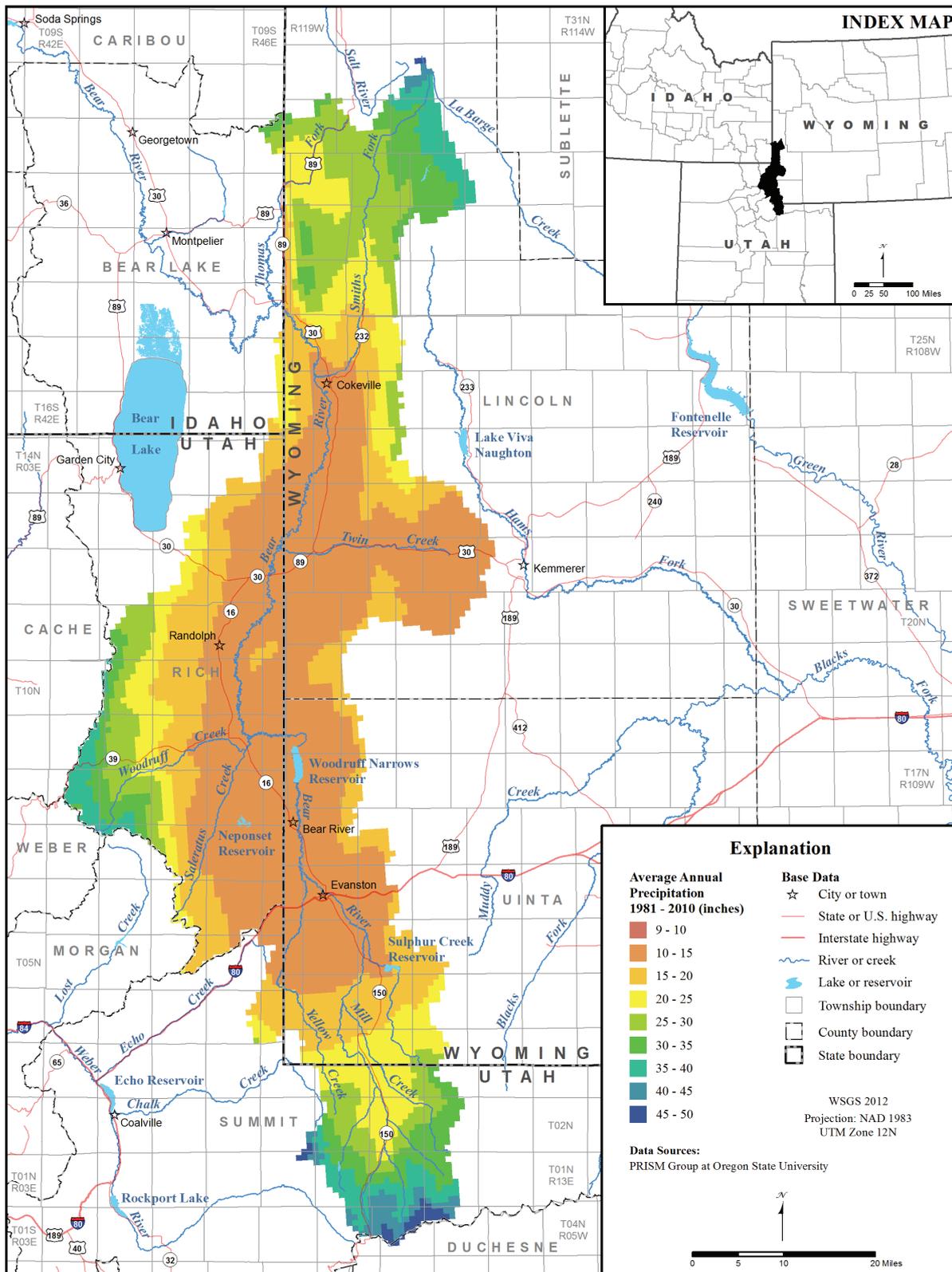


Figure 3-3. Average annual precipitation (1981 - 2010), Bear River Basin.

population. Additional detailed information on the demographic conditions of the basin can be found online in the previous 2006 Bear River Basin Final Report at http://waterplan.state.wy.us/plan/Bear/finalrept/Final_report.pdf.

Land use in the Bear River Basin is controlled primarily by elevation, climate, the distribution of surface waters, precipitation, and the location of mineral resources. Above timberline, the alpine lands are generally used for recreational purposes. At lower elevations, thickly forested areas are utilized for recreation and limited (mostly historic) logging. Grazing is the dominant use for rangelands, foothills, and riparian areas. Agriculture plays a significant role in the basin; approximately 6.6 percent (63,900 acres) of its surface area consists of irrigated cropland (WWC Engineering, Inc. and others, 2007).

Croplands are located primarily along the rivers and major streams where irrigation with surface water is possible. Most of the basin lowlands are covered sparsely with grasses, sagebrush, and other shrubs and are amenable for grazing. The locations of active and historic mineral development properties are described in **Section 5.6.2** and shown in Figures contained in that section.

Approximately 54.7 percent of the land area of the Bear River Basin is federally owned. In general, federal land is controlled or managed by the U.S. Bureau of Land Management within the basin lowlands and by the U.S. Forest Service in the forested mountain lands. Privately owned lands, concentrated along rivers and streams, constitute about 37.5 percent of the land in the basin; 7.7 percent is owned by the state of Wyoming and less than 1 percent is owned or managed by other entities. A map of state, federal, and private land ownership in Wyoming is available online via the 2007 Statewide Water Plan Online Presentation Tool at http://waterplan.wrds.uwyo.edu/fwp/Figures/pdf/Fig3-2_3-3.pdf.

