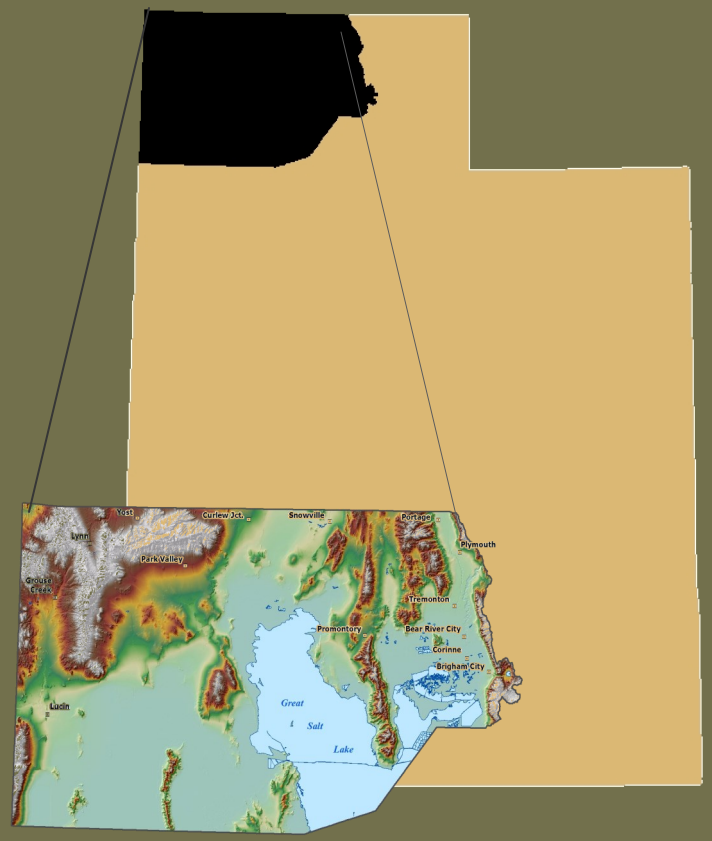
# Box Elder County Resource Assessment

July 2013




*Conserving Natural Resources For Our Future*

Northern Utah & West Box Elder Conservation Districts

UACD Utah Association of Conservation Districts

UDAF Utah Department of Agriculture and Food

USDA NRCS Natural Resources Conservation Service

## Acknowledgments

**Northern Utah Conservation District**
**West Box Elder Conservation District**
*with the:*
Utah Association of Conservation Districts
Utah Department of Agriculture and Food
Natural Resources Conservation Service

*in partnership with the:*
**Utah Conservation Commission**
Utah Conservation Districts Zones 1 - 7
Utah Department of Environmental Quality
Utah Department of Natural Resources
Utah Grazing Board (Chair and Vice-Chair)
Utah School and Institutional Trust Lands Administration
Utah State University Extension
Utah Weed Supervisor Association

**Utah Partners for Conservation and Development**
**State Agencies and Organizations:**
Utah Department of Community and Culture
Utah Department of Environmental Quality
Utah Department of Natural Resources
Utah Resource Conservation & Development Councils
Utah School and Institutional Trust Lands Administration
Utah State University College of Natural Resources
Utah State University Cooperative Extension Service
Utah Energy Office

**Federal Agencies:**
U.S. Department of Interior
Bureau of Land Management
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U.S. Forest Service
Natural Resources Conservation Service
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Farm Service Agency

**Other**
State Historical Preservation Office
Governor's Office of Planning and Budget
Box Elder County Commission

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# Box Elder County Resource Assessment: Executive Summary

## Why a Resource Assessment?

The Northern Utah and West Box Elder Conservation Districts have developed this resource assessment with the goal that conservation efforts in the county address the most important local resource needs. This report identifies natural and social resources present in Box Elder County and details specific areas of concern. Local, state, and regional entities can use this assessment to develop county resource management plans or to target conservation assistance needs.

We recognize that all who could have provided information may not have had the opportunity. This document is dynamic and will be updated as additional information is available.

Your comments are requested:

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## Natural Resource Priorities and Concerns

The Northern Utah and West Box Elder Conservation Districts have identified five natural resource priorities and concerns. These priorities receive special emphasis because of their immediate significance to Box Elder County.

1. **Grazing Land Improvements:** Improving grazing practices to maintain long-term integrity of physical improvements that are implemented.
2. **Noxious & Invasive Weeds:** Noxious and Invasive weeds pose one of the most significant threats to natural resources in Box Elder County.
3. **Wildlife Population Management:** Landowners and public land agency managers are proactive in improving habitat, especially for the threatened sage-grouse.
4. **Irrigation Water Efficiency**: Addressing aging infrastructure of irrigation delivery systems and improving water management.
5. **Soil Erosion:** Soil erosion occurs more with dryland farming, which is a common practice is Box Elder County.

## General Resource Observations

Natural and social resources are categorized as soil, water, air, plants, animals, and humans (SWAPA + H). This assessment describes the general condition of these resources and highlights additional concerns in each category. As opportunities become available to address these issues, and as circumstances change, their emphasis should be elevated accordingly.

**Soil:** field drains, erosion

**Water:** irrigation, stock water, drought

**Air and Climate:** air quality, erratic weather patterns

**Plants:** range condition, crops

**Animals:** sensitive species

**Humans:** socio-economic considerations

# Introduction

## The Conservation District Movement

The Dust Bowl of the 1930s brought the beginning of national programs for conserving soil and water resources in the United States. On April 27, 1935, Congress declared soil erosion "a national menace" and established the Soil Erosion Service. Since then, the agency has changed to the Natural Resources Conservation Service (NRCS). In May of 1936, farmers were allowed to set up their own districts to direct soil conservation practices. Today, Utah has 38 conservation districts.

Box Elder County is directed by two conservation districts. The West Box Elder CD is responsible for the are west of Curlew Junction (20 miles west of Snowville). The Northern Utah CD directs the eastern portion of the county.

The West Box Elder CD has been actively involved in maintaining healthy sage-grouse populations. They have worked hard with NRCS in improving habitat for these threatened birds. The Northern Utah CD has completed mapping drain pipes to prevent damage to the pipes while developing the land. Both districts have been working on mapping noxious and invasive weeds in order to control their spread throughout the county.

*Conservation districts provide local leadership and education to connect private property owners with state and federal assistance to improve, protect, and sustain Utah's soil, water, and related natural resources.*


Roadside sign for the West Box Elder Conservation District.

Riser system for an improved flood-irrigation delivery system.

# County Overview

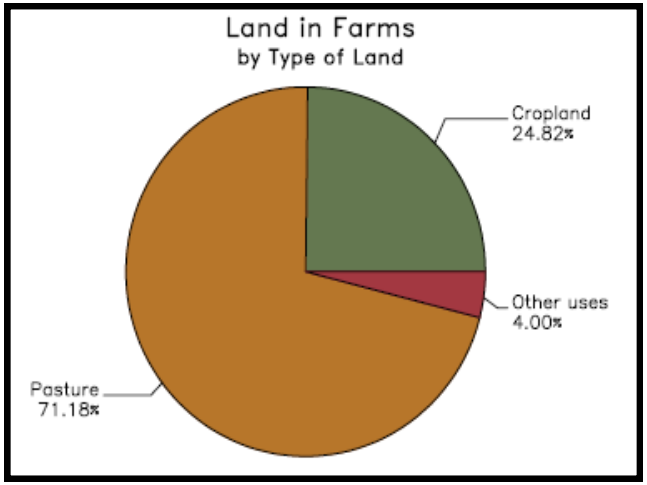
Box Elder County sits in the northwest corner of Utah and is bordered by Idaho and Nevada and consists of approximately 5,745 square miles. Approximately, 43% of the county is used for agriculture purposes, either cropland or rangeland.

Box Elder County is very diverse in its agricultural production. The western part of the county is much different than the fertile ground in the Bear River Valley. Farmers in the Bear River Valley raise a lot of grains and hay, as well as onions, mint, and beans. Most of the western part of the county is limited by water and used primarily for grazing.

Much of Box Elder County lies at the lowest elevations of the ancient Lake Bonneville. The Great Salt Lake remains as a small reminder of the fresh water lake that covered much of Utah 32,000 years ago. Salt flats and mud playas, intermixed with salt-desert shrub vegetation, dominate the southwest portion of the county. The Raft River Mountain Range heralds as one of only two east to west trending ranges in the continental U.S., while the Wellsville Mountain Range is often touted as one of the steepest mountains in North America, due to their height to base ratio.

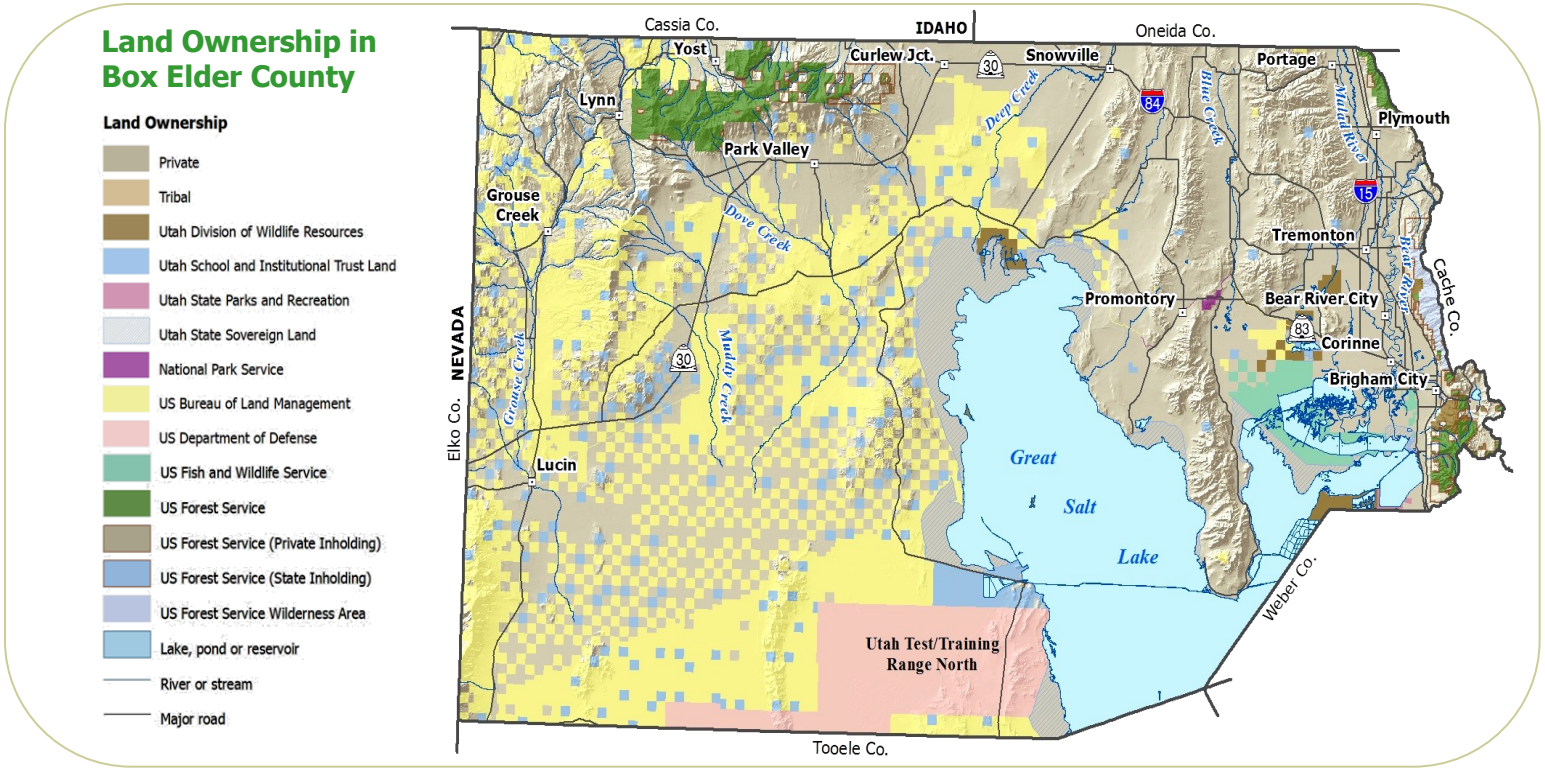
On May 10, 1869, the first transcontinental railroad was completed with the ceremonial driving of the golden spike. Visitors can watch reenactments and drive along portions of the original grade at the Golden Spike National Historic Site. The county got its name from the numerous Box Elder trees that grow in this part of the Great Basin. The first permanent white settlements were established in 1851 when Mormons moved north from the Salt Lake City area and settled in what are now Willard and Brigham City.

As of the 2011 census, 50,466 people call Box Elder County home. In 2007, there were 1,113 farms in the county which combined covered 1,320,177 acres. In Utah, Box Elder ranked first in production of grains and oilseed, fruits and vegetables, and cattle.




http://www.agcensus.usda.gov

Soil Survey of Box Elder County
2010 Utah Agricultural Statistics
Utah Department of Workforce Services
Wikipedia
http://www.bearriverheritage.com/


Land Ownership in Box Elder County
Land Ownership
Private
Tribal
Utah Division of Wildlife Resources
Utah School and Institutional Trust Land
Utah State Parks and Recreation
Utah State Sovereign Land
National Park Service
US Bureau of Land Management
US Department of Defense
US Fish and Wildlife Service
US Forest Service
US Forest Service (Private Inholding)
US Forest Service (State Inholding)
US Forest Service Wilderness Area
Lake, pond or reservoir
River or stream
Major road
Cassia Co.
IDAHO
Oneida Co.
Yost
Curlew Jct.
Snowville
Portage
Lynn
Park Valley
Plymouth
Grouse Creek
Tremonton
Promontory
Bear River City
Corinne
Brigham City
Cache Co.
NEVADA
Elko Co.
Lucin
Great Salt Lake
Weber Co.
Utah Test/Training Range North
Tooele Co.

# Grazing Land Improvements

Box Elder County includes vast areas of rangeland, ranging from the low-level salt-desert shrub around the Great Salt Lake (about 4,200 feet) to sub alpine elevations (near 10,000 feet) in the Raft River Mountains. Much of the lower to mid elevations are subjected to varying degrees of cheatgrass invasion. Due to the absence of historic fire intervals, other areas have seen increased woody vegetation of sagebrush, greasewood, and juniper. These invasions drastically reduce the amount of forage availability, which in turn is detrimental to livestock, wildlife, and the county's economy.

Many projects have been implemented in the past 20 years to improve degraded rangelands. Because introduced weeds have altered the succession of native vegetation, most successful restoration work has been achieved through the use of competitive introduced grasses and forbs. Recent history has shown that efforts to improve Box Elder County rangelands degraded with cheatgrass and/or decadent woody vegetation have been largely successful (Morris et al. 2011). We need to preserve our improved rangelands by rewarding proper grazing techniques and furthering education of grazing management as needed. A continued effort to improve and rehab rangelands is still greatly needed. An example of this would be to continue with brush management, juniper removal, reseedings, prescribed burnings, and use of chemical and mechanical treatments.

| Range land improvements Implemented in cooperation with NRCS 2005-2011 | | | | | |
|---|---|---|---|---|---|
| Brush Management (ac) | Prescribed Grazing (ac) | Range Planting (ac) | Stockwater Pipeline (ft) | Fence (ft) | Firebreak (ft) |
| 37,072 acres | 213,096 acres | 33,368 acres | 564,658 feet | 531,096 feet | 193,000 feet |

Livestock production is a major contributor to this county's lifestyle and economic base. There is a need for better grazing systems and rangeland improvements throughout the county. Livestock watering facilities and encroachment of pinyon/juniper are priority concerns. Promoting rangeland projects that will benefit livestock and wildlife, including the threatened sage-grouse, is also a priority.

## Strategies

- Promote proven, science-based grazing management practices and strategies throughout the county's public and private lands, prioritize larger landscape scale projects, and work with Bureau of Land Management (BLM), U.S. Forest Service, State Trust Lands, and private landowners.
- Assist permittees and ranchers in implementing best management practices (BMPs) on private pastures and public grazing allotments that will improve and increase the carrying capacity of those pastures and allotments, thus maintaining healthy livestock production while stabilizing or increasing animal unit months (AUMs).
- Use the West Box Elder Coordinated Resource Management Committee (WBCRMC) to improve coordination with public land managers in prioritizing critical areas for conservation projects.

## Actions & Tasks

- Utilize Grazing Improvement Program (GIP) staff, district planners, the extension agent, NRCS range specialists, and conservation partners to work with landowners and federal and state land managers to develop rangeland improvement projects, environmental assessments, and project plans for key landscapes needing improved conservation treatments.
- Promote and assist producers in applying for, and giving technical assistance for, federal and state conservation cost-share programs, such as GIP, state Agriculture Resource Development Loans (ARDL), the USDA Environmental Quality Incentive Program (EQIP), and other conservation programs.
- Coordinate with state and federal land managers at West Box Elder Coordinated Management Plan (WBCRMP) meetings, regional conservation coordinating committee meetings, conservation district meetings, range tours and workshops, UACD Zone 1 annual meetings, regional GIP board meetings, and other regional and county functions and venues.
- Promote and look for large-scale management plans that could benefit the ranchers, improve infrastructure (cost), and benefit the landscape for livestock and wildlife.
- Work with land managers to develop projects that will protect and improve the habitat for sage-grouse and increase forage production for livestock (e.g., pinyon/juniper treatments with reseeding as needed).
- Work with all land managers to develop large scale landscape projects that will help prevent catastrophic fires, facilitate other controlled burns, and increase forage production (e.g., green stripping fire breaks, juniper treatments, and proper and timely grazing of cheat grass).

The West Box Elder Conservation District is leading a Coordinated Resource Management Plan (CRMP) that covers most of the western half of Box Elder County. Land management agencies, local officials, special interest groups, and area landowners have formed a committee to analyze and determine long-term resource needs. Specific projects have yet to be identified, but grazing management, sage-grouse, noxious weeds, wildland fire, and other issues affecting grazing lands will be further evaluated and targeted for improvement.

# Noxious & Invasive Weeds

As in many areas throughout the state, noxious and invasive weeds pose one of the most significant threats to natural resources in Box Elder County. A strong weed board and county weed program is necessary to meeting the weed control need. The impacts of noxious weeds are experienced across ownership and jurisdictional boundaries. While it is necessary to identify methods of weed spread, it should not be used to point blame. It is important for impacted parties to work cooperatively to resolve this as a shared problem.

The following are weeds of major concern. These weeds are established, and control measures should focus on containment. Management favoring desired vegetation will reduce the weed's influence and spread to new areas, as well as maintain or improve the desired use of the site. While eradication is unlikely, these weeds must be controlled or their impact will continue to expand.

- **Medusahead rye** (*Taeniatherum caput-medusae)* is rapidly invading eastern Box Elder County, with an estimated 2,000 acres of infestation. The main infestations are found on hillsides near Mantua, north and west of Tremonton, on Promontory Point, and Little Mountain. Satellite populations are scattered throughout the eastern half of the county, but it is not known to occur west of Howell.
- **Cheatgrass** (*Bromus tectorum*) is a significant problem and has degraded thousands of acres in Box Elder County. Control related to this annual grass is most successful when paired with revegetation efforts and proper grazing practices. We need to encourage rehab and management of infested properties, providing technical and financial support whenever possible.
- **Russian knapweed** (*Acroptilon repens)* is a concern in Park Valley. Other knapweeds species scattered throughout the county include diffuse knapweed (*Centaurea diffusa*) and spotted knapweed (*Centaurea biebersteinii*). These are known to occur along the Promontory Mountain Range and north of Tremonton in Johnson Canyon.
- **Hoary cress**, or whitetop, (*Cardaria draba*) is a major issue in considerable portions of the county. It has invaded many waterways and is scattered on rangeland and dry farms throughout the county. Top areas of concern include the entire Bear River Valley, particularly along the Malad River and Salt Creek, and Park Valley.

### Box Elder County Noxious Weed List

The following weeds are officially designated and published as noxious for the State of Utah under the Utah Noxious Weed Act.

- Bermudagrass (*cynodon dactylon*)
- Black henbane (*hyoscyamus niger*)
- Canada thistle (*cirsium arvense*)
- Diffuse knapweed (*centaurea diffusa*)
- Dyers woad (*isatis tinctoria L*)
- Field bindweed (*convolvulus arvensis*)
- Hoary cress (*cardaria drabe*)
- Houndstongue (*cynoglossum officinale*)
- Johnsongrass (*sorghum halepense*)
- Leafy spurge (*euphorbia esula*)
- Medusahead (*taeniatherum caput-medusae*)
- Musk thistle (*carduus mutans*)
- Ox-eye Daisy (*chrysanthemum leucanthemum*)
- Perennial pepperweed (*lepidium latifolium*)
- Perennial sorghum (*sorghum halepense L & sorghum almum*)
- Poison Hemlock (*Conium maculatum*)
- Purple loosestrife (*lythrum salicaria L*)
- Quackgrass (*agropyron repens*)
- Russian knapweed (*centaurea repens*)
- Saltcedar (*onopordum acanthium*)
- Scotch thistle (*onopordum acanthium*)
- Spotted knapweed (*centaurea maculosa*)
- Squarrose knapweed (*centaurea squarrosa*)
- St. Johnswort (*hypericum perforatum*)
- Rush skeletonweed (*Chondrilla juncea)*
- Yellow starthistle (*centaurea solstitialis*)
- Yellow toadflax *(linaria vulgaris Mill.)*

Focus on early detection and rapid response will be the best use of resources against noxious weeds. The following weeds should receive our highest attention as infestations are relatively small and isolated.

- **Rush skeletonweed** (*Chondrilla juncea)* was recently discovered in three patches in the greater Howell area. The Box Elder County Weed Department and private landowners have been aggressive in attacking this weed, and eradication is still possible. Aggressive cooperative efforts are being pursued to detect and map all patches.
- **Yellow starthistle** (*Centaurea solstitialis)* has moved into the county. It is has been found on the slopes and the edges of fields north of Brigham City and south on the border with Weber County. It prefers dry sites in rangeland and sites traditionally occupied by annual grasses.

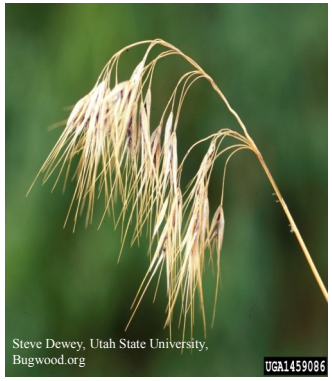
## Strategies

- Increase funding opportunities for noxious weeds and invasive species.
- Maintain cooperation with the Northern Utah, Weber River, and Utah/Idaho CWMAs.
- Improve early detection and rapid response mechanisms to identify and respond to small infestations.
- Increase coordination between agencies and private citizens to improve county inventory of noxious weeds.

## Actions & Tasks

- Develop funding proposals, in cooperation with the Box Elder County Weed Department and CWMAs, for species highlighted in this report.
- Work with USU Extension to develop a database and mapping system. Continue to upgrade county-wide weed and invasive species inventory maps for effective coordination and planning efforts.
- Develop a county noxious weed and invasive species information and education program through the CWMA, weed board, and conservation district.
- Sponsor noxious weed spray days in critical areas, with CWMA partnership and local landowners.
- Coordinate efforts with the CWMA, private landowners, and agencies to mitigate Russian olive and develop conservation plans for private landowners and public lands.





# Irrigation Water Efficiency

Irrigation has become an essential part of agricultural production in Box Elder County. Surveying for the development of an irrigation system in the Bear River Valley started as early as 1868, and construction of the now Bear River Canal system began in 1889. Currently 75% of irrigated ground in the county is supplied by off-farm sources, such as the Bear River Canal. The remaining 25% comes from on-farm deep wells.


As of 2007 in Box Elder County, over 112,113 acres were irrigated, with 96,944 acres as cropland and 15,169 acres as pasture. Irrigated agriculture in Box Elder County only accounts for 33% of total wheat acres, yet it provides over 66% of total wheat production. In 2007, grain corn crops produced $4.9 million in marketable goods on 5,890 acres (an average income of over $800 per acre), which would not be possible without irrigation. The use of irrigation has played a crucial part in making Box Elder County one of the prime agricultural counties in Utah and is an essential driving force in the county economy.

Increasing the efficiency of this key resource has been a top priority of local, state, and federal efforts in Box Elder County. Through USDA funded programs, such as the Environmental Quality Incentives Program (EQIP) managed by the Natural Resource Conservation Service (NRCS), along with the Agricultural Resource Development Loan (ARDL) program from the Utah Department of Agriculture and Food (UDAF), many improvements have been made to farm irrigation systems all around Box Elder County. Such improvements have included enclosing ditches and conveyances to reduce water loss to seepage, replacing less efficient sprinkler systems with higher efficiency overhead irrigation/center pivot systems, precision laser leveling of flood irrigated fields, and converting orchards to ultra-efficient micro-irrigation/drip systems, as well as providing awareness and technical assistance to help improve farmers' management skills of this precious resource.

| Irrigation Improvements with NRCS Cooperation 2004-2012 | | |
|---|---|---|
| Conveyance Pipe | Sprinkler | Land Leveling |
| 27.75 miles | 6,157 acres | 2,938 acres |

Yet, even with current programs, these vital systems are continuing to age and fall further into disrepair. Much of the over 140 miles of canal and laterals in the county are in need of repair and remain unimproved due to overwhelming cost. Improvements of both on-farm and off-farm systems with modern technology and technics needs to remain one of the top priorities, not only within the agricultural community but the county as a whole. Continued support of current programs and awareness campaigns must be encouraged, as well seeking additional funding and support, especially for the improvement and updating of the aging system of canals and ditches.

Looking to the future as the population increases along the Wasatch front, demand upon limited resources, such as water, will continue to grow. Agriculture, as the largest water user, will continue to be pressured to relinquish more of this resource to meet municipal needs, yet goods will continue to be expected to be produced at the same, or even greater levels, to meet demand. It is estimated that the current capacity of the Bear River Watershed will be exceeded, due to population growth, by 2050. As a key part of a solution to meet this demand, continued investment in water conservation practices is needed, especially in the improvement of irrigation efficiency in the agricultural sector.

## Strategies

- Conservation of water resources, through increasing on-farm irrigation systems by updating equipment, enclosing conveyances, and using improved management tools, such as soil moisture sensors, along with updating and improving off-farm conveyance systems to increase the systems overall efficiency.

## Actions & Tasks

- Continue the support of local, state and federal programs and efforts directed to the conservation of water resources, encouraging the use of cost share incentives to improve and update on farm irrigation systems.
- Encourage the development and use of public / private agreements such as the West Box Elder Coordinated resource Management Plan that include plans for the development, improvement and protection of water resources for use in agriculture production.
- Increase the public awareness of issues related to the need to conserve water resources through outreach and education activities and programs in both agriculture and municipal sectors.
- Promote the targeting of additional funding to the improvement of water resources related to the updating of aging irrigation conveyance systems.
- Support the development of policies and legislation directed to the protection of water right and use for agricultural production.


Broken concrete lined ditches, such as this, are common throughout the Bear River Valley.

# Soil Erosion

Soil erosion occurs when soil particles are moved from one location to another by some force, mostly by water or wind. The rate and risk of soil erosion increases with the removal of vegetative cover. The force of a rain drop on bare soil is greater than the force of a raging river, detaching soil particles and causing them to move with runoff. Bare soil is also subject to the forces of wind, causing the detachment and transport of soil particles.

Soil erosion is a serious risk to sustainability of agricultural lands, including both crop and rangeland. The detachment and transportation of the soil particles by wind or water is one of the most destructive forces on earth and greatly affects the productivity of agricultural land. Soil erosion, if left unchecked, has the potential to completely destroy the productivity of land within a short few years.

Top soil is the most productive layer of soil, containing the essential minerals, nutrients, and organic matter used to support life. The formation of soil comes from the continuous weathering of rock and decaying of materials though the natural process of wind, rain, and ice. These natural processes can take more than 500 years to form just one inch of soil. Soil erosion in a native environment is minimal, in most circumstances, yet as soil is disturbed in such processes as tillage or grazing, the erosion process increases its destructive capabilities. Soil erosion can result in the loss of as much as 300 tons of soil per acre, which would equal about two inches of top soil being loss each year. At that rate of erosion, a soil would potentially become unproductive in mater of a few years.

The erosion of top soil from wind and water poses a great risk to the productivity of agricultural land. After the devastating effects of the dust bowl in the early 1920s, Hugh Hammond Bennett, a pioneer in the field of soil conservation and founder of the Soil Conservation Service (now NRCS), warned that if we did not address the issue of soil erosion we stood the risk of losing 360 million acres of farmland. Fortunately, through the effort of Bennett and others, the nation has been able to decrease the rapid erosion and degradation of much of America farmlands. Yet, soil erosion continues to be a major threat.

| 2004-2012 Erosion Control Practices according to NRCS Performance Reporting System | | | |
|---|---|---|---|
| Terraces | Diversions | No till | Mulch/Residue Management |
| 167,935 ft. | 5,200 ft. | 1,380 ac | 8,036 ac |

Soil erosion due to water runoff in the spring.


Terrace installed during the EWP project.

Box Elder County has vast amounts of rangeland acres. Due to poor grazing management over the years and neglect, these rangelands are highly erodible. Junipers and sagebrush have taken over a lot of acres, taking over the forage. Forage has a hard time competing for water and usually dies out, leaving the ground bare and vulnerable to soil erosion. Ranchers and landowners are working on controlling junipers and sagebrush and reclaiming with grasses and other vegetation. This will not only benefit landowners by improving rangeland but will also protect the soil from erosion. Rangeland is also being invaded by cheatgrass and other invasive annual grasses. These grasses are short lived and are only palatable to animals for a short time. This build up of dry grass is a great source of fuel for fires later in the year. When these fires come through they burn off all the vegetation. After all the vegetation is gone, it leaves the ground as a prime candidate for wind and water erosion. The Grazing Improvement Program (GIP) has installed what they call "green strips". These strips are vegetated with plants that retain high moisture content throughout the summer months. These are built in fire breaks that are also beneficial to animals. And, unlike traditional firebreaks, they protect the soil from erosion because of their vegetation.


Photo courtesy of Clair Zollinger

## Cropland

In Box Elder County, the most at risk areas for soil erosion are in dryland production systems, due to aggressive slopes, fragile soil types, and rainfall patterns. Current efforts to prevent soil erosion in these areas include promoting the retention of crop residue through the use of minimal and direct seeding (no-till) tillage programs and installing terraces and diversions to manage rainfall runoff, as well as converting highly erodible land to permanent vegetative cover.

These efforts, promoted through the Environmental Quality Incentive Program (EQIP), the Emergency Watershed Program Blue Creek project, and the Conservation Reserve Program (CRP), have helped to reduce the amount of both wind and water induced soil erosion incurred in these areas.

Overgrazing of rangelands removes excessive amounts of vegetation, leading to increased soil erosion due to the exposure of bare soil to the effects wind and water. The use of a grazing management system that stresses leaving at least three inch stubble to insure proper ground cover, promotes healthier grass stands, overall. In addition, improvements in stock watering systems and deferred rotation grazing systems reduce compaction of soil from the impact of animals in concentrated areas.


Photo courtesy of Diane Tanner

# Wildlife Population Management

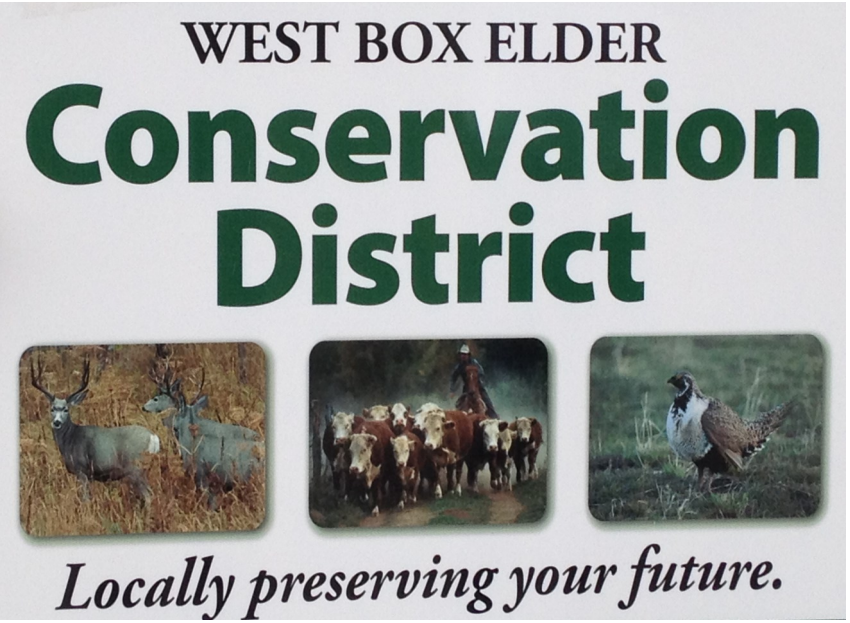
Population cycles are commonplace in the natural world. This play is acting out on the Box Elder County stage. Mule deer populations have declined throughout the West, compared to 1950's population estimates. In contrast, elk numbers have steadily increased. Considerable evidence exists suggesting pronghorn antelope and bighorn sheep were historically more prevalent than they are today, though recent experience suggests both are becoming more common.

Predator populations in Box Elder County have also ebbed and flowed. During the peak of the livestock industry, particularly sheep ranching, predator control practices significantly reduced coyotes, wolves, mountain lions, and bobcats. Poisoning likely impacted other species, such as magpies, crows, ravens, eagles, red fox, skunks, and badgers. This may have unintentionally benefitted alternative prey species, such as jack rabbits, sage-grouse, sharp-tailed grouse, and others.

Today, without the broad use of predator control poisoning, it is likely that some predator populations are increasing. This is complicated further by the fact that human activities, such as roadways, land fills, and livestock, may present alternative food supplies to scavenging predators. Once again, this is sure to have unintended consequences that are not completely understood.

Some interactions are beginning to be understood. For example, research in western Box Elder County has shown poor success rates for sage-grouse recruitment, with 70-80 percent of either eggs or chicks not surviving to adulthood. The primary cause of nest failure is predation. More research is being conducted, but predation appears to be one of the main factors in sage-grouse recruitment.

Historical perspective is an important aspect of desired objectives. Such is the case with the current societal goal of "more sage-grouse". However, while we may know that there were more sage-grouse "back then", we may have failed to recognize other historical factors that may not be active today.




## Objectives

- Maintain balance among wildlife populations, according to accepted state wildlife management plans.

## Strategies

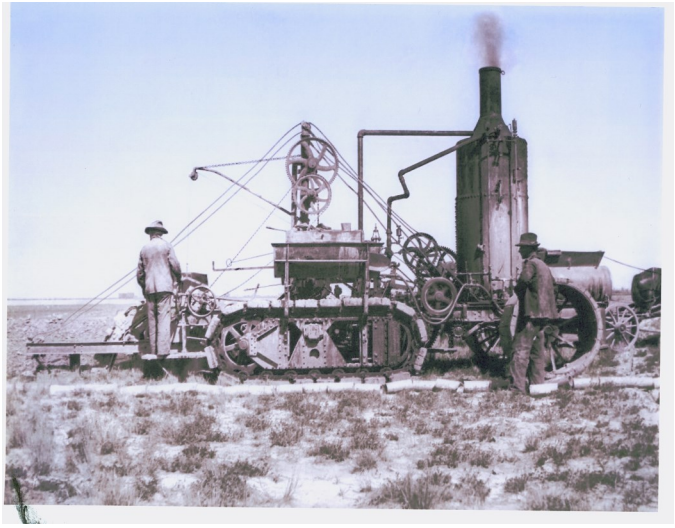
- Recognize research-supported limiting factors that prevent the achievement of desired objectives, and take steps accordingly.
- Capitalize on funding opportunities for sage-grouse habitat improvement.
- Increase coordination between agencies and private citizens to improve cooperation and protect private property rights.
- Support the West Box Elder Coordinated Resources Management Plan (CRMP), the West Box Elder Greater Sage-grouse Conservation Plan, other state wildlife management plans.

## Actions & Tasks

- Develop funding proposals, in cooperation with participants of the West Box Elder CRMP and the Box Elder County Local Working Group.
- Increase predator control where data shows impacts limit desired objectives.
- Provide input to state wildlife management plans, representing local agricultural interests.

# Soil

Box Elder County has very diverse soil types throughout the county. The county is split into two different soil surveys. There is one for the eastern part of the county and one for the western part of the county. The eastern soil survey was issued in June of 1975; the western soil survey was issued in 1997. The eastern part of the county is where the most profitable crop land is available, due to the soil type and also the availability of water. As Lake Bonneville receded in the western part of the county, it left terraces along the mountainsides. These terraces are full of very course and well-drained soils. Many of the terraces in Box Elder County are open-face gravel and sand pits. The well-drained rocky side hills are also prime land for orchards and fruit production. Up on the benches, the more temperamental trees can avoid the damaging frost that settles in the bottom of the valley. The orchards of Perry and Willard are fairly unique to the state of Utah. The a valley floor is full of fine textured, very poorly drained soils. A lot of the ground in the valley floor would be unsuitable for farming or building if it were not for the drainage system that has been installed.



## Eastern

The eastern part of Box Elder County ranges in soil type from well drained gravely soils to poorly drained alkali soils. The use of these soils differs as much as the soils themselves. The alluvial fans and terraces are mined for rock and sand. The deposit of these soils near Brigham City is a main source of high quality sand for the region. Also, the well-drained gravelly soils are a good fit for fruit production in the communities of Willard and Perry. This area has been taken over by development in the recent years, but it is still famous for the fruit produced there. The valley bottoms are used for crop production. The Bear River flood plain provides the best agriculture land in the county.

The other soils in the bottom of the valley are fine textured and very poorly drained. These soils have a very high water table and also high concentration of salts. It was said that nothing south of Garland would make productive farmland. With the installation of field drains, the alkali swamp ground of eastern Box Elder County has become some of the best remaining cropland in the state. The tile drain systems drain excess water and salts from farm ground. The Corinne drainage district was formed in 1951, making it the oldest drainage district. The once useless farm ground is now used to grow a variety of crops. Onions, mint, corn, and alfalfa are the main crops now grown on this ground. Districts were formed to manage the drains.

Field Drain Map Sample

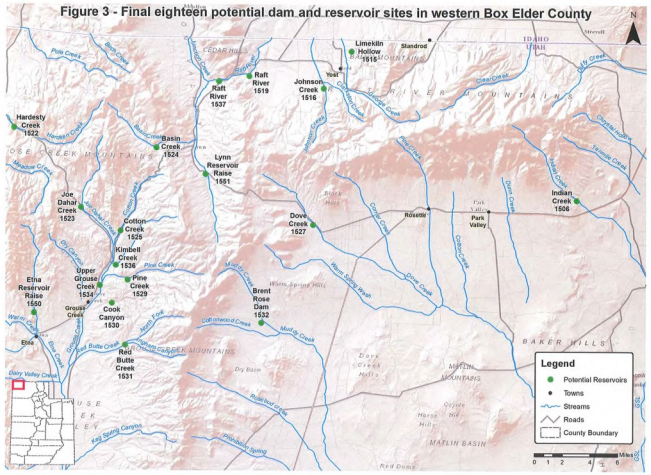
## Western

The western part of Box Elder County is mostly undeveloped land. About 70% of the land taken in by the soil survey is used for agriculture purpose. The other 30% is not used, due to natural limiting factors. Of the 30% of the land not used for agriculture, 25% is mudflats and 5% is steep or rocky mountainsides not suitable for grazing. Agriculture land is mostly used for grazing of livestock, mostly sheep and cattle. Only 1% of agricultural land is used for cropping; water and high salt in the soil limit this ground. The soils in western Box Elder County contain high concentrations of salts. The presence of these salts limit plant varieties. The rangeland in western Box Elder County varies in use. The high mountain tops are used for spring and summer grazing, while the low deserts are great for fall and winter grazing.

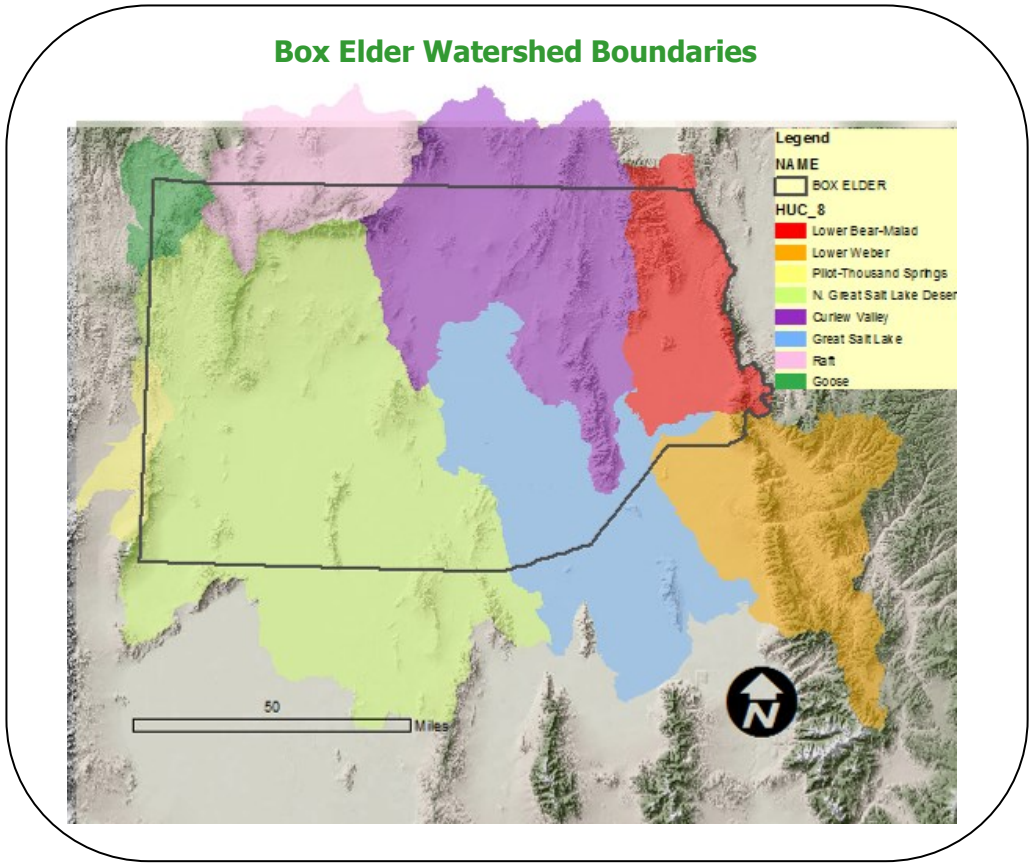
# Water

Water is precious, made more so by its scarcity…a statement of the obvious, right? Well, scarcity itself is defined by one's perspective. Your perspective might change dramatically in just a short drive from eastern to western Box Elder County.

When it comes to water, Box Elder has a split personality. By comparison to western Box Elder County, the Bear River Valley has water in lavish abundance. For farmers in Park Valley, Grouse Creek, and Yost, growing hay for winter livestock forage is a race against the sun. Outside of three small reservoirs, there is no irrigation water storage. Most farmers are cutting back in June and are out of water by mid-July. Range is the dominant landscape use, depending solely upon often miserly skies to supply water to thirsty soils. The West Box Elder CRMP suggests a reservoir suitability analysis be conducted to determine the feasibility of constructing new reservoirs and/or upgrading existing storage. A preliminary analysis identified potential reservoir locations in west Box Elder, based on estimates of annual runoff and local topography. Thirty-four potential reservoir sites were identified. Of these, sixteen were removed quickly due to "fatally" unfavorable characteristics, such as topography, geology, federal land ownership, or a combination of these and other factors. Known water demand, base flow requirements, and significant cost per acre-foot usable storage limit the remaining potential sites further. A reasonable cost-benefit ratio could not be obtained due to the reconnaissance level of investigation. Some of the sites would likely be cost prohibitive. Feasibility of the most promising sites will require more site-specific analysis and consideration of funding alternatives.




The final eighteen potential dam and reservoir sites in western Box Elder County.

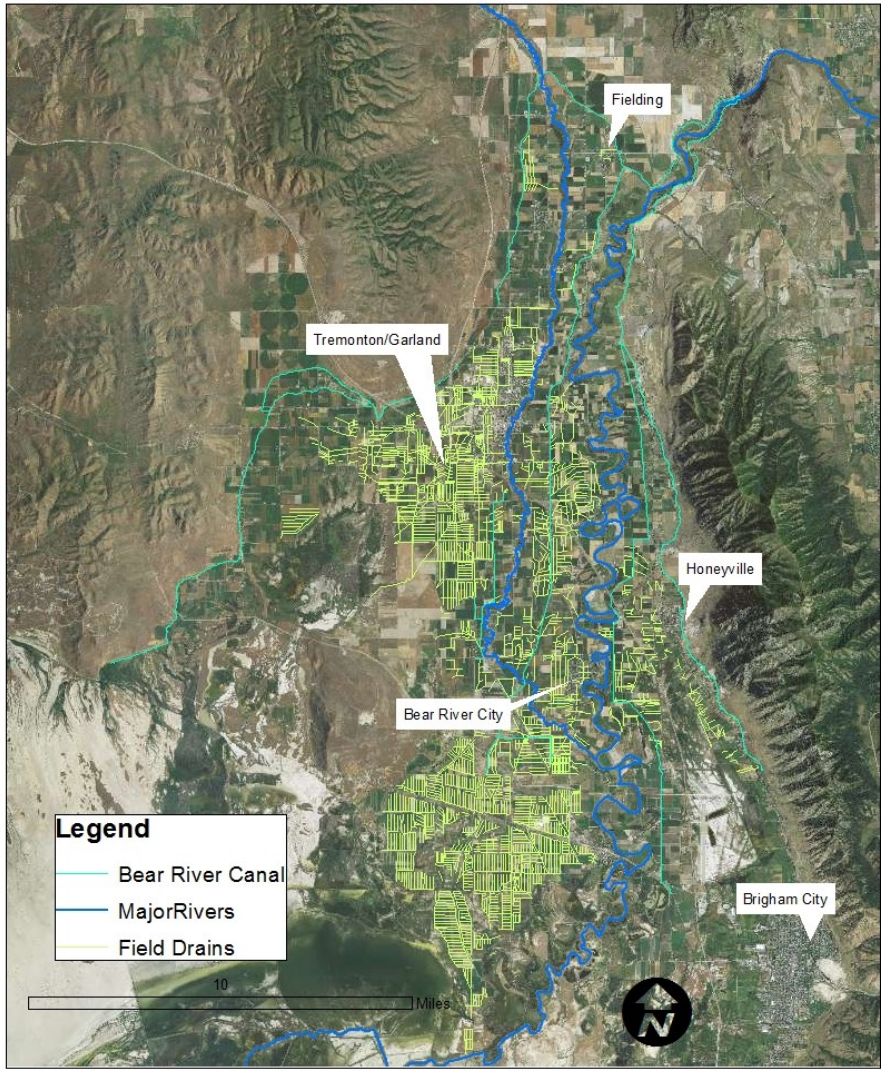


Though precipitation is higher, eastern Box Elder County's fate is really determined by the presence of the Bear River. Dominated by the Bear River Canal Company, irrigation canals snake from Fielding to Bothwell and south to Bear River City and Corrine. The level landscape and soils allow for efficient flood irrigation, which is still dominant today. Water is stored up-river in Bear Lake during spring run-off, later providing for lush green crops throughout the growing season. The vitality of the Bear River irrigation system to the valley cannot be understated.

Beneath the soil surface lies a little-known infrastructure that is also important to Bear River Valley. Essentially unknown to citizens outside of agriculture, nearly the entire valley floor is a grid of field drains. Initially the purpose of these drains was allow for and improve crop production. Field drains serve to lower a natural or irrigation-induced water table. They also allow for the removal of excess salts built up in the soil profile. While continuing to meet their intended purpose, they now also prevent basement flooding and other high water-table issues.

The Bear River Migratory Bird Refuge relies on in-stream and irrigation return flow throughout the summer months.

## Bear River Valley Water



# Air & Climate

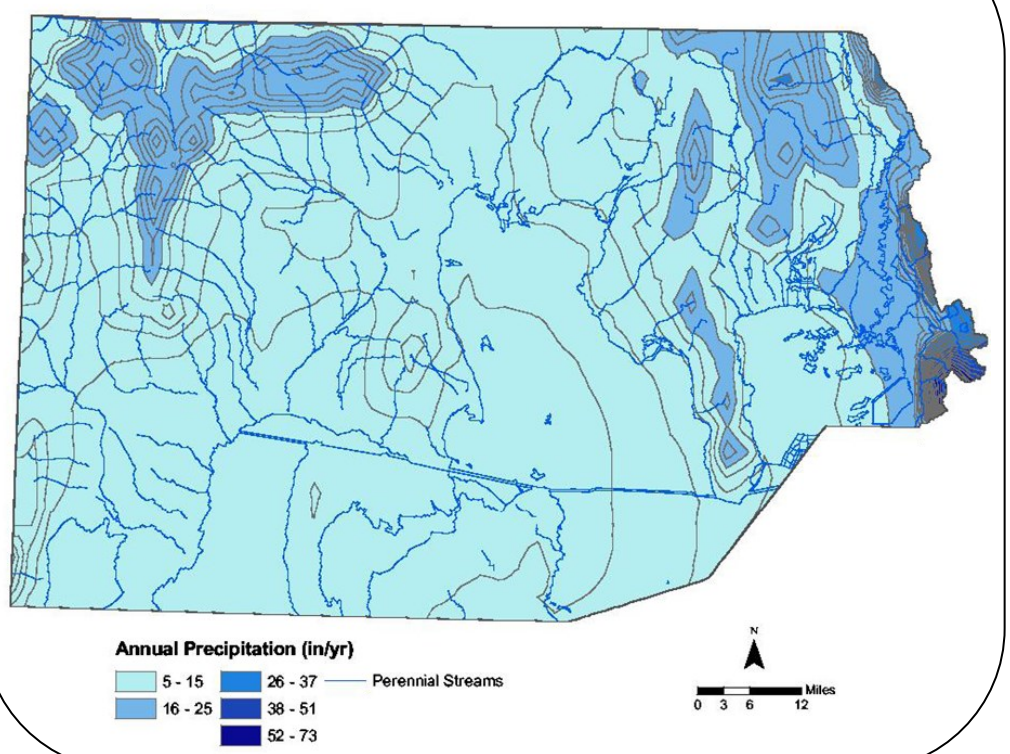
All four seasons are represented in Box Elder County. The climate ranges from semi-arid to humid-continental. Humid-continental climates are found over large areas of land in the mid-latitudes, where there is a zone of conflict between polar and tropical air masses. The humid-continental climate is marked by variable weather patterns and a large seasonal temperature variance. Summers are often warm and humid, with frequent thunderstorms, and winters can be very cold, with frequent snowfall and persistent snow cover.

Precipitation varies according to location in the county, with mountainous and hilly areas receiving more than the desert areas. Precipitation occurs in the mountains throughout the year, and a deep snowpack accumulates during winter. During summer, precipitation in the valleys occurs as showers and occasionally as thunderstorms. During winter, the ground is covered by snow much of the time. Along the Great Salt Lake there is only about four inches precipitation per year, while the higher reaches of the Wasatch receive over 30 inches per year. The central area, which is the most concentrated agricultural area, generally receives about fourteen to sixteen inches per year. Park Valley, in the western part of the county, receives an annual precipitation of nine and a half inches. Chinook winds in this portion of the county are warm and dry, often melting and evaporating the snow.

The presence of the Great Salt Lake, to the south of the area, has a moderating effect on temperature in the area, yet seasonal and daily temperatures vary throughout the county. At Brigham City, in the eastern portion of the county (elevation 4,315 feet), the average daytime temperature in July is 93° F with a low of 62° F. Park Valley, near the Nevada border (elevation 5,548 feet), experiences corresponding temperatures of 88°F and 55°F. In January, the average high temperature for Brigham City is 36°F with a low of 19°F. At the same time, temperatures in Park Valley are 34°F and 15°F, respectively. The lowest temperature on record, which occurred at Park Valley on December 10, 1972, is -28°F.

Frosts are fairly common in the spring and fall, with a frost free period ranging from 60 to 165 days. In the mountain areas, frost may occur in every month of the year. Longer growing seasons occur in the eastern portion of the county along the base of the Wasatch Mountains on the terraces left by Lake Bonneville.

**Annual Precipitation in Box Elder County**

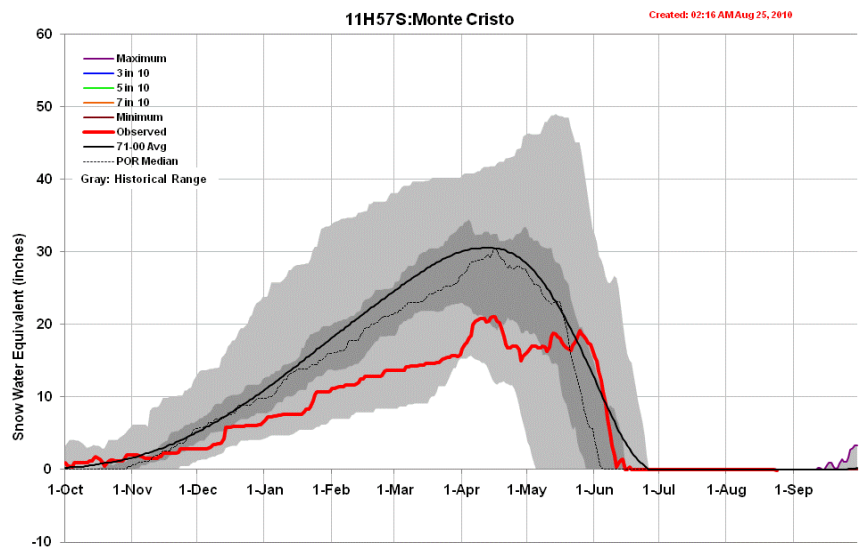


## NRCS Snow Survey

The NRCS Snow Survey Program provides mountain snow pack data and stream flow forecasts for the western United States. Common applications of snow survey products include water supply management, flood control, climate modeling, recreation, and conservation planning.

Timing and amount of snow pack, along with temperature fluctuations throughout the spring and summer months, impact the amount of water available for irrigation throughout the growing season. The Utah Snow Survey provides valuable data that is used to help manage water usage to maximize the water that is available. During dry years, it becomes very challenging to provide adequate water to landowners. As a result, it is common to have inadequate water resources available to sufficiently supply the land with irrigation needs for maximum crop growth.

### Water Availability Projection




The above projection graph takes historical average data that is used to help predict expected available water throughout the growing season. The amount of moisture within the soil profile is also an important factor in determining the amount of forage and water runoff that will occur during a given season. In Box Elder County, data collection indicates that forage type and vegetative cover also has an influence on available water within a watershed. The information provided provides valuable data for determining range forage conditions.

For additional information contact the Natural Resources Conservation Service. Information about the Utah Snow Survey Program is located at: http://www.ut.nrcs.usda.gov/snow.

# Plants

## Crops and Pasture

Box Elder County has some of the most productive soils in Utah, which are used for wheat, barley, oats, safflower, alfalfa, corn grain and silage, and onion production. It was the number one county in total grain production for the state of Utah and was the state's largest producer of wheat in 2007, producing 39% of the state total. Orchards in Willard and Perry produce an abundance of apricots, peaches, pears, apples, and sweet and tart cherries. Of the 1,320,177 acres of Box Elder County designated as farmland, 71.18% is in pasture and 24.82% is in cropland. Most of the western half of Box Elder County is used for livestock grazing.

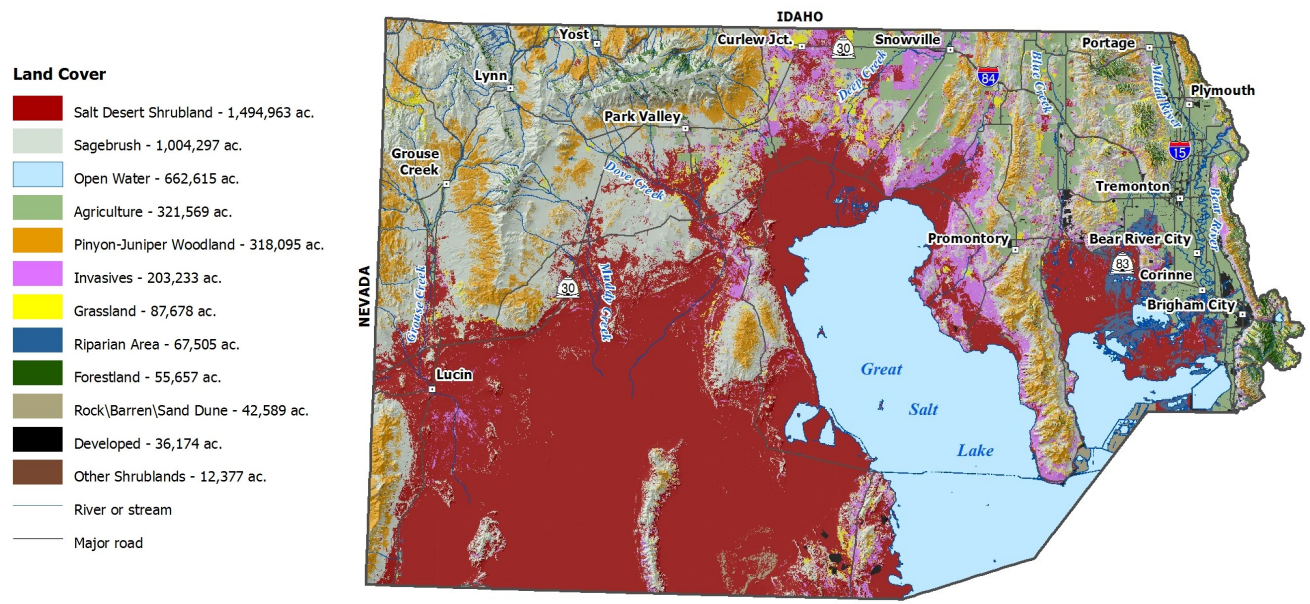
## Rangeland

Rangeland is a very important agricultural resource in Box Elder County, where approximately 1,485,000 acres, or about 70% of the total land acreage, is native vegetation used as rangeland. The dominant vegetative types include perennial grasses, forbs, and shrubs. Some areas support stands of juniper and, to a lesser extent, pinyon pine. Rocky ridges have stands of curl-leaf mountain mahogany. The higher mountainous areas support coniferous trees on north and northeast aspects and aspen thickets in depressions where snow accumulates. Numerous small, wet meadow sites are in the mountain areas.

Livestock graze the higher mountain ranges from June through September. They winter on bottom haylands and in the lower semi-desert and desert ranges, with some supplemental feeding.

Brush management is needed to control juniper invasion and sagebrush on approximately 35% of rangeland. Range seeding is needed on approximately 35% of rangeland. About 60% of rangeland in the area could produce more forage if proper management practices and grazing systems were applied.

### Land Cover in Box Elder County



## Rangeland Management

Range management requires knowledge of soil type and the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, reduction of undesirable species, conservation of water, and control of erosion.

## Forest Land

Forested land covers 100,000 acres of the county. These forests provide some of the county's most valuable watershed, wildlife, and recreation areas. They are capable of providing multiple benefits, as well as posing risks for nearby homes and communities if not properly managed. Threats and challenges include the degradation of watersheds and potentially irreversible changes in forest health that could result from poor management, such as overgrazing, excessive timber harvest, and residential or recreation related development, and surface mineral development.

Box Elder County forests are in good condition. Bark beetles and other common forest pests are found less frequently in Box Elder County than many of the surrounding counties. Continued forest harvesting, thinnings, tree planting and regeneration, and/or fuels reduction are encouraged and will reduce the risks of epidemic populations of beetles. Rural forest landowners, ranchers, and farmers have many opportunities to improve forest lands through the wise use of this resource, conservation plantings, and following best management practices.

# Animals

## Agriculture: Cattle and Sheep

Box Elder County is home to vast acreages of range and pasture. This makes extensive production of livestock possible. Box Elder County ranks number one in Utah in beef cattle inventory, at about 40,500 head, and 88th in the nation. The county is also home to 10,000 dairy cows and 35,600 head of sheep.[1] Unlike many counties in Utah, Box Elder County has maintained a stable livestock industry since 1950. During that time period, sheep numbers have remained relatively constant and beef cattle numbers have roughly doubled.[2]

**Animal Inventory According to 2011 Utah Agriculture Statistics**

| Animal Breed | Inventory 1/1/2011 | Percent of State Total | Rank in State |
|---|---|---|---|
| All Cattle | 93,000 | 12% | 1 |
| Beef Cattle | 38,500 | 12% | 1 |
| Milk Cows | 10,300 | 12% | 4 |
| All Sheep | 41,500 | 15% | 2 |

## Aquatic Life

The Great Salt Lake comprises 75% of Utah's wetlands, and 60% of the lake is in Box Elder County. Emergent marshes, wet meadows, artesian springs, saline playas, and mudflats combine with open water and uplands to provide a variety of wetland types. The resulting habitat provides vital resources for 257 avian species, either living or migrating between winter and summer ranges. Thirty percent of the waterfowl migrating on the Pacific Flyway stop at the Great Salt Lake's wetlands.[3]

Bear River waters are home to walleyes, black crappies, channel catfish, smallmouth bass, common carp, gizzard shad, and black bullhead. In a compilation of surveys included in the Lower Bear River Watershed Restoration Action Strategy, it appears that fish species richness is decreasing.[4]

## Upland Game

Box Elder County has strong populations of mule deer, elk, and pronghorn. Moose are present but not common. Mule deer herds are below management objectives in Box Elder County. This is partially due to healthy populations of bobcats, mountain lions, and coyotes. Predators however are only one of the many intermingling factors of population dynamics.

Western Box Elder County has one of the strongest sage-grouse populations in the state. Landowners and managers have been aggressively seeking to address sage-grouse needs.[5] These populations decrease moving eastward to where sharp-tailed grouse, Hungarian partridge, ring-necked pheasants, and chuckars inhabit lowland and foothill areas. Forest grouse, such as ruffed and blue grouse, live at higher elevations.

Black-tailed jackrabbit, vole, badgers, red fox, raccoons, and ground squirrels are common throughout the county, and populations rise and fall, characteristic of their cyclical nature.

1 http://extension.usu.edu/boxelder/htm/agriculture
2 http://governor.utah.gov/publiclands/PLPCOStudies/LivestockGrazinginUtahHistory&Status.pdf
3 http://www.cnr.usu.edu/quinney/files/uploads/SpecialCollection/Bear%20River/Boxelders.pdf
4 http://bearriverinfo.org/files/publications/publication/pub__3851601.pdf
5 Utah Division of Wildlife Resources (UDWR). 2002. Strategic Management Plan for Sage-grouse. Utah Department of Natural Resources, Division of Wildlife Resources, Publication 02-20, Salt Lake City, Utah, USA.

## Sensitive Species

Species that are receiving special management under a Conservation Agreement, to preclude listing:

- Bluehead sucker (*Catostomus discobolus*)
- Bonneville cutthroat trout (*Oncorhynchus clarkia Utah*)
- Northern goshawk (*Accepiter gentilis*)

Other sensitive species in Box Elder County:

- American white pelican (*Pelecanus erythrorhynchos*)
- Bald eagle (*Haliaeetus leucocephalus*)
- Black swift (*Cypseloides niger*)
- Bobolink (*Dolichonyx oryzivorus*)
- Burrowing owl (*Athene cunicularia*)
- California floater (*Anodonta californiensis*)
- Deseret mountainsnail (*Oreohelix peripherica*
- Ferruginous hawk (*Buteo regalis*)
- Grasshopper sparrow (*Ammodramus savannarum*)
- Great Plains toad (*Bufo cognatus*)
- Kit fox (*Vulpes macrotis*)
- Lewis's woodpecker (*Melanerpes lewis*)
- Long-billed curlew (*Numenius americanus*)
- Lyrate mountainsnail (*Oreohelix haydeni)*
- Mountain plover (*Charadrius montanus)*
- Northwest Bonneville pyrg (*Pyrgulopsis variegate*)
- Preble's shrew (*Sorex preblei*)
- Pygmy rabbit (*Brachylagus idahoensis*)
- Sharp-tailed grouse (*Tympanuchus phasianellus*)
- Short-eared owl (*Asio flammeus*)
- Townsend's big-eared bat *(Corynorhinus townsendii)*
- Utah physa (*Physella utahensis*)
- Western pearlshell (*Margaritefera falcate*)
- Western toad (*Bufo boreas)*
- Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*)

Utah Conservation Data Center

Animals in Box Elder County that are federally listed, or candidate species, under the Endangered Species Act:

- Gray wolf (*Canis lupus)*
- Greater sage-grouse (*Centrocercus urophasianus*)
- June sucker (*Chasmistes liorus*)
- Lahontan cutthroat trout (*Oncorhynchus clarkii ahenshawi)*
- Least chub (*Iotichthys phlegethontis*)
- Yellow-billed cuckoo (*Coccyzus americanus*)

## Bear River Migratory Bird Refuge

The Bear River Migratory Bird Refuge (MBR) lies on the northern shores of the Great Salt Lake where the Bear River creates marshes that are the largest freshwater component of the Great Salt Lake ecosystem. Over 250 species of migratory birds utilize this area annually. The Bear River MBR contains nearly 80,000 acres of marsh, open water, uplands, and alkali mudflats. The Bear River MBR is an excellent place to observe wildlife, along a twelve-mile auto tour route, as well as enjoy hunting, fishing and wildlife photography. Bear River MBR has several priority bird species dependent on the wetland habitats of the Great Salt Lake, such as cinnamon teal, white-faced ibis, and Black-necked stilt.

# Humans: Social and Economic Considerations

Of historical significance in Box Elder County is the Golden Spike National Historic Site, where the Union and Central Pacific Railroads joined their rails at Promontory Summit, Utah Territory, changing the destiny of our nation.

Recreational opportunities abound in Box Elder County. Willard Bay, at the southeast end of Box Elder County, allows for boating and other watersports. The Bear River Migratory Bird Refuge offers some of the best waterfowl viewing opportunities in the West. The Bear River and surrounding area allows waterfowl hunting and warm water fishing. The Wellsville Mountains on the east and the Raft River Mountains to the west have many hiking and riding trails. Antelope, mule deer, and elk are hunted throughout the county.

In addition to these common species, there are some species of conservation concern, namely the greater sage-grouse, pygmy rabbits, boreal toads, Yellowstone cutthroat trout, and lahontan cutthroat trout. West Box Elder County is home to the only native range in Utah of Yellowstone cutthroat trout. There is widespread concern that if any of these species are listed as endangered, regulations regarding human or domestic animal use of their habitat could impose management restrictions and severe cost for mitigation of impacts. Economically and socially, this could result in dramatic changes to the livelihoods of Box Elder County residents and recreational activities for all who visit Box eEder County.


Golden Spike National Historic Site, Promontory, Utah.


Greater Sage-Grouse

**Box Elder County Population Data**

| | |
|---|---|
| Period Year | 2011 |
| Population | 50,466 |
| Births | 903 |
| Deaths | 322 |
| Natural Increase | 581 |
| Net Migration | -225 |
| Annual Change | 356 |
| Annual Rate of Change | 0.7% |

Source: Utah Population Estimates Committee
http://www.governor.state.ut.us/dea/UPEC.html

Box Elder County has roughly three socio-economic regions. As somewhat of an extension of the Wasatch Front, the communities of Brigham, Willard, and Perry are developed commercially and residentially. Many of the residents of these communities commute to Ogden or even further south to work. Others can find employment at the local businesses that exist in that area. Despite the extensive development in this area, farming still exists. A thriving fruit industry exists in the foothills along Utah's Famous Fruit Way.

Moving north, the population is more sparsely distributed, with farmland surrounding relatively small cities, such as Corrine, Tremonton, and Fielding. This area has a robust agricultural, as well as industrial, economy, despite land use conflicts between agriculture and development and industrial setbacks, such as ATK reductions and the Lay Z Boy plant shut-down. New businesses, like Proctor and Gamble, seem to be attacked to this part of Box Elder County for many reasons. A few of these reasons include having room to grow, cheaper inputs to get started, and laws/regulations that are business friendly.

Moving west of Tremonton, the population decreases significantly with each mile. From Snowville to Park Valley and Grouse Creek, family farms and ranches are the norm with little other occupational pursuits. There are an estimated 400 permanent residents that live across the 1.5 million acres of the West Box Elder Conservation District. The economy is primarily agricultural and ranch-based, and most traditional economic activity depends upon the vitality of ranching. With narrowing profit margins for range-based ranching, there is a trend towards larger ranches and fewer small family owned operations. This tends to cause a downward trend to populations, social opportunities, and services for the residents of West Box Elder. Currently, few businesses in West Box Elder capitalize on the ranching commodities produced there, and only a few non-ranching or farming jobs are available to augment the West Box Elder economy.


Yellowstone Cutthroat Trout

**Box Elder County Labor Force**

| | 2010 | 2011 | 2012 |
|---|---|---|---|
| **Labor Force** | 22,143 | 21,148 | 20,261 |
| ***Employed*** | 20,092 | 19,421 | 18,872 |
| ***Unemployed*** | 2050 | 1727 | 1389 |
| ***Unemployment Rate*** | 9.3% | 8.2% | 6.9% |
| **Ag/Forestry/Hunt & Fish** | 304 | 347 | 378 |
| **Mining** | 31 | 25 | 16 |
| **Construction** | 1037 | 990 | 1046 |
| **Manufacturing** | 5774 | 4972 | 4488 |
| **Trade/Trans/Utilities** | 3469 | 3385 | 3465 |
| **Information** | 109 | 101 | 96 |
| **Financial Activities** | 372 | 369 | 380 |
| **Profess/Business Svcs** | 596 | 767 | 856 |
| **Ed/Health/Social Svcs** | 1475 | 1583 | 1611 |
| **Leisure/Hospitality** | 1364 | 1366 | 1385 |
| **Other Services** | 295 | 289 | 308 |
| **Government** | 2580 | 2481 | 2580 |
| **Total Establishments** | 1206 | 1195 | 1197 |
| **Total Wages ($Millions)** | 533.8 | 588.5 | 704.4 |

Source Utah Dept. of Workforce Services
http://jobs.utah.gov/jsp/wi/utalmis/gotoLaborforce.do
http://jobs.utah.gov/jsp/wi/utalmis/gotoIndustry.do

## References


1. Soil Survey of Cache County Utah, 1982, created by the U.S. Dept. of Ag., Soil Conservation Service, Forest Service, Dept. of Interior and Bureau of Land Management in cooperation with the Utah Agricultural Experiment Station.
2. 2010 Utah Agricultural Statistics and Utah Department of Agriculture and Food Annual Report. Prepared by *Utah Agriculture Statistics*. A copy of the report is available at http://ag.utah.gov/news/publications/documents/10annualreport.pdf
3. Utah Department of Workforce Services. Population and economic data retrieved from http://jobs.utah.gov/opencms/wi/regions/northern/cache/cachefs.pdf
4. Governor's Office of Planning and Budget http://planning.utah.gov/super/SUPER/State%20Resources/LandUse2008.pdf
5. Bear River Basin: Planning for the Future, 2004. Utah State Water Plan, Division of Water Resources. Document available at: http://www.water.utah.gov/Planning/SWP/bear/bearRiver-1A.pdf
6. Utah Department of Agriculture and Food. Utah Noxious Weed List, October 2010, retrieved from www.ag.utah.gov/divisions/plant/noxious/documents/noxUtah.pdf
7. Utah Conservation Data Center, State of Utah Natural Resources, Division of Wildlife Resources. Information on the Maguire Primrose retrieved from http://dwrcdc.nr.utah.gov/rsgis2/Search/Display.asp?FlNm=primmagu. Information on Cache County's sensitive animal species was retrieved from http://dwrcdc.nr.utah.gov/ucdc/ViewReports/sscounty.pdf
8. US Census Bureau. Box Elder County Quick Facts retrieved on June 19, 2013 from quickfacts.census.gov/qfd/states/49/49005.html
9. Utah Division of Wildlife Resources, Statewide Management Plan for Mule Deer, http://wildlife.utah.gov/dwr/learn-more/mule-deer.html on 5-1-2013
10. West Box Elder Greater Sage Grouse Local Conservation Plan, http://www.utahcbcp.org/htm/groups/boxelder
11. 2012 Annual Report, Demography, Vital Rates, Habitat-Use, and Seasonal Movements of Greater Sage-Grouse in the Ruby Pipeline HUC 8 Watershed: Phase 1. WRI Project ID: 2119, http://www.utahcbcp.org/htm/groups/boxelder
12. 2012 Annual Report, Greater sage-grouse (*Centrocercus urophasianus*) habitat selection and use patterns in response to vegetation management practices in Western Box Elder County, Utah
13. West Box Elder Coordinated Resource Management Plan. January 15 2013. Available at http://www.uacd.org/county-resource-assessments.html
14. Northwestern Box Elder County Surface Water Storage Options Draft 1 Analysis. Obtained from Utah Division of Water Resources February 2013.


## Map Data Sources

**Box Elder County Land Ownership**: Land ownership status and areas of responsibility for the State of Utah. The Utah School and Institutional Trust Lands Administration (SITLA) and the Bureau of Land Management revise this data regularly to reflect changes in ownership. Available for download from the Utah Automated Geographic Reference Center at: http://gis.utah.gov/sgid-vector-download/utah-sgid-vector-gis-data-layer-download-index?fc=LandOwnership

**Irrigation Companies**: The irrigation company boundaries were taken from a dataset showing irrigated acreage for the entire state, created by Utah Division of Water Rights. Available for download from the Utah Division of Water Rights website at: http://www.waterrights.utah.gov/gisinfo/wrcover.asp

**Watersheds**: A subset of the National Hydrography Dataset (NHD). The National Hydrography Dataset (NHD) is a comprehensive set of digital spatial data that contains information about naturally occurring and constructed bodies of water, paths through which water flows, and related entities. The NHD was developed by U.S. Geological Survey (USGS) in cooperation with U.S. Environmental Protection Agen-

cy, USDA Forest Service, and other Federal, State, and local partners. Available for download from the USGS National Map website at http://nationalmap.gov/index.html

**Hydrology**: A subset of the National Hydrography Dataset (NHD). The National Hydrography Dataset (NHD) is a comprehensive set of digital spatial data that contains information about naturally occurring and constructed bodies of water, paths through which water flows, and related entities. The NHD was developed by U.S. Geological Survey (USGS) in cooperation with U.S. Environmental Protection Agency, USDA Forest Service, and other Federal, State, and local partners. Available for download from the Utah Automated Geographic Reference Center at: http://gis.utah.gov/sgid-vector-download/utah-sgid-vector-gis-data-layer-download-index?fc=StreamsNHDHighRes and at http://gis.utah.gov/sgid-vector-download/utah-sgid-vector-gis-data-layer-download-index?fc=LakesNHDHighRes

**Noxious Weeds**: Dataset compiled by Utah Department of Agriculture and Food from data collected by Cache County Weed Department for the time period 2003 – 2005. Not all areas containing noxious weeds have been surveyed; only surveyed areas are shown. Available for download from the Utah Automated Geographic Reference Center at: http://gis.utah.gov/sgid-vector-download/utah-sgid-vector-gis-data-layer-download-index?fc=NoxiousWeeds_Point

**General Soils Data**: General soil properties derived from the following SSURGO soil survey: UT 602—UT603 using Soil Data Viewer, a tool created by USDA Natural Resources Conservation Service as an extension to ArcMap that allows users to create soil-based thematic maps. SSURGO Soil Surveys are available for download from the NRCS Soil Data Mart: http://soildatamart.nrcs.usda.gov/

**Land Cover**: USGS National Gap Analysis Program. 2004. Provisional Digital Land Cover Map for the Southwestern United States. Version 1.0. Produced by RS/GIS Laboratory, College of Natural Resources, Utah State University. Published 9/15/2004. Multi-season satellite imagery from 1999 – 2001 were used in conjunction with digital elevation model derived datasets to model natural and semi-natural vegetation.

**Annual Precipitation**: Produced by U.S. Department of Agriculture Natural Resources Conservation Service – National Cartography and Geospatial Center. This vector data set provides derived average annual precipitation according to a model using point precipitation and elevation data for the 30-year period of 1971 – 2000.

**Roads**: This data set represents street centerline data for the State of Utah as compiled by the Utah Automated Geographic Reference Center from data contributed by local, county, state, federal and tribal governments. Available for download from the Utah Automated Geographic Reference Center at: http://gis.utah.gov/sgid-vector-download/utah-sgid-vector-gis-data-layer-download-index?fc=Roads

**County Boundaries**: This data set represents county boundaries in Utah at 1:24,000 scale. Last updated 8/18/2009.Available for download from the Utah Automated Geographic Reference Center at: http://gis.utah.gov/sgid-vector-download/utah-sgid-vector-gis-data-layer-download-index?fc=Counties