ELMORE COUNTY
WATER SUPPLY ALTERNATIVES

Prepared for

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Executive Summary

Background and Purpose

Groundwater pumping in portions of the Mountain Home Plateau in Elmore County has resulted in chronic water-level declines. Appropriation of groundwater for new consumptive uses in these areas is prohibited, and curtailment of some groundwater rights is possible as water levels continue to decline. This has led to concerns that (1) water supplies are insufficient to support existing uses and future development, and (2) a curtailment of groundwater rights will result in substantial impacts to the local economy.

The purpose of this water-supply study (study) was to quantify study-area water needs and explore possible sources of additional supply. Specific objectives of the study were to:

1. Estimate existing and future irrigation, municipal, industrial, and other water demands;
2. Quantify current water supply deficits;
3. Determine the economic benefit from improving Elmore County water supplies to meet demands;
4. Estimate the approximate costs of developing additional water supplies to achieve water-supply sustainability and support future economic development.

Water Supply Sources and Groundwater Use

The study area for this analysis is the portion of Elmore County coinciding with Mountain Home Area Water District 161 (Figure 1). Surface water and groundwater are used as water supply sources within the study area. Irrigation is the primary water use. Approximately 70,000 acres are irrigated within the study area.

Surface water sources utilized within the study area include (1) local drainages that discharge to the Mountain Home Plateau, (2) Boise River tributaries discharging to Little Camas Reservoir, and (3) the Snake River. Local drainages and Little Camas Reservoir supply irrigation to approximately 20,000 acres. These water sources are subject to drought and are not reliable for full irrigation supplies each year. The Snake River provides reliable full-season irrigation supplies to approximately 33,000 acres.

Groundwater is used as a primary supply for irrigation of approximately 18,000 acres, and as a supplemental supply on approximately 8,000 acres. Groundwater is also used for municipal (including municipal irrigation), stockwater, domestic, commercial, and industrial purposes.

Total annual groundwater diversion within the study area is estimated to be approximately 80,000 acre feet (AF), of which 85% is diverted for agricultural irrigation, 5% for municipal-supplied irrigation, and 10% is supplied for other uses including domestic (including municipal-supplied domestic), stockwater, commercial, and industrial.

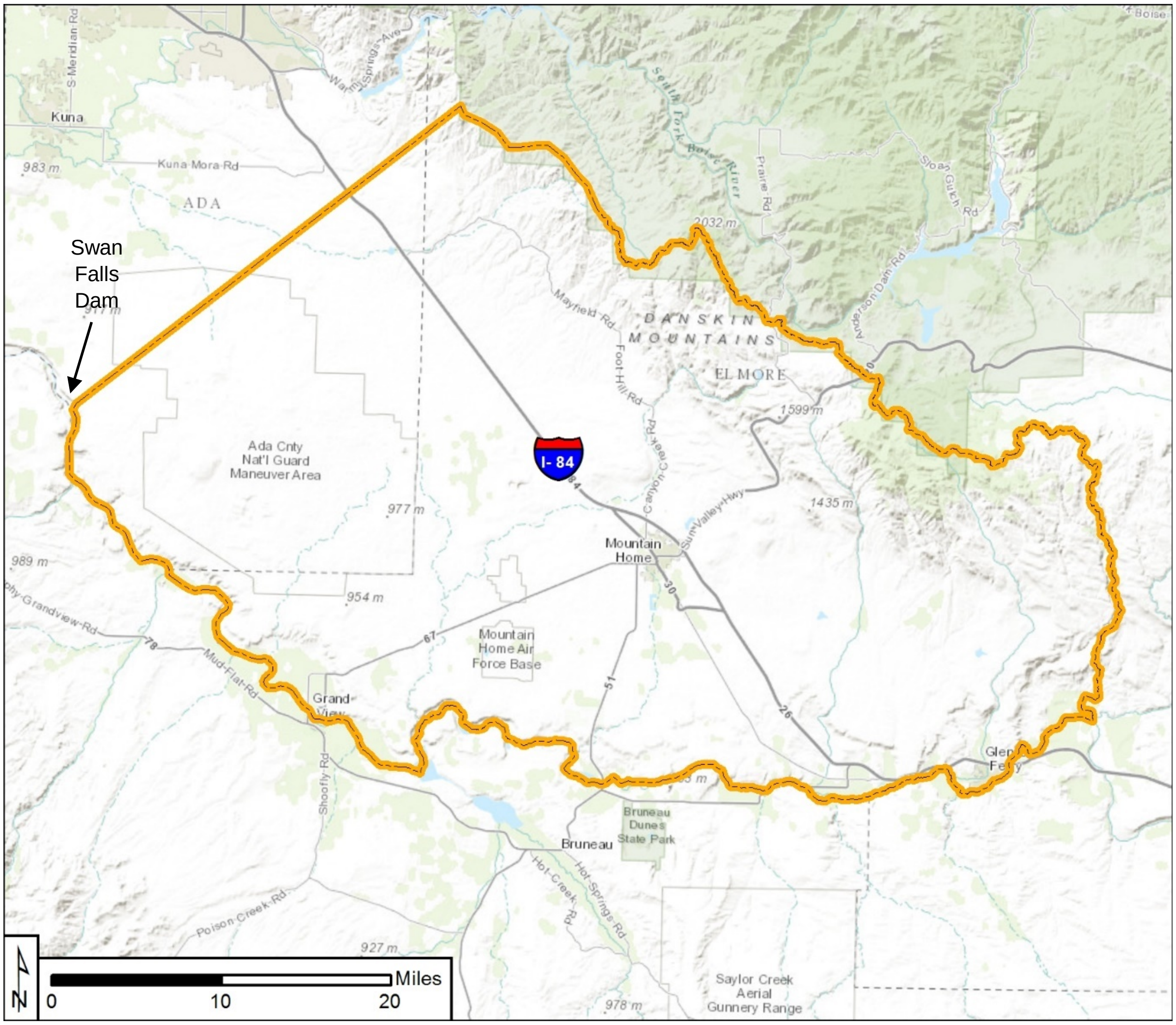

Figure 1. Study Area Boundary

Groundwater Conditions

Groundwater is found in a regional aquifer in basalt and sediments of the Bruneau Formation and in sediments of the Glenns Ferry Formation. Groundwater is also found locally in perched aquifers near Mountain Home and approximately 10 miles northwest of Mountain Home near Tipanuk. The perched aquifers are not a significant source of supply.

Groundwater levels within the regional aquifer show declines in areas of concentrated pumping. The areas of significant decline are east of Cinder Cone Butte, within and south of the City of Mountain Home, Mountain Home Air Force Base (MHAFB), and ground-water irrigated lands to the east and west of MHAFB.

- Cumulative water-level declines since the 1960s near Cinder Cone Butte exceed 100 feet, and may be approaching 200 feet in some locations. Water levels are currently declining at a rate of approximately 5 feet per year in some wells.

- Cumulative water-level decline on the south side of the City of Mountain Home appears to be approximately 80 feet. Water levels are declining at a rate of approximately 3 feet per year. Water levels do not show declines in zones above the regional aquifer, or within the regional aquifer on the northeast side of the City.

- Cumulative water-level declines at MHAFB are approximately 60 feet, with current declines of approximately 1.5 feet per year.

- Declines of nearly 100 feet have been recorded beneath ground-water irrigated lands west of MHAFB. Declines appear to have stabilized in this area, potentially due to changes in pumping patterns.

- East of MHAFB, the cumulative decline is approximately 80 feet, and the current rate of decline is approximately 2 feet per year.

In contrast to the water-level declines described above, other areas within Water District 161 generally show stable long-term water-level trends. North of Mountain Home, stable water levels appear to be related to groundwater recharge from Canyon Creek and Mountain Home Irrigation District (MHID) facilities. In other areas, stable groundwater levels occur in areas without local irrigation pumping. For example, water levels are relatively stable within only a few miles of the areas of significant decline at Cinder Cone Butte and east of MHAFB. These data demonstrate that water-level declines are localized to the areas of significant groundwater pumping and are not pervasive across the study area. Unlike some other aquifers within the state (i.e., Eastern Snake Plain Aquifer), aquifer stabilization activities in one location on the Mountain Home Plateau might not provide benefit to areas only a few miles distant. The local effects of pumping also pose challenges for water right administration, as curtailment of junior-priority groundwater rights in one area is unlikely to provide relief to senior-priority groundwater rights in an area ten miles away.

Groundwater deficits were determined by calculating the estimated volume of water lost from groundwater storage. The volume was estimated based on comparison of groundwater levels in the 1970s to recent groundwater levels. The annualized average annual pumping deficit is estimated to be 43,000 AF per year. The estimated annual pumping deficits are 24,000 AF in the Cinder Cone Butte area, 7,000 AF in the City of Mountain Home vicinity, and 12,000 AF in the MHAFB vicinity (including lands to the east near Highway 51).

Methods to Achieve Groundwater-Level Stabilization

Groundwater-level stabilization can be achieved by reducing the net groundwater use within the areas of water-level decline. Net reductions can be achieved by reducing groundwater pumping or increasing groundwater recharge.

- Groundwater pumping can be reduced by conversion of existing groundwater irrigation supplies to imported surface-water supplies from the Boise River or Snake River. Imported water supplies would also be beneficial for supplemental irrigation of lands without reliable surface water irrigation supplies and for municipal and industrial uses. Groundwater pumping can also be reduced through conservation; however, given that 85 percent of groundwater use is associated with agricultural irrigation, conservation would consist of either increasing efficiency or reducing pumping. Most groundwater irrigated lands utilize relatively efficient sprinkler systems to minimize power use; hence, the opportunities to significantly reduce water use through increased efficiency are probably limited. Switching to less water-intensive crops can allow reduced pumping, but such crops provide less economic benefit to the county. There may be some potential to reduce municipal water use through conservation, although the total water savings is likely to be relatively small compared to overall groundwater use within the study area.
- Groundwater recharge, through either surface recharge or injection wells, can also provide a net reduction in groundwater use.

Availability of Boise River and Snake River Water Supplies

Flows in the Boise River basin within Ada and Elmore counties are generally fully appropriated, except in years of above average supply and only for a limited duration. Boise River flows that might be appropriated have occurred in 24 of the last 34 years, but the duration of the flows range from only a few days to a few months. A more reliable source of supply would be stored water in the Boise River reservoir system or senior-priority natural flow water rights. Contracts for stored water are not currently available, but could become available in the future due to either freeing up of currently “uncontracted” storage that has been dedicated to flow augmentation or through creation of new storage space. However, the effective annual cost for new storage space is expected to be high, in the range of $100 to $160/AF. It is likely that storage space contracts, for new or existing uncontracted storage, will not be available for many years. Similarly, senior-priority Boise River natural flow water rights are not readily available for purchase; if available, annualized costs might be similar to the costs for new storage space.

Flows in the Snake River exceed established minimum stream flows more than 99% of the time.

- Snake River flows above the minimum streamflow, but less than 8,400 cfs, are classified as “trust water” in the reach of the river upstream from Swan Falls Dam

(Figure 1). Appropriation of trust water from the Snake River is currently restricted by statute and rule, and must be determined to be in the public interest. A finding that appropriation of trust water is in the public interest will be necessary to support a large-scale project to divert Snake River water from points within Elmore County for aquifer stabilization and economic development. Such a finding will require an appropriator to show that the benefit of the appropriation outweighs impacts to hydropower generation, electrical utility rates, and the full economic development and multiple use of the water in the Snake River Basin.

- Snake River flows downstream of Swan Falls Dam in Ada County are available for appropriation without trust water restrictions. Water can be appropriated on a year-round basis for all beneficial uses, including primary irrigation.

Acquisition of existing Snake River natural flow water rights might be considered if appropriation of trust water is prohibited and the costs to convey water from downstream of Swan Falls are infeasible. Due to costs, acquisition of existing water rights is unlikely to be practical for irrigation.

Infrastructure Alternatives for Water Importation

Five infrastructure alternatives for delivering Boise River water supplies to the study area were evaluated. Two alternatives propose diversion from Anderson Ranch Reservoir and two alternatives propose diversion from the South Fork Boise River. All four of these alternatives would deliver water to the vicinity of the City of Mountain Home through Canyon Creek and associated MHID facilities. The fifth alternative proposes diversion of water from Lucky Peak Reservoir to the Cinder Cone Butte vicinity. Unit costs for delivery of Boise River water range from approximately $100 to $200/ AF. The annual volumes delivered were 10,000 AF for the Anderson Ranch Reservoir and South Fork Boise River alternatives and 25,000 AF for the Lucky Peak alternative. Increasing durations of pumping to deliver a given annual volume, or increasing the annual volumes pumped, will decrease the per AF cost for each alterative. Costs of less than $100/ AF were calculated for three alternatives with longer pumping durations. These annual costs do not include any costs for acquisition of water rights. Water acquisition could increase costs by an additional $100/AF or more for a project supported by a combination of appropriated junior-priority natural flow and new storage.

Eight infrastructure alternatives for delivering Snake River water supplies to the study area were evaluated. Four of the alternatives each provide 10,000 AF annually of water to the vicinity of the City of Mountain Home for supplemental irrigation, municipal, and groundwater recharge uses. Two alternatives provide 25,000 AF to Cinder Cone Butte, and one alternative provides 10,000 AF to groundwater-irrigated lands located south of the City of Mountain Home and east of MHAFB. The final alternative provides 20,000 AF annually for replacement of groundwater diversions on lands located south of the City of Mountain Home and east of MHAFB and for supplemental irrigation, municipal, and recharge uses near Mountain Home. Unit costs for delivery of Snake River water range from approximately $90 to $270/AF. These costs do not include water right acquisition; however, such costs may be minimal if new supplies can be appropriated. If water cannot be appropriated, delivered costs for each alternative will increase by an estimated $75/AF.

Economic Evaluation

Significant economic benefits could potentially be realized by improving the water supply to the study area. Municipal and industrial users can most readily bear the burden of higher cost water. Water costs above $50/AF would not be viable for many irrigators, and costs above $100/AF would not be viable for most irrigators. As a result, a water supply improvement project may need to be subsidized to be successful.

Recommendations

Elmore County can organize and assist water users to improve water supplies within the study area. The following steps are recommended.

1. Seek a determination from the director of the Idaho Department of Water Resources that diversion of trust water from the Snake River upstream from Swan Falls Dam for supplemental irrigation, aquifer recharge, and municipal purposes that results in Snake River depletions of more than 2 acre feet per day are in the public interest under the criteria of Idaho Code 42-203C(2). The public interest arguments could focus on aquifer stabilization, preservation of the local economy, and compliance with State Water Plan goals. Recent developments of wind and solar power generation within the County may serve as an offset to depletions in power generation due to reduced Snake River flows. Development of projects seeking appropriation of Snake River water are predicated on a determination that such an appropriation is in the public interest.

2. Conduct a value engineering study for a pumping station and pipeline from the Snake River directly north to Mountain Home. The study would seek ways to minimize project costs and maximize project benefits. The pumping station and pipeline would supply the following uses.

    - A replacement supply for up to 4,000 acres that are currently irrigated with groundwater in this area. The Snake River water would be used when available to reduce groundwater diversions for aquifer stabilization purposes.

    - A supplemental supply for participating acres within MHID. The Snake River water would be used when MHID supplies are limited due to water supply conditions.

    - An available municipal supply for the City of Mountain Home. The water could be appropriated under a reasonably anticipated future needs application, and be made available to support City growth. To the extent utilized, the water could be used as raw water in pressurized irrigation or be treated to support new industry and residential growth.

- An available supply for aquifer recharge to support municipal and existing irrigation uses. It may be possible to exchange Snake River water delivered to the southern end of MHID for Canyon Creek water used for aquifer recharge north and west of Mountain Home in the Canyon Creek streambed, gravel pits, or Mountain Home Reservoir.

3. Conduct a value engineering study for a pumping station and pipeline from the Snake River to Cinder Cone Butte. Use of this water would be for replacement of existing groundwater supplies, by direct irrigation use, aquifer recharge, or both.
4. Participate in activities to develop additional Boise River water storage for the benefit of Elmore County. In the event that storage should become available, conduct value engineering of water delivery infrastructure.
5. Increase aquifer recharge from Canyon Creek and tributary streams crossing the Mountain Home Plateau to prevent runoff to the Snake River during years of above average precipitation. Aquifer recharge can be enhanced through diversion to gravel pits and construction of check structures on stream channels (including reconstruction of Fraser Dam on Canyon Creek).

Acknowledgements

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1. Elmore County Commissioners (Al Hofer, Wes Wootan, and Bud Corbus) provided general project guidance and report review.
2. Scott Campbell, Esq. (Moffatt Thomas) provided general project guidance and report review.
3. Isaac Castellano, Ph.D. (Boise State University) evaluated the economics of current water-supply deficits and additional water supplies.
4. John Church (Idaho Economics) prepared Elmore County, City of Mountain Home, and MHAFB population projections as part of a recent Treasure Valley water-demand study (SPF, 2016).
5. Multiple report figures used the ESRI World Topo Map for background imagery.

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1. INTRODUCTION

1.1. Background

The economy of southern Elmore County is directly or indirectly dependent on water. However, groundwater-level declines and limited surface-water supplies in the Mountain Home Plateau have led to concerns that water supplies in Elmore County (referred herein to as “County” or “Elmore County”) are insufficient to support existing uses and future development.

Groundwater pumping in portions of the Mountain Home Plateau has resulted in chronic water-level declines. Groundwater-level declines have been most acute in the vicinity of Cinder Cone Butte, MHAFB, and the City of Mountain Home (referred to herein as “City” or “City of Mountain Home”). In addition, surface water flows from higher-elevation areas are highly variable; water from these streams and reservoirs are insufficient in most years to supply the current irrigation demands or restore local groundwater-level declines. Because of limited supply, appropriations for new consumptive uses of groundwater in most parts of the Mountain Home Plateau are not available without some form of mitigation.

The limited water availability in the Mountain Home Plateau constrains economic growth. Continued groundwater-level declines or more aggressive water-rights administration could lead to the curtailment of some existing groundwater pumping. Any curtailment of existing water uses would result in a decrease in economic activity. To address these issues, Elmore County has commissioned this water supply investigation.

1.2. Purpose and Objectives

The purpose of this Elmore County Water-Supply Study was to explore additional sources of water supply, especially for areas with decreasing groundwater levels. Specific objectives were to

1. Estimate existing and future irrigation, municipal, industrial, and other water demands;
2. Quantify current water-supply deficits;
3. Identify alternative water supplies to achieve water-supply sustainability and to provide water for future economic development;
4. Prepare conceptual-level cost estimates for various water-supply alternatives; and
5. Determine the economic benefit from improving Elmore County water supplies to meet demands.

1.3. Study Area

Elmore County is a rural county located adjacent to the more urban and populated Treasure Valley.[1] With just under 26,000 people (Table 1), the population of Elmore County is larger than many others in the state, and retains significant agricultural production, boasting a multi-million-dollar market value. In addition, the County is home to the Mountain Home Air Force Base (MHAFB), which currently employs 3,167 active duty personnel, in addition to 910 civilian employees. The MHAFB has an estimated $342 million economic impact on the region on an annual basis.[2]

The study area for this analysis is the portion of Elmore County coinciding with Mountain Home Area Water District 161 (Figure 2). The Idaho Department of Water Resources (IDWR) created the district on February 29, 2016 for water-right administration purposes. The district covers approximately 1,548 square miles and includes all or portions of approximately 56 townships (Figure 3Figure 3). Water District 161 includes all groundwater rights[3] within Administrative Basin 61 and a portion of Administrative Basin 63 (Mayfield to Swan Falls).

Within the boundaries of the study area are the Cinder Cone Butte Critical Ground Water Area (CCBCGWA) and the Mountain Home Ground Water Management area (MHGWMA). These administrative areas were established in the 1981 and 1982, respectively, to limit new groundwater appropriations in response to declining groundwater levels.

1.4. Report Organization

This report begins with a description of water-use characteristics (Section 2), including estimates of diversions for irrigation, municipal, commercial, and industrial use, and projections of future municipal demand. Section 3 describes the general aquifer characteristics, groundwater-level trends, and provides estimates of water-supply deficits in areas that have seen groundwater-level declines. Section 4 outlines water-supply alternatives for expanding the use of surface water; and, to a limited extent, groundwater. Infrastructure requirements and preliminary cost opinions for increasing the water supply in the areas of greatest demand are described in Section 5. Section 6 addresses the economic implications of the existing water supply and potential water-supply increases. The results of this analysis are discussed and summarized in

[1] The Treasure Valley encompasses the metropolitan areas of Boise, Meridian, Nampa, and Caldwell.

[2] 2015 Economic Impact Statement Produced by the 366th Comptroller Squadron.

[3] Except domestic and stock water uses as defined by Idaho Code § 42-111.

Section 7. Tables and figures associated with each section are presented at the end of each section. Supporting information is provided in Appendix form.

1.5. Tables and Figures

Selected Elmore County Statistics[1]	
Population[1]	25,876
Housing Units	12, 218
Population 16 or older in workforce from 2010-2014	10, 200
Percentage of population 16 or older in workforce from 2010-2014	57.40%
Share of workforce in Agriculture	4.80%
Average Wage of Agricultural worker	$32,130
Unemployment	4.40%
Median Household Income	$45,049

Notes:
(1) 2016 data, from Idaho Department of Labor (Elmore County Workforce Trends)
(2) USDA Economic Research Service.

Table 1. Selected Elmore County statistics.

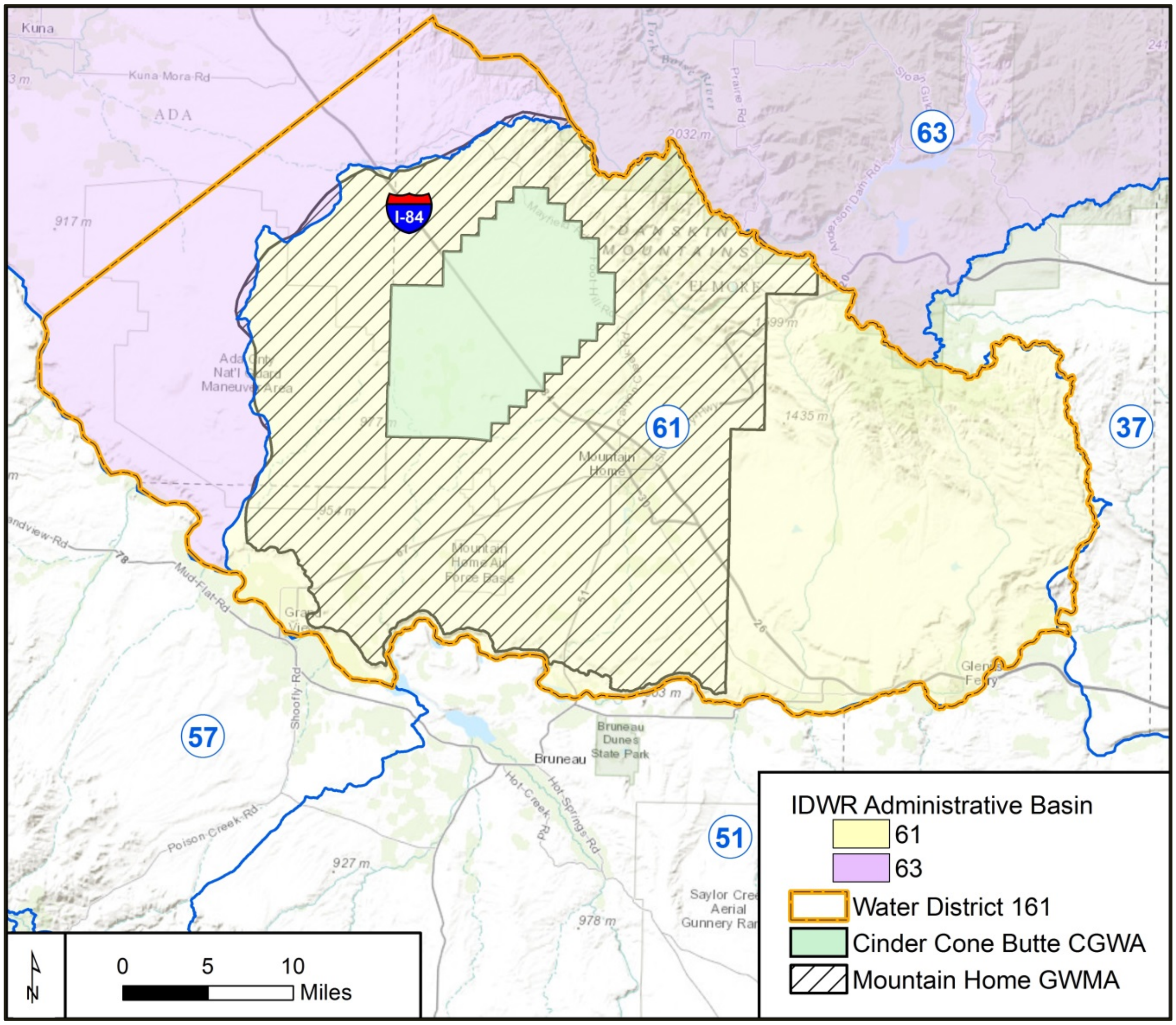

Figure 2. Water District 161; Elmore County water supply study area.

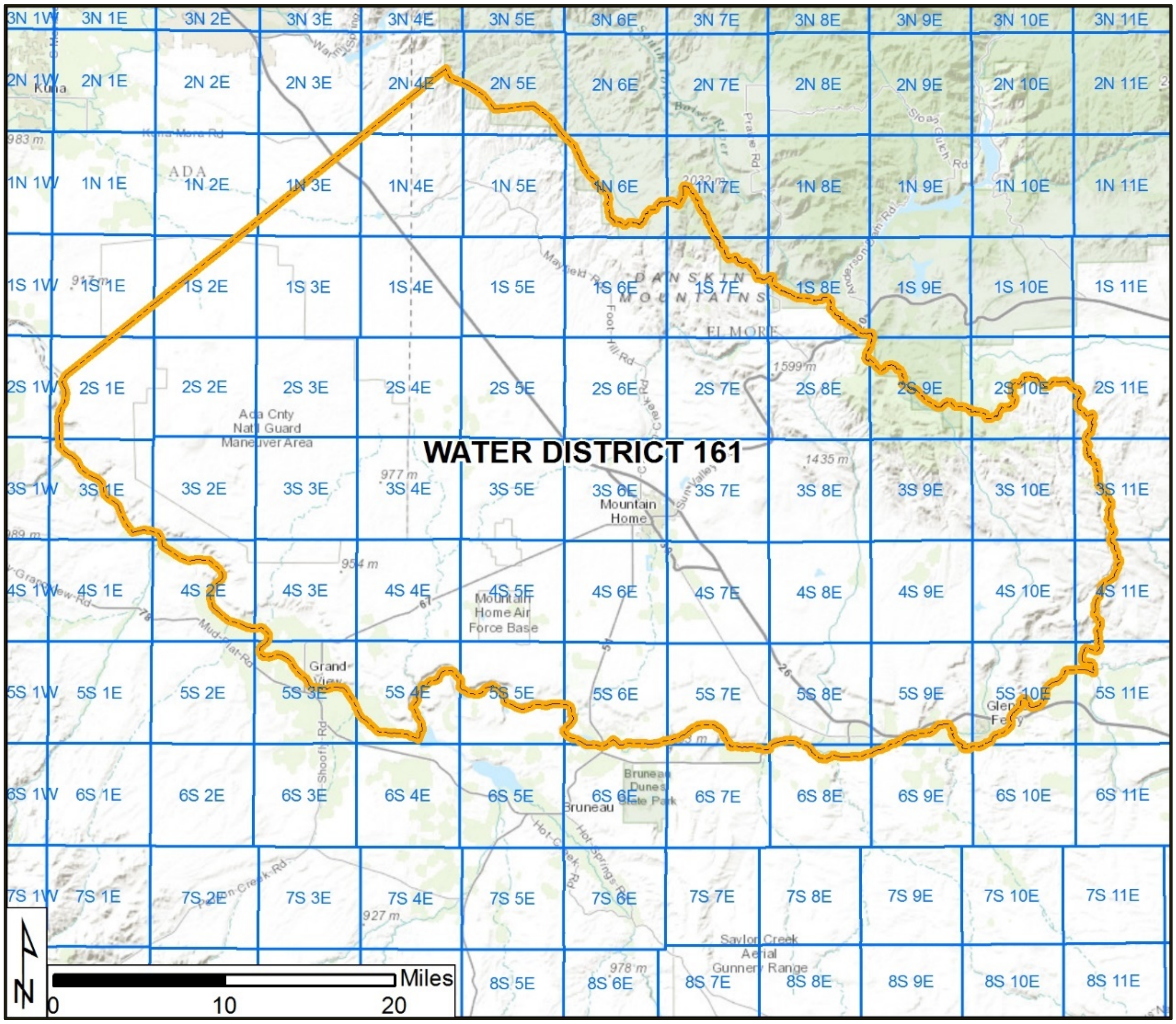

Figure 3. Public Land Survey System (PLLS) overview of study area (Water District 161).

2. WATER-USE CHARACTERISTICS

2.1. Introduction

Study-area water sources include both surface water and groundwater. The following section briefly describes surface water use (Section 2.2), but then focuses on describing estimates of current and historical groundwater diversions (Section 2.2).

2.2. Surface Water

Surface-water sources utilized within the study area include (1) local drainages within the study area that discharge to the Mountain Home Plateau, (2) Boise River tributaries, and (3) the Snake River. Local drainages that discharge to the Mountain Home Plateau within the study area include (from north to south) Indian Creek, Canyon Creek, Rattlesnake Creek, Bennett Creek, Cold Springs Creek, Little Canyon Creek, and King Hill Creek. Surface-water uses from these sources include irrigation (the primary use), commercial, stockwater, recreational, aesthetic, and other minor uses.

2.2.1. Local Drainages and Boise River

The primary entity diverting from surface sources within the study area is the Mountain Home Irrigation District (MHID), which delivers water for agricultural and residential irrigation for irrigation of approximately 4,404 acres[4] within a 7,420-acre service area (Figure 4 and Table 2). MHID diverts water from Little Camas Creek and Cat Creek within the South Fork Boise River drainage, and Canyon Creek and Rattlesnake Creek tributaries of the Snake River within the Mountain Home Plateau. MHID stores water in Little Camas, Long Tom, and Mountain Home Reservoirs, with capacities of 24,000; 3,700; and 5,400 acre-feet, respectively.[5] Little Camas Reservoir does not fill each year and stored water is carried over when possible.

Little Camas Reservoir lies within the Boise River drainage. Water from the reservoir is conveyed by canal and tunnels to Long Tom Creek, from where it flows through Long Tom Reservoir, then into Canyon Creek and to MHID's place of use (POU). A portion of this water is diverted from Canyon Creek through Mountain Home Reservoir. Mountain Home Reservoir is also fed from Rattlesnake Creek.

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[4] Based on communication with MHID staff.

[5] Elmore County 2014 Comprehensive Plan.

Private water users divert water from streams discharging to the Mountain Home Plateau, springs, and drains for irrigation of approximately 15,000 thousand acres. Water from Bennett Creek, Little Canyon Creek, King Hill Creek, and Hot Springs Creek is stored in reservoirs for irrigation purposes. Water from Indian Creek is stored for recreational purposes.

Surface water rights in the Canyon Creek drainage have priority dates ranging from 1874 to 1913, with only one additional water right having a 1957 priority date. Surface water rights generated within the basin but outside the Canyon Creek drainage have priority dates ranging from 1867 to 1996. The water right priority dates demonstrate that these streams were utilized for irrigation purposes beginning in the 1860s and 1870s, with additional irrigation development occurring following construction of reservoirs from the 1890s through approximately 1970.

2.2.2. Snake River

Water from the Snake River is used to irrigate approximately 33,000 acres (Table 2). Most of these acres are in relative proximity to the Snake River (Figure 4), and primarily include lands served by (1) high-lift and low-lift pumps south of Mountain Home, (2) the Snake River Irrigation District in the southwest portion of the study area, (3) the King Hill Irrigation District in the southeast portion of the study area.

Snake River water rights generally show the more recent development, having priority dates ranging from 1892 to 1983, with much of the high-lift pumping development occurring from about 1960 to 1980.

2.3. Groundwater

This study was prompted, in part, by constrained groundwater availability and declining groundwater levels. This section describes groundwater withdrawals within the study area; groundwater-level declines resulting from these diversions in general groundwater availability are discussed in Section 3.4.

Groundwater is used within the study area for irrigation; domestic, commercial, municipal, and industrial (DCMI) uses; and watering stock. Minor amounts of groundwater are also pumped for heating/cooling, recreation, and fire protection.

Estimates of groundwater diversions for irrigation (the primary groundwater use) were made based on water-right information, irrigated area, and irrigation requirements for typical crop rotations (Sections 2.3.1 through 2.3.3). Groundwater diversions for municipal uses were summarized based on municipal-provider data (Section 2.3.4). Estimates of groundwater diversions for private commercial and industrial uses were made based on water-right information (Section 2.3.5). Groundwater diversions for stock water rural domestic uses are discussed in Section 2.3.6. Groundwater diversions for all uses are summarized in Section 2.3.7.

2.3.1. Groundwater Irrigated Area

The groundwater-irrigated acreage within the study area was identified using IDWR water-right information. Perfected surface-water and groundwater rights[6] were identified by conducting a search for points of diversion (PODs) within the study area[7] using geographic information system (GIS) technology. This list of water rights was reduced (simplifying subsequent review) by removing water rights authorizing primarily non-consumptive or *de minimis* uses.[8] Non-consumptive or *de minimis* uses include diversions for heating, cooling, domestic (under 0.3 cfs), fire protection, power, wildlife, wildlife from storage, wildlife and stockwater (under 0.3 cfs total), and domestic and stockwater (under 0.3 cfs total).

The number of water rights requiring review was further reduced by removing all remaining irrigation water rights with total diversion rates less than 0.3 cfs. Even in aggregate, these smaller water rights were assumed to have a relatively small impact on groundwater resources. IDWR's database contained 473 water rights with diversion rates of 0.3 cfs or more in the study area; 432 of those rights include irrigation as a use. Of these 432 rights, 251 rights authorize diversions from a surface-water source and 181 rights authorize groundwater diversions.

Groundwater rights were further categorized as authorizing primary irrigation or supplemental irrigation.[9] Supplemental groundwater rights were identified based on overlapping authorized places of use (POUs).[10] Identifying supplemental rights required "unstacking" overlapping rights and examining combined-use limits and

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[6] Perfected water rights consist of all water rights decreed in the Snake River Basin Adjudication (SRBA) and water rights that have been licensed since the SRBA began.

[7] Text-based search tools are also available, but this additional step would likely only uncover additional pertinent water rights if there were an error or other unusual circumstance in IDWR's GIS mapping. A text-based search would be appropriate if greater detail is needed at a later date.

[8] Water rights were removed from the list because diversions under these rights have an assumed negligible impact on water resources.

[9] Primary rights are those that do not overlap with other rights. Supplemental rights authorize diversions to supplement in existing water supply – usually surface water.

[10] Overlapping water rights may be the result of water system expansion, increases in maximum diversion rates (raising, for example, diversion rates to a full inch per acre), or integration of multiple water-delivery systems. Overlapping water rights frequently have a combined-use limit. As such, typical pumping rates or annual volumes for overlapping rights often do not correspond with maximum instantaneous diversion rates (or annual volume limits) listed on individual rights. Furthermore, individual overlapping rights generally have different priority dates.

priorities dates.[11] This process often required making some assumptions as to the actual date and extent of development of new irrigated lands with each additional water right. Of the 181 rights authorizing groundwater diversions, 135 authorize primary irrigation and 46 authorize supplemental irrigation.

Thirteen water-right permits[12] were also identified within the study area (Figure 5). These permits authorize diversions predominantly for municipal and domestic uses. Four of the largest municipal permits authorize diversions in the northwestern portion of the study area (near Mayfield).

In aggregate, perfected groundwater rights authorize the primary or supplemental irrigation of approximately 26,000 acres (Table 2). Of these, approximately 18,200 acres are authorized for primary irrigation and 7,800 acres are authorized for supplemental irrigation.

2.3.2. Irrigation Requirements

Consumptive agricultural irrigation use was estimated by multiplying irrigated acreage (see previous section) by an estimated irrigation requirement. The irrigation requirement was estimated using actual evapotranspiration data from ET Idaho[13] for a typical crop mix reported by the Farm Service Agency (FSA).[14] The typical crop mix in 2015 was predominantly alfalfa, winter wheat, corn, sugar beets, and potatoes. The average annual precipitation deficit for these crops ranges from approximately 1.7 to 3.0 feet (Table 3)[15] The average, weighted, net irrigation requirement (i.e., precipitation deficit) for these crops is approximately 2.4 feet (Table 4).

The full irrigation requirement was assumed to be met with groundwater for acres authorized under primary groundwater rights. Assuming an average irrigation efficiency of 75%, gross irrigation requirement for the typical crop mix is estimated to 3.2 acre feet per acre. For acreage authorized under supplemental groundwater rights, it was assumed that groundwater pumping was only that portion of the irrigation requirement not met by surface water. It was assumed that, on average, surface

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[11] A water right was classified as authorizing supplemental groundwater based on water-rights conditions or comments made in a beneficial use field exam. In all cases, supplemental groundwater rights authorize supplemental groundwater pumping for acreage also irrigated with surface water.

[12] Permits authorize the development of a water source, up to the elements of a permit. The permit is ultimately licensed based on the amount of water actually put to beneficial use.

[13] http://www.kimberly.uidaho.edu/ETIdaho/online.php.

[14] https://www.fsa.usda.gov/.

[15] ET Idaho values, based on 1969-2006 weather data.

water from local drainages and the Boise River provides approximately 2 feet of water per year. This assumption was based on average deliveries from Mountain Home Irrigation District (Table 5). Thus, it was assumed that approximately 1.2 feet per acre are pumped in an average year under supplemental groundwater rights. Lands with Snake River water rights typically do not have supplemental groundwater rights because the Snake River provides a full supply each year.

2.3.3. Estimates of Groundwater Withdrawals for Irrigation

Based on the above-described approach, approximately 67,800 acre-feet are pumped for irrigation purposes from study-area aquifers (Table 4). Of this amount, approximately 58,400 AF are withdrawn for primary irrigation and approximately 9,400 AF are diverted for supplemental irrigation.

Most of this groundwater is pumped from the following vicinities: Cinder Cone Butte, the City of Mountain Home, MHAFB and irrigated lands to the east, and southwest of the MHAFB (Figure 6). Additional groundwater pumping occurs near Indian Cove and Hammett (Township T5S/R8E), Glenns Ferry (Township T5S/R10E), and along the Snake River (Townships T5S/R4E, T5S/R5E, T5S/R6E, T5S/R7E, and T5S/R9E). However, the magnitude of groundwater pumping in these areas is small, because most water for irrigation comes from the Snake River.

Groundwater pumping also occurs in the vicinities of Orchard and Mayfield within the northern portion of the study area (Townships T1N/R4E, T1N/R5E, and T1S/R4E). Historically, this pumping supported limited domestic uses and a few hundred acres of irrigation. However, several large-scale residential developments have been proposed in this area, and water-right permits have been approved for diversion of nearly 10,000 acre feet in total, primarily for municipal purposes. To date, the residential developments remain in the planning stages and municipal groundwater pumping has not been initiated.

2.3.4. Groundwater Diversions for Municipal Use

This subsection provides a summary of historic population growth, current municipal water use, projected population, and projected municipal water demand. Municipal-use information was taken from a larger study for the Treasure Valley of southwestern Idaho (SPF, 2016) prepared for the Idaho Water Resource Board (IWRB).

The primary municipal water users include the City of Mountain Home, MHAFB, and the City of Glenns Ferry. This section focuses on groundwater use by City of Mountain Home and the MHAFB. The City of Glenns Ferry does not rely on groundwater – the City has access to an ample supply of water from the Snake River.

2.3.4.1. City of Mountain Home

The City of Mountain Home's water system consists of 8 active wells and a distribution system that serves approximately 14,500 residents. The water system has 5,455 total connections. Almost all of the connections are metered (except a few remaining City park connections and mobile home parks).

From 2010 to 2014, Mountain Home's annual groundwater diversions (Table 8) averaged 4,723 acre-feet (AF), ranging from a low of 4,396 AF (2011) to a high of 4,915 AF (2012). Monthly diversions ranged from a low of approximately 98 AF per month during winter to approximately 1,008 AF per month during the summer (Table 9 and Figure 10). According to the 2011 Water Master Plan, completed by Keller & Associates, the percentage of "unaccounted water"[16] is trending downward from about 17 percent in 2009. As the City continues to meter more connections, fix leaks, and replace old lines, the unaccounted water percentage is expected to decline further.

The City holds 55 shares of Mountain Home Irrigation District water which is diverted for irrigation of the Desert Canyon Golf Course. The wastewater effluent from the City's lagoon system is used (along with water from a deep well) to irrigate 350 acres of a farm located south of the City.

For the past 4 years, the City of Mountain Home has distributed voluntary water conservation notices asking for alternate-day watering during peak summer months.

2.3.4.2. Mountain Home Air Force Base

The MHAFB's water system consists of seven active wells and a distribution system that serves approximately 3200 residents. There are an additional 2,500 off-site military and civilian employees that utilize the water system. The water system has 1,187 total connections. Metering is used to track water delivery to "billable facilities," such as Burger King, the school, bank, housing, etc. Housing has historically been metered as a whole, but meters are currently being installed on individual housing units.

From 2010 to 2014, MHAFB's annual groundwater diversions (Table 10) averaged 1,630 acre-feet (AF), ranging from a low of 1,440 AF (2011) to a high of 1,850 AF (2013). Monthly diversions (Table 11 and Figure 10) ranged from a low of approximately 33 AF per month during the winter to almost 300 AF per month during the summer. Unaccounted water ranges from 10 to 15 percent and is attributed primarily to water main flushing and fire protection.

All wastewater goes to a federally-owned treatment facility on the base. The effluent is treated and used to irrigate the wastewater treatment plant grounds (1.34 acres, turf

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[16] "Unaccounted water" is municipal water that is produced (i.e., pumped from aquifers) but not delivered to customers. Unaccounted water includes water that was lost by flushing, line breaks, distribution-system leaks, and fire-hydrant use.

grass) and the base golf course (100.8 acres). The wastewater permit only allows the base to apply approximately 76 MG (233 acre feet) of treated effluent per year. As a back-up, the base maintains a wastewater NPDES permit, under which wastewater is discharged to a permitted outfall (Outfall 001, AKA McCalley Dam).

2.3.4.3. Municipal Projections

Water-demand projections for municipal use are based, in part, on projected population. Population projections are based, in part, on historical population growth. Since future population growth is influenced by unforeseen economic and political factors, water demands may or may not follow projections.

The Elmore County population grew from approximately 5,500 people in 1940 to 26,100 in 2014 (Table 6 and Figure 9). The City of Mountain Home grew from approximately 1,200 people in 1940 to 13,800 people in 2014. The City of Glenns Ferry had approximately the same population in 2014 (1,240 people) as it did in 1940 (1,290 people).

In the 1940s and 1950s, Elmore County (and in particular, the City of Mountain Home) experienced substantial population gains (Table 7), and did so again between 1990 and 2010. However, since 2010 the County and the cities of Mountain Home and Glenns Ferry have seen small decreases in population.

Population projections for Elmore County, the City of Mountain Home, MHAFB, and the City of Glenns Ferry were prepared by John Church (Idaho Economics) using an econometric model originally developed for the Idaho Power Company. The model forecasts population, households (occupied housing units, rather than total dwelling units), and employment. The model has been used to forecast population, households, and employment in each of Idaho's counties.

It was projected that the MHAFB would experience modest increases in population and households over the next 50 years (Table 12 and Table 13), but that the population in Elmore County, City of Mountain Home, and Glenns Ferry could see modest declines. However, any substantial expansions in MHAFB activities would likely lead to increases in City of Mountain Home population, households, and employment.

Absent increased economic activity at the MHAFB or in the City of Mountain Home, the municipal water demand is projected to decrease over the next 50 years (Table 16 through Table 18). However, expansion of the MHAFB would lead to increased DCMI water demand. Similarly, any additional water availability in the Cinder Cone Butte

Critical Ground Water Area or Mountain Home Ground Water Management Area could lead to increased agricultural or industrial activity that could result in increased municipal demand.

In fact, the draft Elmore County 2014 Comprehensive Plan[17] projects a growing population. The plan projects the county-wide population of approximately 41,000 people by the year 2024, with the City of Mountain Home and the MHAFB growing to approximately 21,505 and 5,000 people by the year 2024, respectively. These projections are substantially greater than those projected by Mr. Church (SPF, 2016) for these entities (approximately 14,000 and 3,100 by the year 2025 respectively). The municipal water demand would be substantially greater than that projected here if the Comprehensive Plan population projections are realized.

A growing population is also contemplated by proposed residential developments in the Orchard to Mayfield area. Approved water right permits authorize diversion of nearly 10,000 acre feet of groundwater annually for municipal and irrigation purposes in the Mayfield area. The proposed municipal uses occur in both Elmore and Ada counties (Figure 5).

2.3.5. Groundwater Diversions for Commercial and Industrial Uses

Some commercial and industrial users rely on private water supplies (i.e., water not supplied by a municipal provider). There are 6 water rights for industrial uses (e.g., food processing plants) and 12 rights for commercial uses (e.g., dairies) authorizing diversions of 0.3 cfs or more. These rights represent an aggregate annual diversion of approximately 2,800 ac-ft.

2.3.6. Groundwater Diversions for Stockwater and Rural Domestic

The 2012 USDA Census of Agriculture[18] reported that cattle production in Elmore County totaled approximately 156,000 head, of which approximately 21,500 were dairy cows, 19,200 were beef cattle and 115,300 were "other." Assuming water consumption per animal to be 35 gallons per day (gpd) for dairy cows, and 12 gpd for beef cattle, total 2012 stockwater use was approximately 2,650 AF (Table 19).

In 2010 the USGS (Maupin et al., 2014) estimated the rural population of Elmore County to be 8,275, with a per capita indoor use of 149 gallons per day (gpd). This results in an estimated use of approximately 1,400 AF/year. However, this volume is

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[17] https://www.google.com/search?q=Elmore+County+comprehensive+plan+Idaho&ie=utf-8&oe=utf-8

[18] www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_County_Level/.

largely non-consumptive, and is therefore considered to be negligible compared to other consumptive groundwater uses within the study area.

2.3.7. Summary of Groundwater Use within Study Area

Total annual groundwater diversions in the study area are estimated to be approximately 79,600 AF (Table 20). Of this amount, approximately 67,800 AF (85%) of groundwater is diverted for irrigation, 6,400 AF (8%) is diverted for municipal use, and the remainder for private commercial, industrial, stock water, and rural domestic purposes. More than 90% of the water is used for agricultural and municipal-supplied irrigation, and approximately 95% of all groundwater use occurs during the irrigation season. Most of this groundwater is diverted in the Cinder Cone Butte, City of Mountain Home, and MHAFB areas (Figure 6).

2.4. Tables and Figures

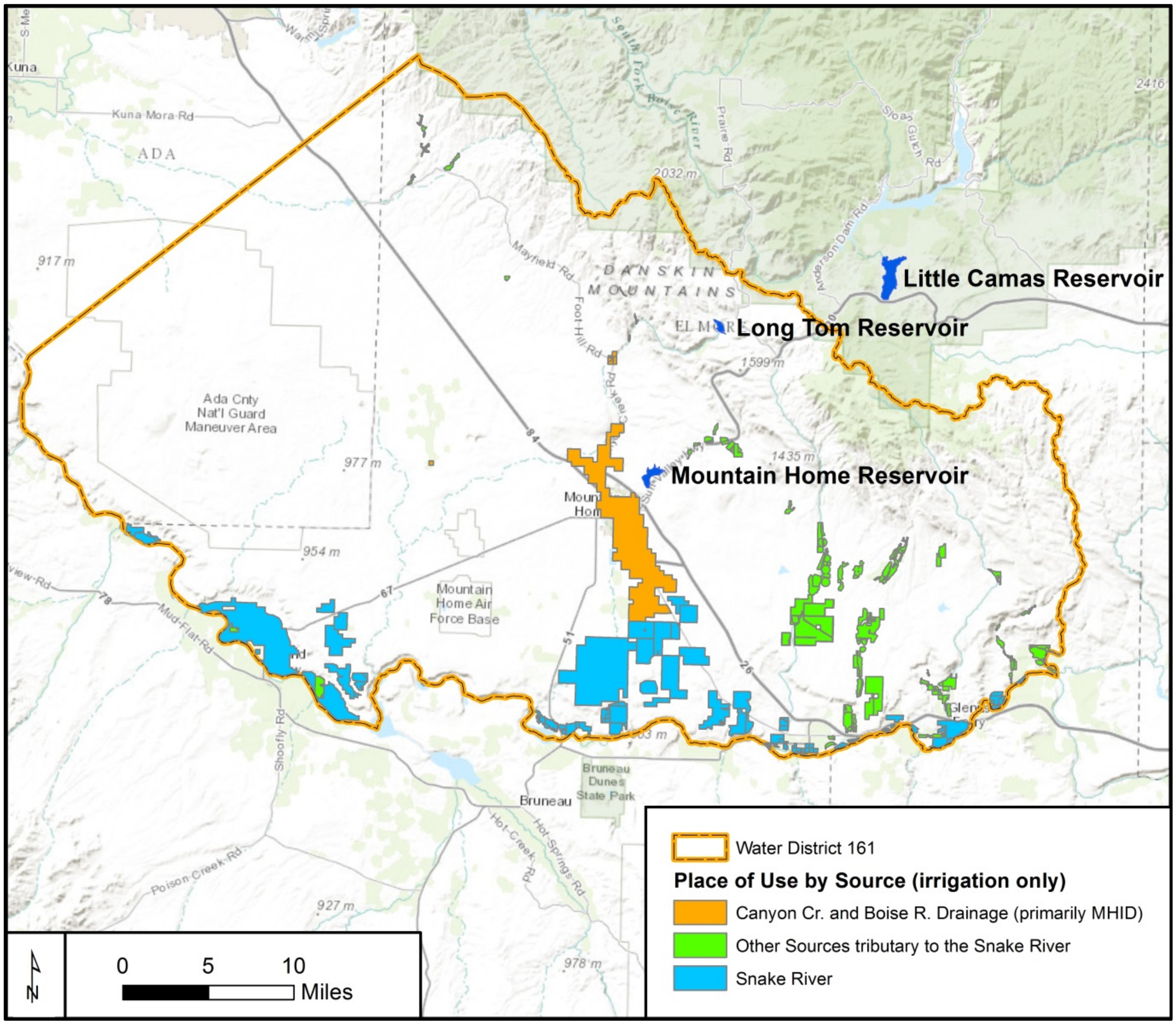

Figure 4. District 161 surface-water irrigation.

Irrigated Acres by Source		
Source		**Authorized Acres**
Surface Water	Snake River (includes Malad River rights diverted from the Snake River by the King Hill Irrigation District)	33,000
	MHID (surface water from within study area and Little Camas Reservoir)(1)	4,400
	Surface water from other sources (e.g., Bennett Creek, Cold Springs Creek, King Hill Creek, etc.)	15,000
	Total	52,400
Groundwater	Primary irrigation	18,200
	Supplemental irrigation	7,800
	Total	26,000
Total groundwater and surface water(2)		70,600

Notes:
(1) MHID w ater rights authorize the irrigation of 7,420.2 acres. How ever, MHID personnel indicate that w ater is provided to only 4,404 acres.
(2) Excludes acres authorized for supplemental groundw ater irrigation; acres authorized for supplemental irrigation are counted as surface-w ater acres.

Table 2. Irrigated acres by source.

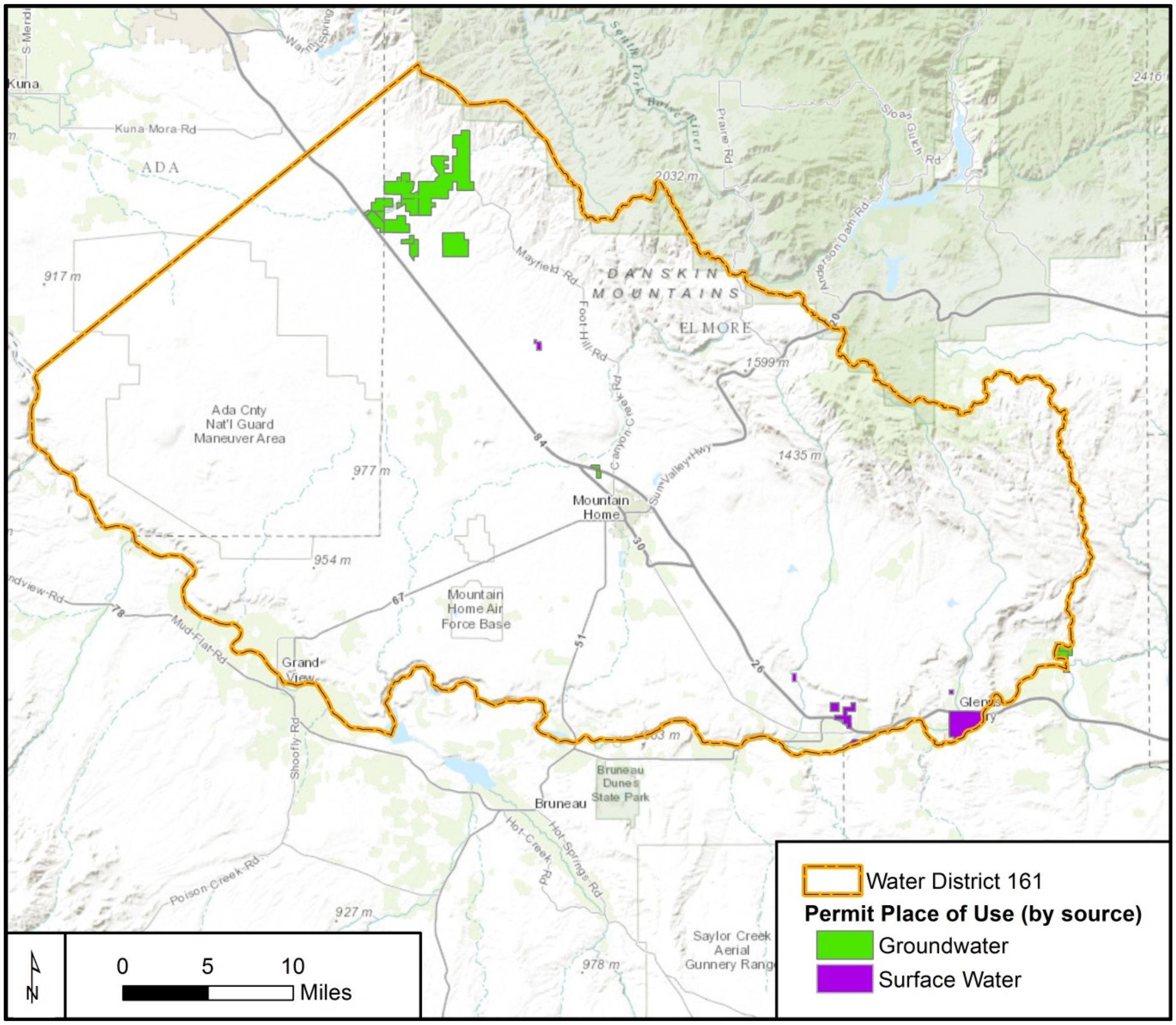

Figure 5. Current water right permits within District 161.

Estimate of Precipitation Deficit					
Crop Type	**Assumptions**	**Precipitation Deficit (AF/ac/yr)**	**Acres within Study Area[2]**	**Percentage of Total Acres**	**Weighted Precipitation Deficit (AF/Acre)**
Corn	Field corn, moderate season	2.0	12,375	21%	0.4
Winter Wheat	--	1.8	13,654	23%	0.4
Spring Wheat	--	1.8	1,056	2%	0.0
Alfalfa	Frequent Cuttings	3.0	25,869	44%	1.3
Sugarbeets	--	2.5	3,593	6%	0.2
Potatoes	Average of early and late times	1.7	1,955	3%	0.1
Total		12.8	58,502	100%	2.4

[1]Average annual precipitation deficit (1969 - 2006) obtained from ET Idaho website for NWS- Mountain Home 1W station. Precipitation deficit is analgous to net irrigation requirement.

[2] Reported 2015 acreage for Elmore County and Ada County (FSA). Acres intercepting the study area determined by GIS analysis.

Table 3. Estimate of precipitation deficit.

Groundwater Diversions for Irrigation			
Use	**Parameter**	**Value**	**Units**
Groundwater rights authorizing primary irrigation	Irrigated area	18,186	acres
	Precipitation deficit(1)	2.4	acre feet/acre
	Irrigation efficiency	75	%
	Irrigation requirement(2)	3.2	acre feet/acre
	Estimated GW volume(3)	58,400	acre feet
Groundwater rights authorizing supplemental irrigation	Irrigated acres	7,826	acres
	Precipitation deficit(4)	0.9	acre feet/acre
	Irrigation efficiency	75	%
	Irrigation requirement(2)	1.2	acre feet/acre
	Estimated GW volume(3)	9,400	acre feet
Total groundwater diversions for irrigation		67,800	acre feet

Notes:
(1) Average w eighted precipitation deficit based on reported average crop type.
(2) Precipitation deficit divided by irrigation efficiency.
(3) Rounded values
(4) Assumed value based on average MHID delivery of approximately 2 ft/acre - see Section 2.3.2.

Table 4. Groundwater diversions for irrigation.

MHID Water Diversions, 2006-2016[1]			
Year	**Total Delivery (AF)**	**Average Delivery per Acre[2] (AF)**	**Cutoff Date**
2006	10,538	2.4	--
2007	12,283	2.8	--
2011	11,795	2.7	30-Sep
2012	12,958	2.9	30-Sep
2013	4,656	1.1	26-Jun
2014	4,643	1.1	23-Jun
2015	4,930	1.1	5-Jul
2016	8,728	2.0	7-Aug
Average	8,816	2.0	

Notes:
(1) Data provided by MHID to SPF via a telephone conversation on September 1, 2016. No information w as available at the time of this reporting for 2008, 2009, and 2010.
(2) Average delivery estimates are based on w ater delivery to 4,404 acres.

Table 5. MHID diversions, 2006-2016.

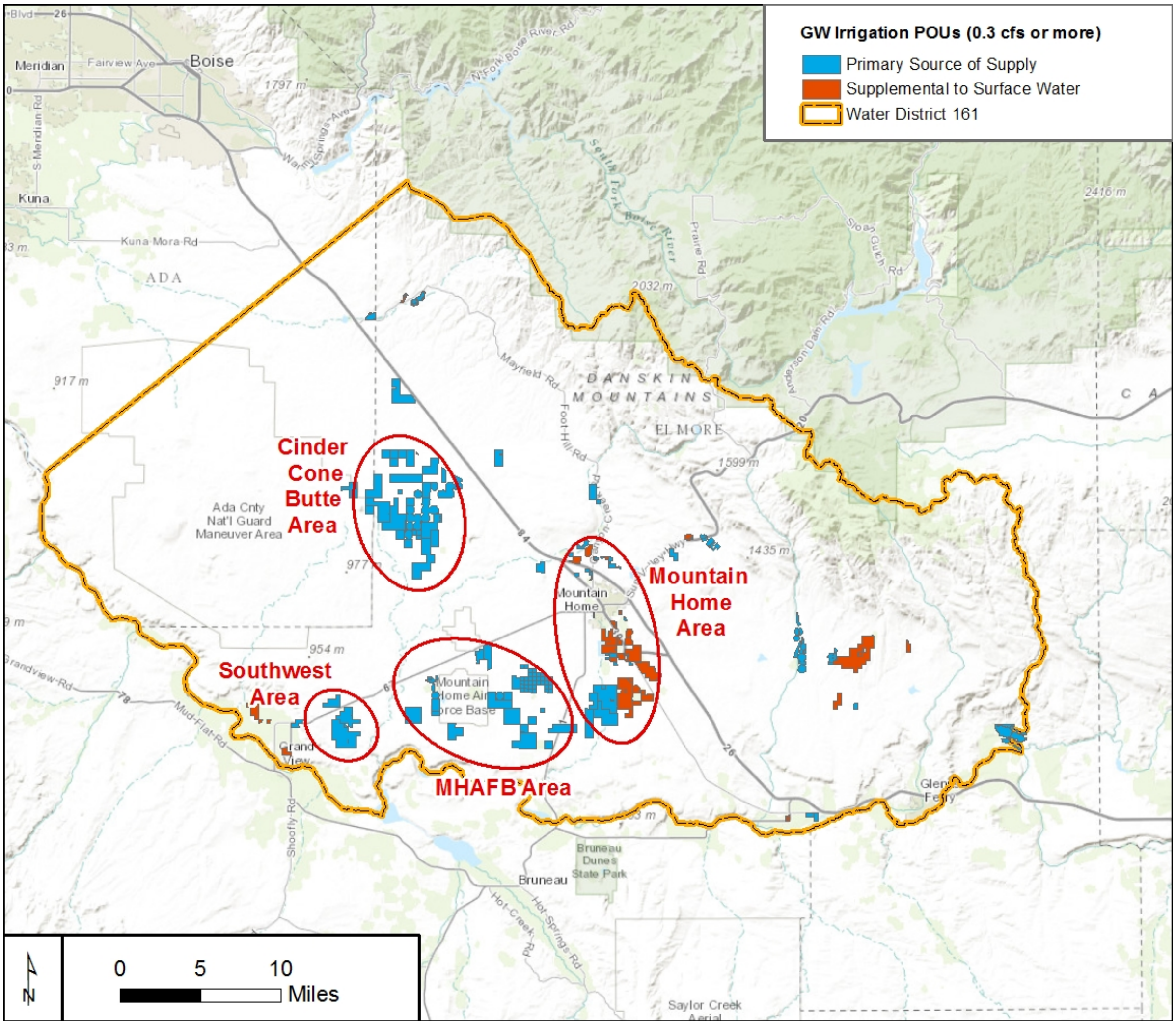

Figure 6. Groundwater-irrigated acreage, Water District 161.

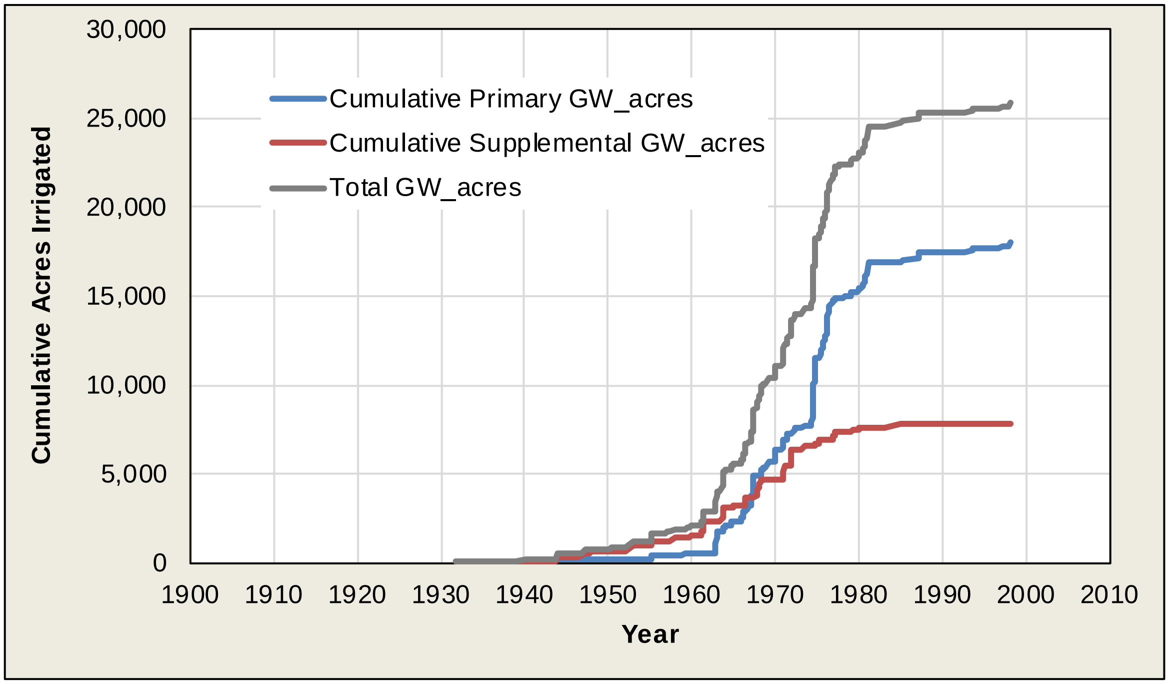

Figure 7. Groundwater Rights for Irrigation within Elmore Study Area (1900 – 1998 Priority Dates)

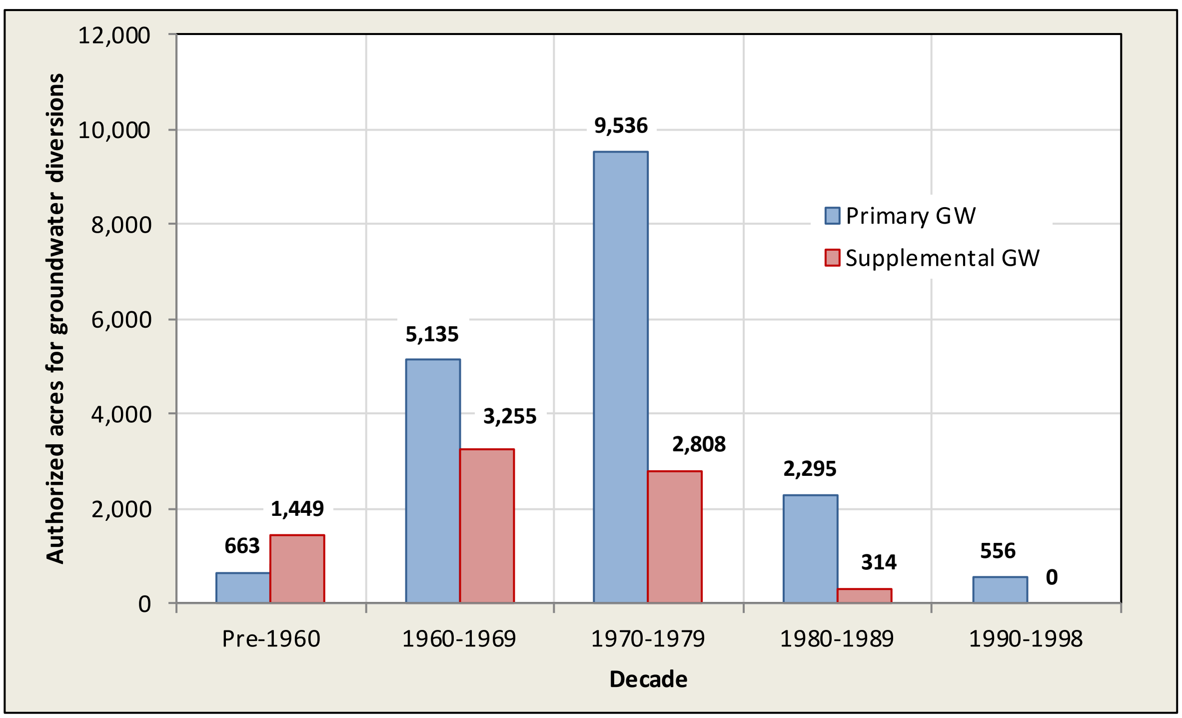

Figure 8. Groundwater development (based on priority date by decade).

Population Summary, 1940-2014									
County/ City	**1940**	**1950**	**1960**	**1970**	**1980**	**1990**	**2000**	**2010**	**2014**
Elmore County	5,520	6,690	16,700	17,500	21,600	21,300	29,100	27,100	26,100
Glenns Ferry	1,290	1,520	1,370	1,390	1,370	1,300	1,610	1,320	1,240
Mountain Home	1,190	1,890	5,980	6,450	7,540	7,910	11,100	14,200	13,800
Source: U.S. Census Bureau (www.census.gov). Data from 2011-2014 were based on mid year estimates.									

Table 6. Elmore County population summary, 1940-2014.

Percent Change in Population by Decade*								
County/City	**1940-1950**	**1950-1960**	**1960-1970**	**1970-1980**	**1980-1990**	**1990-2000**	**2000-2010**	**2010-2014***
Elmore County	21%	150%	5%	23%	-1%	37%	-7%	-4%
Glenns Ferry	17%	-9%	1%	-1%	-5%	24%	-18%	-6%
Mountain Home	58%	217%	8%	17%	5%	41%	27%	-3%
Source: U.S. Census Bureau (www.census.gov). 2011-2014 data based on mid-year estimates. * All intervals are 10 years, except for 2010-2014, which is a 5-year interval.								

Table 7. Elmore County percentage change in population.

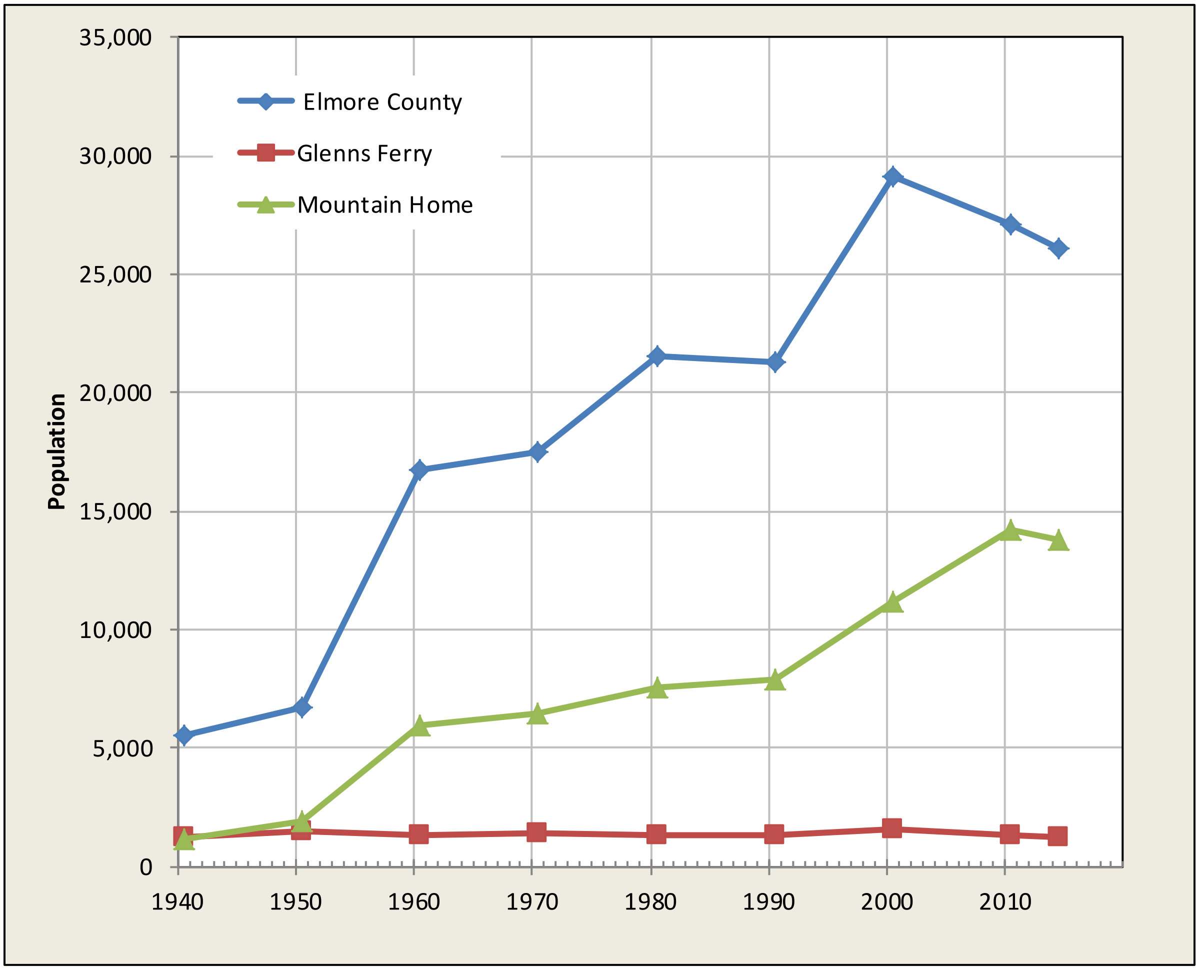

Figure 9. Historical population growth, Elmore County, 1940-2014.

City of Mountain Home Annual Diversions, 2010-2014		
Year	Annual Volume (gal x 1,000)	Annual Volume (AF)
2010	1,470,420	4,513
2011	1,432,282	4,396
2012	1,601,438	4,915
2013	1,591,580	4,884
2014	1,599,460	4,909
Average	1,539,036	4,723
Maximum	1,601,438	4,915
Minimum	1,432,282	4,396

Table 8. City of Mountain Home annual groundwater production, 2010-2014.

Average Monthly City of Mountain Home Water Production 2010-2014						
2010-2014	Average (gals x1000)	Average (AF)	Maximum (AF)	Minimum (AF)	Average Estimated Irrigation Use (AF)	Average Estimated Domestic Use (AF)
Jan	39,344	121	137	114	3	117
Feb	34,753	107	118	98	0	107
Mar	40,948	126	142	109	8	117
Apr	72,701	223	312	142	106	117
May	163,298	501	626	355	384	117
Jun	214,811	659	780	512	542	117
Jul	293,208	900	974	821	782	117
Aug	293,595	901	1,008	809	784	117
Sep	215,530	661	721	627	544	117
Oct	92,710	285	334	239	167	117
Nov	40,914	126	162	111	8	117
Dec	37,225	114	124	105	0	114
Total	1,539,036	4,723			3,327	1,396
* Domestic use is represented by average w ater use in December through February.						

Table 9. City of Mountain Home monthly groundwater production, 2010-2014.

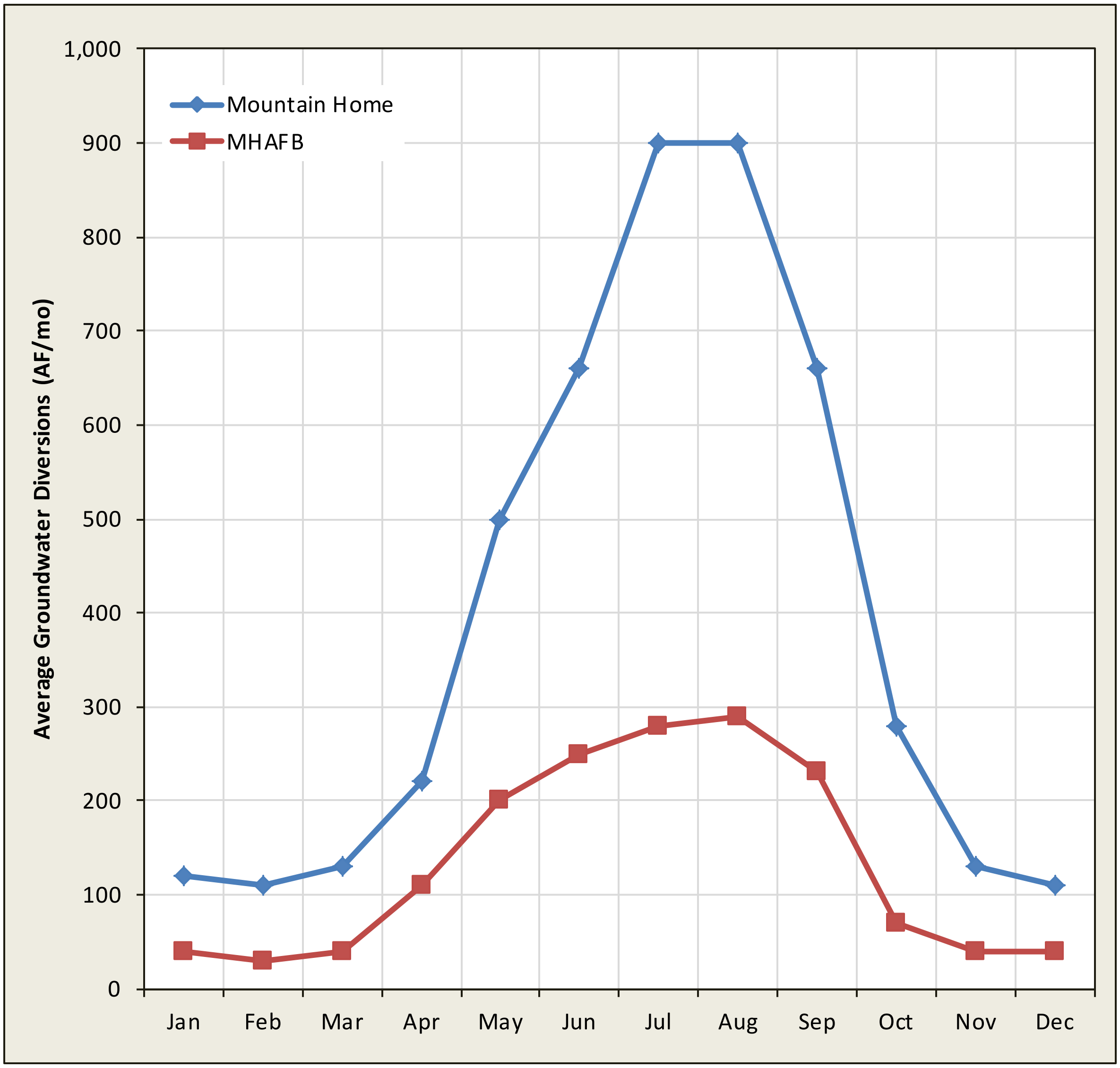

Figure 10. Average monthly DCMI water diversions.

MHAFB Annual Diversions, 2010-2014		
Year	**Annual Volume (gal x 1,000)**	**Annual Volume (AF)**
2010	543,418	1,668
2011	518,200	1,590
2012	527,232	1,618
2013	469,918	1,442
2014	603,552	1,852
Average	532,464	1,634
Maximum	603,552	1,852
Minimum	469,918	1,442

Table 10. MHAFB annual groundwater production, 2010-2014.

Average Monthly MHAFB Water Production, 2010-2014						
2010-2014	**Average (gals x1000)**	**Average (AF)**	**Maximum (AF)**	**Minimum (AF)**	**Average Estimated Irrigation Use (AF)**	**Average Estimated Domestic Use (AF)**
Jan	13,441	41	47	35	4	37
Feb	10,774	33	42	26	0	33
Mar	12,692	39	49	35	2	37
Apr	36,412	112	144	69	75	37
May	64,134	197	259	139	160	37
Jun	82,846	254	319	210	217	37
Jul	92,474	284	341	105	247	37
Aug	94,949	291	386	191	254	37
Sep	75,957	233	264	181	196	37
Oct	23,621	72	104	44	35	37
Nov	13,005	40	46	28	3	37
Dec	12,159	37	44	28	0	37
Total	532,464	1,634			1,192	442
* Domestic use is represented by average w ater use in December through February.						

Table 11. MHAFB monthly groundwater production, 2010-2014.

Population						
Year	Glenn's Ferry	Mountain Home	MHAFB	Rural	Total Elmore County	% Increase
2010	1,320	14,210	3,240	8,300	27,060	
2015	1,260	14,340	3,140	7,100	25,840	-1.1%
2020	1,240	14,480	2,990	6,700	25,410	-0.4%
2025	1,200	14,390	3,120	5,890	24,590	-0.8%
2030	1,150	13,810	3,230	5,420	23,600	-1.0%
2035	1,130	13,630	3,380	5,150	23,300	-0.3%
2040	1,110	13,380	3,380	5,000	22,870	-0.5%
2045	1,110	13,350	3,450	4,910	22,820	-0.1%
2050	1,110	13,320	3,470	4,870	22,770	-0.1%
2055	1,110	13,290	3,490	4,840	22,720	-0.1%
2060	1,100	13,260	3,500	4,800	22,670	-0.1%
2065	1,090	13,100	3,530	4,680	22,400	-0.3%

Table 12. Elmore County population projections, 2010-2014.

Households						
Year	Glenn's Ferry	Mountain Home	MHAFB	Rural	Total Elmore County	% Increase
2010	570	5,720	870	2,990	10,140	
2015	540	5,760	840	2,520	9,660	-1.2%
2020	540	5,920	800	2,420	9,680	0.1%
2025	530	5,950	840	2,160	9,470	-0.5%
2030	520	5,830	880	2,060	9,280	-0.5%
2035	520	5,880	930	2,040	9,370	0.2%
2040	530	5,950	930	2,070	9,480	0.3%
2045	520	5,900	950	2,020	9,400	-0.2%
2050	520	5,850	960	1,990	9,320	-0.2%
2055	520	5,810	960	1,960	9,250	-0.2%
2060	510	5,770	970	1,930	9,180	-0.2%
2065	510	5,720	980	1,900	9,110	-0.2%

Table 13. Elmore County household projections, 2010-2014.

Employment		
Year	Elmore County	% Increase
2010	6,390	
2015	6,290	-0.4%
2020	6,270	-0.1%
2025	5,970	-1.2%
2030	5,600	-1.5%
2035	5,390	-0.9%
2040	5,220	-0.8%
2045	5,170	-0.2%
2050	5,120	-0.2%
2055	5,070	-0.2%
2060	5,020	-0.2%
2065	4,970	-0.2%

Table 14. Elmore County employment projections, 2010-2014.

Per Capita Water Use		
Entity	Average annual per capita water use (gpd)	Average winter water use (Dec-Feb) per capita (gpd)
MHAFB	224	62
Mountain Home	291	85
Average	258	74

Table 15. Elmore County per capita DCMI water use.

Indoor Demand Projection (AF)			
Year	Mountain Home	MHAFB	Total
2010	1,360	230	1,590
2015	1,370	220	1,590
2020	1,380	210	1,590
2025	1,370	220	1,590
2030	1,320	220	1,540
2035	1,300	240	1,540
2040	1,280	240	1,520
2045	1,280	240	1,520
2050	1,270	240	1,510
2055	1,270	240	1,510
2060	1,270	240	1,510
2065	1,250	250	1,500

Table 16. Initial Elmore County DCMI indoor water-demand projection, 2010-2065.

DCMI Projection (AF)			
Year	Mountain Home	MHAFB	Total
2010	4,630	810	5,440
2015	4,170	700	4,870
2020	4,210	670	4,880
2025	4,180	700	4,880
2030	4,010	720	4,730
2035	3,960	760	4,720
2040	3,890	760	4,650
2045	3,880	770	4,650
2050	3,870	780	4,650
2055	3,870	780	4,650
2060	3,860	790	4,650
2065	3,810	790	4,600

Table 17. Initial Elmore County DCMI total water-demand projection, 2010-2065.

DCMI Irrigation Demand Projection (AF)			
Year	Mountain Home	MHAFB	Total
2010	3,270	590	3,860
2015	2,800	490	3,290
2020	2,830	460	3,290
2025	2,810	480	3,290
2030	2,700	500	3,200
2035	2,660	520	3,180
2040	2,610	520	3,130
2045	2,610	530	3,140
2050	2,600	540	3,140
2055	2,600	540	3,140
2060	2,590	540	3,130
2065	2,560	550	3,110

Table 18. Initial Elmore County DCMI irrigation water-demand projection, 2010-2065.

Stockwater Use (2012)			
Animal	Number[1]	Assumed Daily Use (gal/day/head)[2]	Annual Water Use (AF/yr)
Dairy Cow	21,500	35	840
Beef Cattle	19,200	12	260
Other	115,300	12	1,550
Total	156,000	—	2,650

Notes:
(1) Data from 2012 agricultural census (rounded).

Table 19. Stockwater use.

Estimated Current Groundwater Use		
Category		**Annual Volume (AF)**
Irrigation		67,800
Municipal	City of Mountain Home[1,2]	4,720
	MHAFB[1,2]	1,630
Private commercial & industrial[2]		2,800
Stockwater[2]		2,650
Total		79,600

Notes:
(1) Average annual use, 2010-2014.
(2) See text.

Table 20. Groundwater diversion summary.

3. GROUNDWATER PUMPING DEFICITS

3.1. Introduction

This section provides a brief description of aquifer characteristics, a review of groundwater-level trends, and an estimate of annual groundwater pumping deficits.[19] Pumping deficits provide the basis for identifying, evaluating, and sizing water-supply alternatives described in Section 5.

3.2. Aquifer Description

3.2.1. Geologic Setting

District 161 (the study area) is located predominantly within the Western Snake River Plain (WSRP), a northwest-trending topographic depression that extends approximately 150 miles from near Hagerman to Weiser. The WSRP (Figure 11) is a late-Tertiary (Neogene) continental rift basin (Wood and Clemens, 2004), separating granitic mountains associated with the Idaho Batholith in central Idaho from the metamorphic/granitic/volcanic Owyhee Mountains in southwestern Idaho. The WSRP is a graben feature, bordered by normal faults associated with continental rifting (Mabey, 1982; Wood and Anderson, 1981).

3.2.2. Stratigraphy

The stratigraphy of the study area generally consists of Quaternary alluvial sediments and Quaternary basalt (Table 21) underlain by Tertiary-age sediments. The Quaternary basalts associated with the Kuna-Mountain Home volcanic rift are generally thickest (1,000 to 2,000 feet) in the area between Mountain Home and Cinder Cone Butte, and thin outward in all directions (Whitehead, 1986). The basalts are generally thin or non-existent in the northeastern portions of the study area. Thicker sand and gravel deposits are present south of Mountain Home and north of the Snake River. The Bruneau Formation, characterized by sediments and basalt interbeds, thins towards the east, where a transition occurs to the Glenns Ferry Formation, comprised primarily of lake and stream sediments (Ralston and Chapman, 1970; Norton et al., 1982).

The Danskin Mountains (Bond and Wood, 1978) in the northern portion of the study area are composed of granodiorite associated with the Idaho Batholith in the

[19] For the purposes of this report, groundwater deficit is defined as annual groundwater withdrawals in excess of average annual recharge.

northwestern portion of the study and rhyolite in the north-central and northeastern portions of the study area (Figure 12). These granitic and volcanic materials underlie the Tertiary-age basin sediments and basalt (Figure 13).

Faulting, trending primarily in a northwest-southeast direction, has had a substantial impact on basin stratigraphy (Figure 12 and Figure 13). For example, the generalized geologic cross-section, trending from the Owyhee Mountains (southwest) to Mount Bennett Hills (northeast), shows the effects of faulting within the basin.

3.3. Aquifers

Groundwater is present in localized perched aquifers in the Cinder Cone Butte and Mountain Home areas (described in Section 3.3.1) and a deeper regional aquifer system (summarized in Section 3.3.2).

3.3.1. Perched Aquifers

Shallow perched aquifers (Figure 14) underlie approximately 38,000 acres in the vicinity of Mountain Home and in a smaller area within the Cinder Cone Butte CGWA near Tipanuk (Norton et al., 1982). The perched aquifers are generally not a sufficient source of supply for municipal or large irrigation wells, but do support smaller diversions (such as for domestic uses). These aquifers are present in Quaternary alluvium (clay, silt, sand, and gravel deposits), and to a lesser degree in Quaternary basalts of the Snake River Group and Bruneau Formation and alluvial fan deposits of the Bruneau Formation (Norton et al., 1982).

The depth to water in the perched aquifers ranges from 10 feet to approximately 200 feet below ground surface (Bendixsen, 1994). The perched system in the Mountain Home area has been observed to fluctuate as much as 50 feet in response to seasonal cycles and climatic conditions, but the water-level trend appeared to be relatively stable between 1975 and 1998 (Harrington and Bendixsen, 1999). Groundwater flow within the perched aquifers is generally to the southwest, with some local fluctuations resulting from domestic use (Norton et al., 1982).

Recharge to the perched aquifers in the Mountain Home vicinity is thought to originate primarily as seepage from Rattlesnake Creek, Canyon Creek, Mountain Home Reservoir, and irrigation canals (Norton et al., 1982), with canal seepage as the main source of shallow recharge (Baker, 1988). Recharge to the perched zone in the Cinder Cone Butte CGWA is primarily from infiltration in intermittent streams (Harrington and Bendixsen, 1999); the perched area is located east of the area of intense irrigation within the CGWA. Average recharge volumes to the perched aquifers have not been determined.

Discharge from the perched aquifers includes vertical leakage to the deeper regional aquifer system, spring flow at Rattlesnake Spring tributary to the Snake River, and groundwater withdrawal for domestic, stockwater, and small irrigation uses (Norton et al., 1982).

3.3.2. Regional Aquifer System

The deeper regional aquifer system occurs primarily within the Idaho Group in basalts of the Bruneau Formation and "poorly consolidated detrital material and minor basalt flows" associated with the Glenns Ferry Formation (Norton, et al., 1982). The depth to water in the regional system is generally greater than 250 feet, and well yields range between 10 gpm and 3,500 gpm (Harrington, 2004).

Recharge to the regional aquifer occurs primarily as infiltration from precipitation in the Danskin Mountains; seepage from intermittent stream channels, surface impoundments, and canals; percolation from the shallow perched aquifer; and underflow from the north (Norton et al., 1982; Bendixsen, 1994). Average recharge volume to the regional aquifer has not been determined. Discharge from the regional aquifer occurs as well withdrawals primarily for irrigation and spring and surface water discharge to the Snake River (Norton et al., 1982).

Groundwater flow directions (Figure 15) within the regional aquifer are generally towards the west/southwest from recharge areas near the Danskin Mountains toward the Snake River as a discharge area (Lindholm, 1988), although locally, groundwater flow is likely toward pumping centers. Groundwater contours and flow directions in Figure 15 are shown for 1980 conditions.

3.3.3. Regional and Perched Aquifer Interaction

The regional and perched aquifers in the Mountain Home area appear to merge on the northeast side of the City of Mountain Home. The interaction between these aquifer systems is not well understood. Substantial vertical gradients are not present between shallow and deep wells in the vicinity of Mountain Home Reservoir, but south of I-84 in the Mountain Home area, greater vertical gradients are apparent as static water-level elevations typically decrease with increasing well depth. South of the City, the difference between the perched system and the regional system appear to be more distinct, with regional water levels several hundred feet below water levels within the perched aquifer.

3.3.4. Geothermal Aquifer

A geothermal aquifer is utilized for irrigation at the base of the Mt. Bennett Hills, east of Mountain Home and north of Hammett. Wells tapping the geothermal aquifer are used for irrigation of a few hundred acres in the vicinity of Bennett Creek and Cold Springs Creek. Due to interference between wells, and the resulting effects on historical hot springs in the area, litigation occurred between local water users that resulted in a decree for the wells within the geothermal aquifer system. Although the geothermal aquifer is outside of the Mountain Home GWMA boundary, the previous litigation suggests that additional development for consumptive uses would result in groundwater-level declines.

3.3.5. Distribution of Wells

The majority of wells within the study area are located in the vicinity of the City of Mountain Home, MHAFB, and Cinder Cone Butte. Fewer wells are located near Orchard/Mayfield and along the Snake River. Groundwater use is primarily for agricultural irrigation, with lesser amounts used for municipal, commercial, and industrial purposes.

3.4. Groundwater-Levels

This section provides an overview of available data and sources (Section 3.4.1), measurement frequency (Section 3.4.2), and spatial trends (Section 3.4.3).

3.4.1. Groundwater-Level Data

Groundwater-level data from IDWR's well-construction database were used to describe groundwater-level trends and estimate groundwater-supply deficits. The database contains records for 704 wells within the District 161 study area.[20] To the extent available, records typically include well-construction information, completion dates, and ground-surface elevations.[21] Of the 704 wells, 521 wells had one or more groundwater level measurements. Of those 521 wells, 450 wells had at least three or more measurements, which is typically the minimum needed to identify a groundwater-level trend). Groundwater-level trends were identified and processed as follows:

1. Only wells with at least three or more groundwater-level measurements were considered for trend evaluation.
2. Wells with long-term level measurements (i.e., between the late 1960s and early 1970s to the present) were selected for trend evaluation as opposed to

[20] This well-construction query was conducted by IDWR between May 31, 2016 and June 1, 2016 and was provided to SPF on June 1, 2016. Data reflect available groundwater-level measurements at the time the database was queried.

[21] Well elevations are reported in the Idaho Transverse Mercator (IDTM) projection in feet in the North American Datum of 1983 (NAD83), obtained from survey, topographic map, and digital elevation model (DEM) sources. Elevations were not available for 75 wells; for those wells, elevation data provided in IDWR GIS shapefile and obtained from U.S. Department of Agriculture, Natural Resources Conservation Service, and National Cartography & Geospatial Center. The source of these latter data is the National Elevation Database (NED), compiled as a mosaic of individual 7.5 x 7.5 minute quadrangles with 10-meter resolution.

those wells with fewer measurements and over a shorter time frame (i.e., over just a few years).

3. Static (i.e., non-pumping) groundwater levels are most useful in describing groundwater-level trends. Groundwater levels measured following recent pumping (or near other wells that are actively being pumped) were filtered from the IDWR dataset. About 600 individual groundwater-level records flagged in the source data ‘nearby pumping’, ‘nearby pumping recently’, ‘pumping’, and ‘pumping nearby’ were excluded from the onset of evaluating groundwater-level trends.
4. Excluding the filtered records, however, did not eliminate all of the apparent effects of individual pumping events. Therefore, additional records showing the effects of apparent pumping were excluded from data used to describe groundwater-level trends.
5. Then, remaining groundwater-level measurements (converted to elevation) were averaged within a given year to represent a single groundwater level per well per year.[22] .
6. Well locations predominantly were mapped based on location data contained in the IDWR database. The locations are generally listed by quarter-quarter based on drillers’ report information. Well elevations were taken from the IDWR database, when provided. When data were unavailable, the approximate ground surface elevation was used to approximate the well elevation[23].

Groundwater-level data are available over a 40- to 50-year period, spanning from 1965/1975 to the present. Over the available period of record (discounting pumping measurements discussed above and flowing artesian wells), the depth to groundwater ranged from 1 foot to 697 feet bgs for wells completed in perched and regional zones.

3.4.2. Groundwater-Level Measurement Frequency

As groundwater use has increased over time, so has the number and frequency of groundwater-level measurements. Trends are described based on township and range:

22 Annual groundwater-level averages diminish the impact of seasonal fluctuations, but provide a basis for comparing groundwater levels over a multi-year period.

23 Depending on the local topography, actual location of the well, and individual well completion (i.e., top of measurement point relative to ground surface), this method of approximation is expected be within a few feet in relatively flat areas to potentially within tens of feet of the true well elevation in areas of steep topography. These assumptions do not affect the evaluation of groundwater level trends over time that are based on relative changes within a well.

- Between 1942 and 1965, groundwater-level data were available for fewer than 10 wells per year. Well locations predominantly were concentrated near Orchard (T1N/R4E; T1S/R4E), the Cinder Cone Butte vicinity (T2S/R5E), and the Mountain Home vicinity (i.e., T3S/R6E; T3S/R7E; and T4S/R5E). Construction of MHAFB was completed in 1943.
- Between 1965 and 1980, about 30 wells per year on average were monitored, with the exception of 1976 when groundwater levels were measured in 140 wells. During this time, water-level measurements were distributed in wells located throughout the primary use areas within the study area (Orchard/Mayfield, Cinder Cone Butte, and City of Mountain Home vicinities).
- Between 1980 and 1989, about 40 wells per year were monitored. A total of 164 wells were monitored in 1990, with the majority of measurements collected during 1990 and 1991 near Mountain Home, including MHAFB (Young, 1992).
- Between 1990 and 2010, about 45 to 50 wells per year were monitored, with a noted increase in locations starting in 1999, when 71 wells were monitored.
- Between 2010 and 2014, groundwater-level measurements are predominantly concentrated in the vicinities of Mayfield/I84 (T1N/R4E and T1NR5E); Cinder Cone Butte (T2S/R4E and T2S/R5E); the City of Mountain Home (T3S/R6E); and MHAFB (T4S/R5E). Also, beginning in 2009, the use of pressure transducers and dataloggers provided a greater frequency of groundwater-level measurements.
- During 2015 and 2016 (as of June), about 30 wells per year were monitored, representing about half of the available measurements in recent years, particularly in the vicinity of MHAFB (T4S/R5E). Measurements continue to be focused in the vicinity of Orchard/Mayfield (i.e., T1N/R4E and T1S/R4E) and near Mountain Home (i.e., T3S/R6E).

3.4.3. Groundwater-Level Trends

Water District 161 has large areas with relatively stable groundwater levels. However, groundwater levels in some areas have declined over 125 feet since the 1960s. Groundwater-level declines are concentrated in 4 general areas (Figure 16): (1) Cinder Cone Butte vicinity, (2) areas within and adjacent to the City of Mountain Home, (3) the MHAFB (including agricultural areas to the east and southeast of the MHAFB), and (4) a small area in the southwestern portion of the study area (referred to hereafter as the “southwestern area”). Note that Figure 15 includes wells with relatively short periods of record, which result in an underestimation of decline.

Groundwater-level declines in Water District 161 have been recognized for many years. Declining groundwater levels led to the designation of the Cinder Cone Butte CGWA in 1981 and the Mountain Home GWMA in 1982. Groundwater levels in portions of the Cinder Cone Butte CGWA and Mountain Home GWMA declined 50 to

60 feet between the 1960s and 1998 (Harrington, 2004). Near MHAFB, groundwater levels showed more than 50 feet of decline since 1968. Steep declines were noted during the late 1960s and early 1970s, followed by apparent stabilization in the mid-1970s to the early 1980s, and subsequent decline in the mid-1980s through the present. The north and northwest parts of the Mountain Home GWMA were observed to have groundwater levels that were stable or increased a few feet between the 1960s and 1998[24] (Harrington and Bendixsen, 1999). Groundwater-level changes between 1976 and 2002 are shown in Figure 17 (Harrington, 2004).

3.4.3.1. Cinder Cone Butte Vicinity

The greatest study-area groundwater-level declines have occurred in the Cinder Cone Butte vicinity in T2S/R4E and T2S/R5E (Figure 16 and Figure A-2 in Appendix A). Groundwater levels have declined over 100 feet since monitoring began (e.g., wells 02S04E 27DDD1; 02S04E 24DBB1; and 03S05E 06ACC1). However, not all of the Cinder Cone Butte CGWA has experienced declining groundwater levels. For example, wells 02S05E 26BDB1 and 02S 5E 36BBB1, east of the main centers of pumping, show less than 10 feet of decline since the mid-1960s, with a current declining trend of approximately 0.3 feet per year.

3.4.3.2. City of Mountain Home Vicinity

Groundwater levels in the northern part of the City of Mountain Home vicinity are generally stable (although groundwater levels in some wells experience annual or multi-year fluctuations of 10 to 20 feet[25]). These wells have open intervals ranging from approximately 20 to over 600 feet; depth to water are generally less than 180 feet, regardless of open interval (there appears to be a slight downward gradient in Cluster 2 wells, see Figure A-3 in Appendix A). South of I-84, hydrographs reveal more of a distinction between the shallow, perched aquifer (e.g., 03S06E 35ABB1) and the deeper, regional aquifer (03S06E 35BCC1). Wells with shallower completions (e.g., less than approximately 200 feet in depth) are generally stable. Wells with deeper completions that penetrate the regional aquifer show declining groundwater levels. By example, Well 03S06E 35BCC1 shows a decline of approximately 80 feet since the 1960s. This well is located immediately southwest of the City of Mountain Home, and the water-level trend in this well is consistent with groundwater levels in regional aquifer wells further to the south and west near MHAFB. The variability in

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[24] The most recent water rights within the study area were issued in 1998 (IDWR, 2016b).

[25] See 03S 06E 15BCD1; 03S 06E 35ABB1; 03S 06E 13AAD1; 03S 06E 13BBA1; and 03S 07E 08DBB1 and wells denoted as “Cluster I” and “Cluster II”.

depth to water and groundwater-level trends in the City of Mountain Home area reflect a complex aquifer system with possible structural controls.

3.4.3.3. MHAFB Vicinity

Groundwater levels in the vicinity of MHAFB (T4S/R5E) have seen declines of 50 to 70 feet (Figures A-4 and A-6 in Appendix A). Declines of more than 50 feet are apparent in agricultural areas east and southeast of the airbase in T4S/R6E and T5S/R6E. These hydrographs appear to reflect conditions in the area around MHAFB extending to and south of the City of Mountain Home. Within T5S/R6E, some wells show stable trends (i.e., 05S 06E 01AAD1 and 14BAAA1) while others indicate groundwater declines up to 60 feet (i.e., 05S 06E 06CAA1 and 04BBC1). Most of the declines appear to be responses to local irrigation pumping; with water-level declines occurring where groundwater is the primary source of irrigation supply (e.g., west of Highway 51) and stable water levels where Snake River water is used for irrigation (e.g., east of Highway 51).

The agricultural area north of the Snake River and west of MHAFB (T5S/R4E – Figure A-6) show declining groundwater trends of almost 100 feet in some wells (e.g., 05S 04E 06ADA1). These declines appear to be the result of local irrigation pumping.

3.4.3.4. Other Areas

Other parts of the study area have relatively stable groundwater levels. Groundwater level trends in areas near Orchard and Mayfield are shown in Figure A-5. Relatively stable groundwater-level trends are observed in the Orchard and Mayfield (Figure A-5) areas in both shallow and deep well completions. In some instances, increasing groundwater levels on the order of a few feet are noted (i.e., 01S 04E 10DAD1). The stable water levels are not surprising, as historically there has been limited groundwater pumping for irrigation purposes in this area.

3.4.3.5. Role of Groundwater Development History on Groundwater Levels

Groundwater use is dominated by irrigation, and the history of groundwater development for irrigation can be traced by priority dates associated with water rights authorizing irrigation uses.[26] Not surprisingly, groundwater level declines coincide with historical groundwater.

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[26] A water-rights's priority date provides an indication, but not the exact time, at which a water right was developed. The priority date generally reflects the date on which an application was received by IDWR. Processing an application can take from months to years, and if a permit is issued, the owner has a period of time (often up to 10 years) in which to develop beneficial use under the right. Nonetheless, absent a

3.4.3.6. Discussion of Trends

Evaluation of the groundwater-level trends, taking into consideration hydrogeologic conditions and water rights development, provide the following insights:

- Pumping effects result in relatively localized groundwater-level declines. For example, wells 02S05E 26BDB1 and 02S05E 36BBB1, which are located northeast of the main centers of pumping in the Cinder Cone Butte CGWA, have shown minimal declines over time, suggesting the effects of pumping have not propagated laterally across the entire CGWA extent. Similar water-level responses are apparent in other areas (southeast of MHAFB in T5S/R6E, and west of the City of Mountain Home in T3S/R6E); chronic declines persist near the pumping centers, but declines at distances of only a few miles from pumping centers are minimal.
- Declining groundwater levels correspond with areas of groundwater pumping in the vicinities of Cinder Cone Butte, the City of Mountain Home and MHAFB. This finding is consistent with previous studies, with the exception of groundwater-level declines near the Snake River (i.e., T5S/R4E) associated with local agricultural irrigation uses that have not been a substantial area of focus.
- Aquifer recharge is limited within the study area, and groundwater-level trends demonstrate that pumping centers can produce more water than is available from natural recharge sources leading to removal of water from aquifer storage.
- Groundwater levels in the areas of Cinder Cone Butte, near the City of Mountain Home, and near MHAFB continue to decline despite establishment of the CGWA and GWMA in the early 1980s. This trend indicates that groundwater is being extracted at a rate that is greater than recharge to the aquifer and will likely not be reversed without a reduction in pumping and/or augmentation with another source of water supply.
- Because of the apparent localized influence of pumping on water-level declines, mitigating actions (including aquifer recharge or curtailment) should focus on the local areas experiencing groundwater-level declines. Providing aquifer recharge or curtailing pumping in one area may not provide a water-level benefit to an area several miles distant.

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much more detailed review of individual water rights, the priority date provides a reasonable indication of when development began.

3.5. Deficit Pumping Volume

Sustained groundwater-level declines indicate that groundwater withdrawals exceed average recharge rates. The volume of water pumped from an aquifer in excess of average annual recharge is the annual deficit pumping volume. A reduction in pumping by an amount equivalent to the annual deficit volume would lead to stabilization of groundwater levels.

The volume of deficit pumping can be quantified in general ways. First, a deficit can be determined by estimating the volume represented by the difference between two groundwater-level surfaces (e.g., original and present-day static groundwater levels). This volume is then multiplied by the specific yield (or effective porosity) to estimate the volume of groundwater depleted from the area.[27] Factors influencing the certainty (or uncertainty) of this approach include the number and spatial distribution of wells having groundwater-level data over extended periods of time and uncertainties associated with effective-porosity estimates.

An alternative approach is to prepare a regional water budget that includes estimates of basin inflows (e.g., precipitation, basin groundwater underflow from up-gradient areas, surface-water inflows) and estimates of basin outflows (discharge to the Snake River, evapotranspiration in rangeland and agricultural areas, etc.). A limitation of this approach is that the uncertainty associated individual water budget components can be large, especially for a large, regional area with sparse data. As such, the uncertainty associated with the regional water budget can mask deficit withdrawals in local areas.

Substantial efforts were made using both approaches for this study, but the first approach (comparing groundwater-level surfaces over time) was thought to provide more meaningful results. Estimates of deficit pumping volume using this approach were prepared as follows:

1. Two groundwater-level surfaces[28] were prepared: the first based on groundwater-level data collected between 1970 and 1979[29] and the second

[27] For example, the groundwater decrease in a 1,000-acre area that has experienced an average 10-foot decline, assuming a 25-percent porosity, would be 2,500 AF (i.e., 1000 acres x 10 feet x 0.25 = 2500 AF). If the decline occurred over a period of 20 years, then the average annual groundwater deficit would be approximately 125 AF per year (i.e., 2500 AF ÷ 20 years = 125 AF/yr).

[28] The surfaces were prepared with ESRI's ArcGIS Spatial Analyst package (version 10.2).

[29] Too few data were available to prepare a pre-1970 groundwater-level surface.

based on data collected between 2000 and 2016. The 10-year starting and ending time periods were used to increase the number of data points available for spatial interpolation. For wells with multiple measurements within the 10-year time periods, the groundwater-level data were averaged to provide a single, representative value.

2. The above-described distillation yielded 30 wells with reliable groundwater-level in both the pre-1979 and post-2000 time periods (Appendix B). Pre-1979 groundwater levels were then subtracted from the post-2000 groundwater levels. The differences were then interpolated to illustrate the spatial distribution of groundwater-level changes over time (Figure 18).[30]
3. Aggregate groundwater depletions from the 1970s to present were estimated by multiplying the gross change in groundwater volume (represented by the difference in groundwater levels from the 1970s to present[31]) by an assumed specific-yield value.[32] The specific yield (or effective porosity) of an unconfined aquifer is less than the total porosity. The total porosity of fractured basalt ranges from 8 to 50 percent; silt and sand porosity ranges from 25 to 50 percent (Freeze and Cherry, 1979). The specific yield for these materials might range from approximately 5 to 30 percent (Driscoll, 1986). In this case, a specific-yield value of 20 percent was used to estimate aquifer depletions.

The estimated aggregate groundwater depletion between the 1970s and present was approximately 1.1 million AF for the Cinder Cone Butte vicinity, 320,000 AF for the City of Mountain Home vicinity, and 548,000 AF for MHAFB, for a total depletion of approximately 1.9 million AF within the study area (Table 22).

The average annual deficit pumping volume was approximated by dividing the total depletions by 46 years (the number of years between 1970 and 2016). In aggregate, the average annual deficit pumping volume was estimated to be 43,000 AF/year, which is not inconsistent with a previous IDWR 30,000-AF/yr estimate (Ondrechen, 2004). We estimate that the Cinder Cone Butte area, City of Mountain Home vicinity, and MHAFB vicinity have current annual deficit pumping volumes of approximately

[30] The Map Algebra feature in Spatial Analyst was used to calculate the change in groundwater elevation over time. A nearest (or natural) neighbor interpolation method was then used to create an interpolated water-table surface using the results of Map Algebra.

[31] The gross volume represented by the difference in groundwater-level surfaces was calculated using the Zonal Analyst program (in Special Analyst).

[32] Specific yield, also sometimes referred to as effective porosity, is the volume of water that can drain from an unconfined aquifer by gravity (Driscoll, 1986).

24,000 AF, 7000 AF, and 12,000 AF, respectively. There are no deficit pumping volumes in areas with stable groundwater levels.

3.6. Tables and Figures

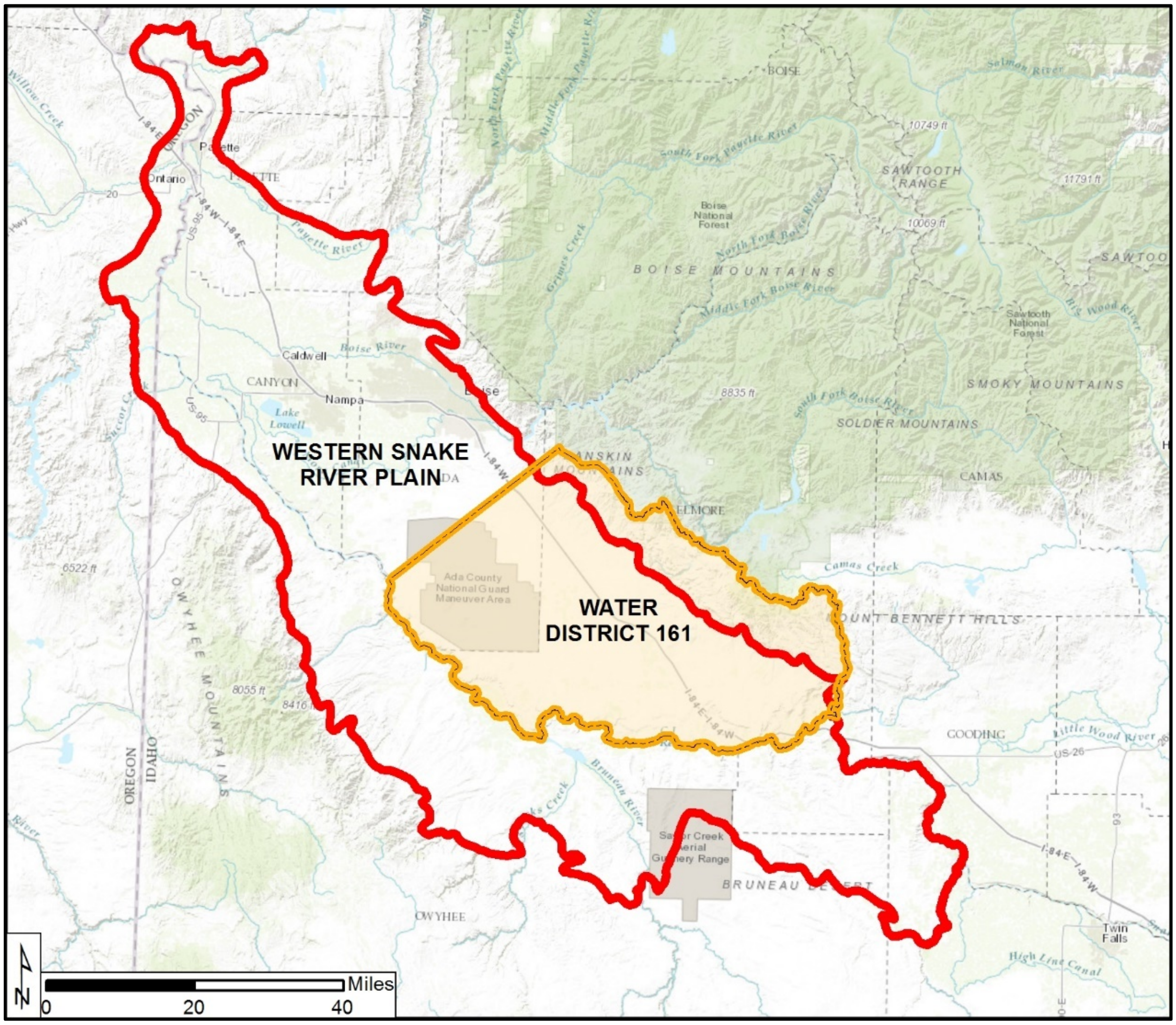
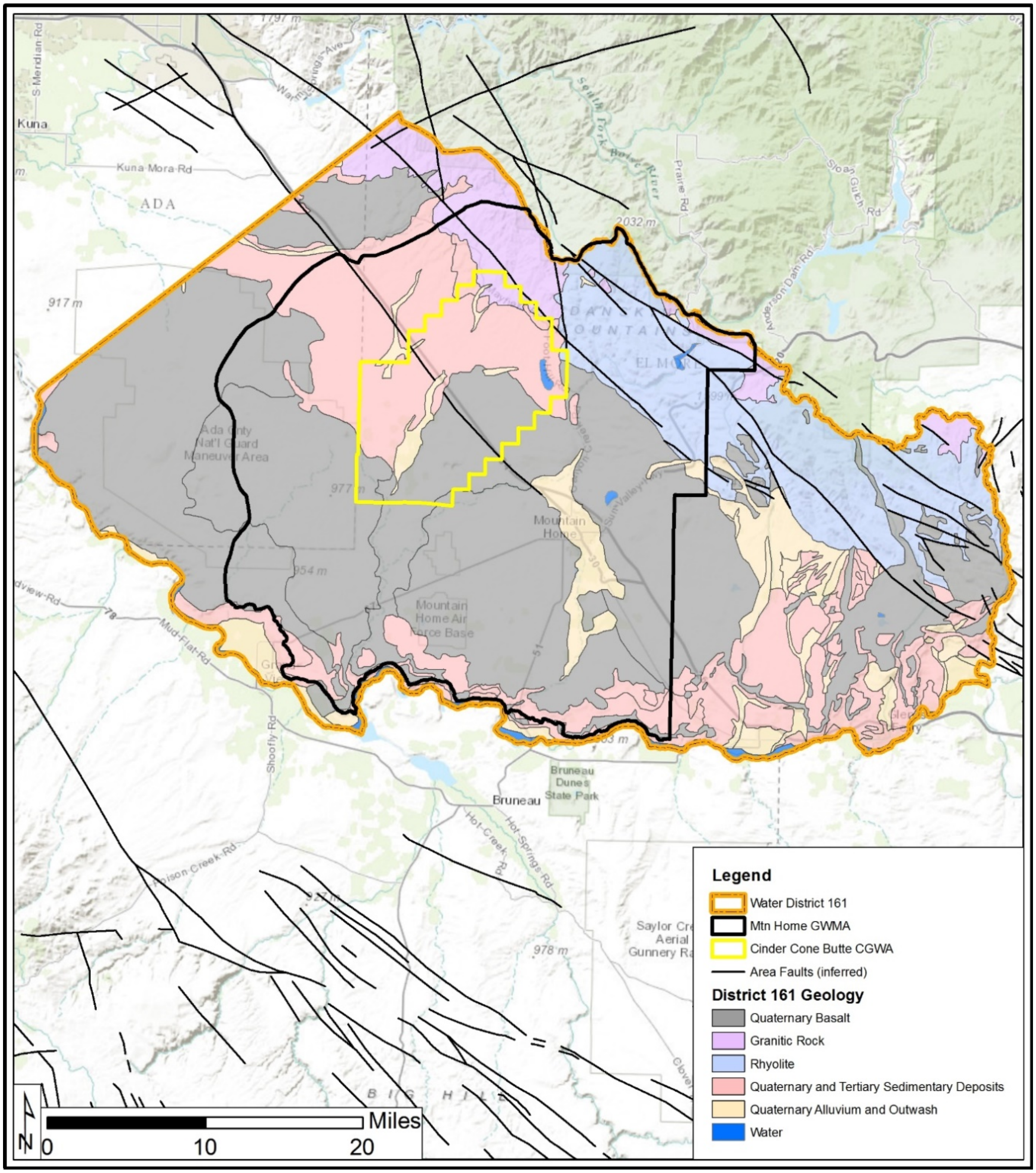


Figure 11. Western Snake River Plain.

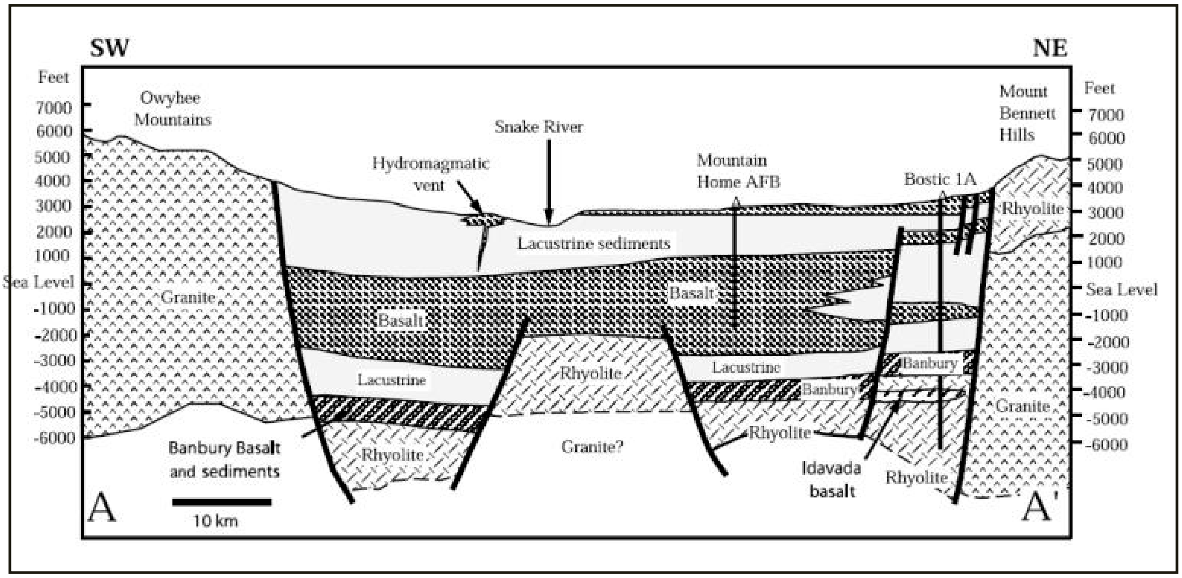
Stratigraphic Units				
Group or Formation		**Description**	**Geologic Time Period**	**Approximate Age**
Recent alluvium		Unconsolidated sand, silt, clay, and gravel deposited by streams	Holocene	<10,000 years
Alluvial and fluvial deposits		Unconsolidated gravel, sand, silt and clay deposited by streams, lakes, and outwash	Pleistocene	<2 million years (Ma)
Snake River Group		Basalt	Pleistocene	<2 Ma
Idaho Group	Bruneau Formation	Basalt and unconsolidated sands deposited on alluvial fans	Pleistocene and Pliocene	<5 Ma
	Glenns Ferry Formation	Weakly-consolidated lake and stream deposits, consisting of clay, silt, sand, and gravel; minor basalt flows	Pleistocene and Pliocene	<5 Ma
Idavada Volcanics		Pyroclastic deposits including rhyolite, welded tuff, and ash	Miocene	5 to 24 Ma
Idaho Batholith		Granitic rocks including quartz monzonite and granodiorite	Cretaceous	65 to 144 Ma

Table 21. Stratigraphic units within study area.



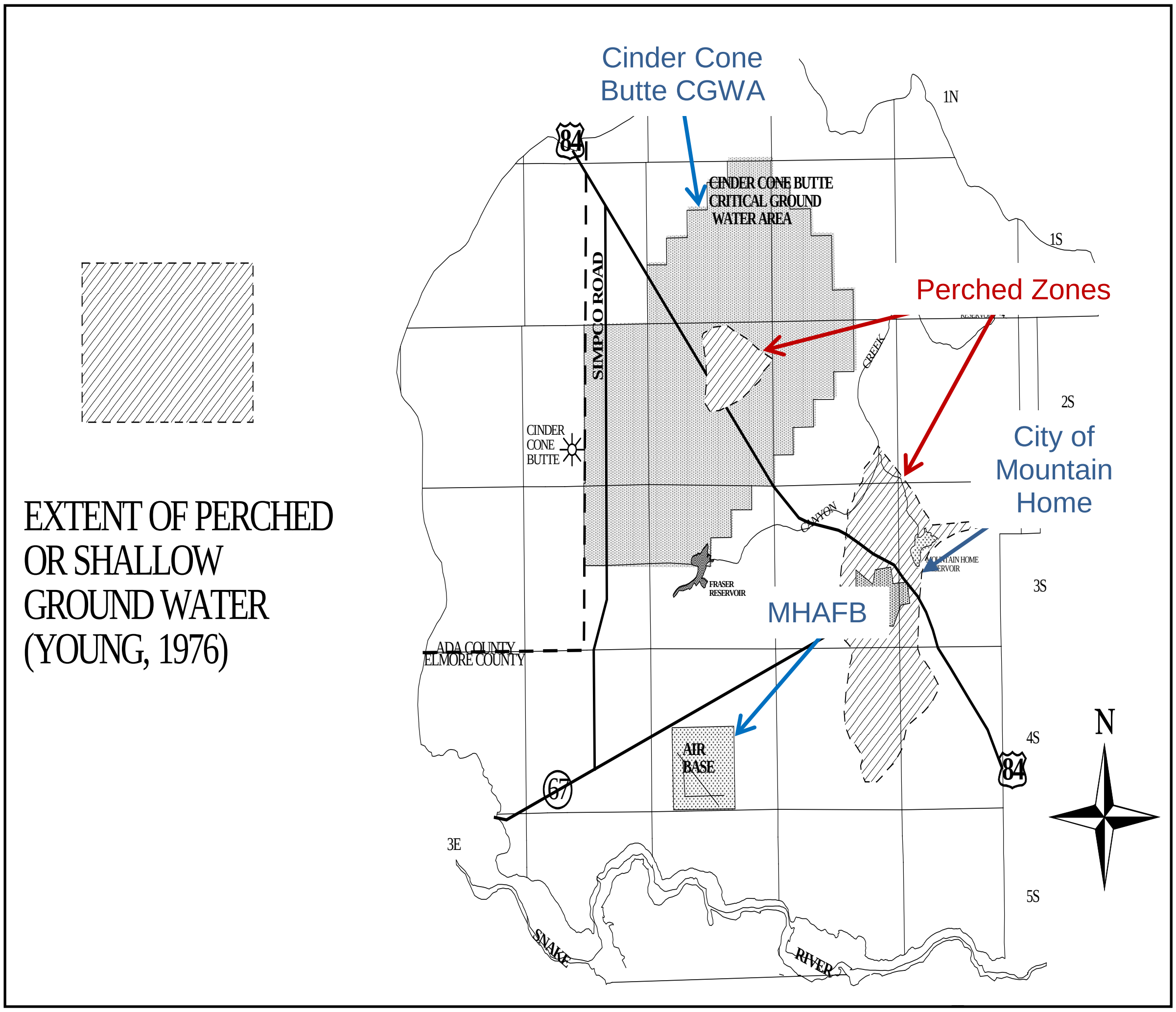
Adapted from Bond and Wood (1978); USGS Mineral Resources (2005)

Figure 12. Surficial geology.



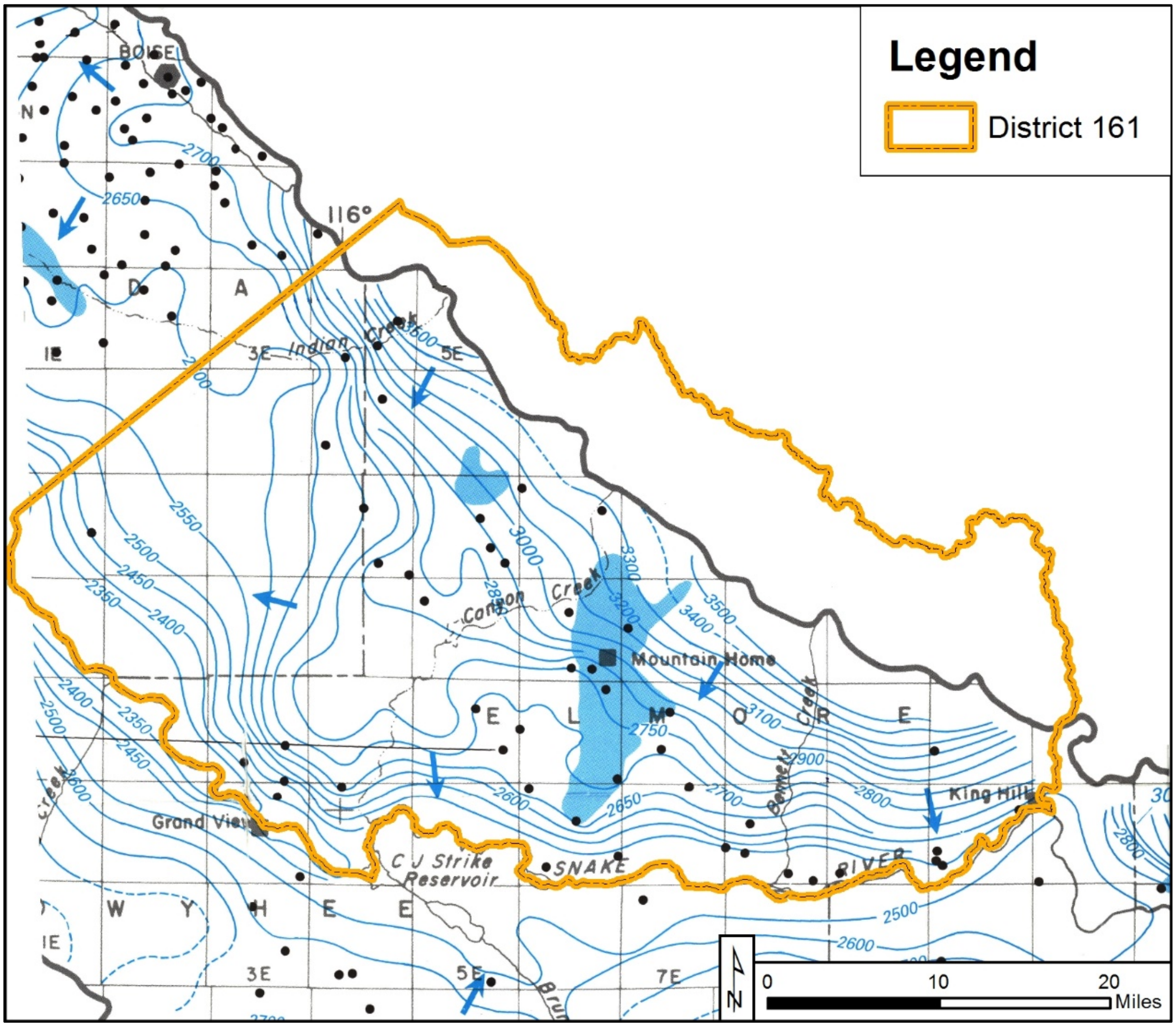
From Shervais (2002).

Figure 13. Generalized geologic cross-section.



Adapted from Harrington, 2004.

Figure 14. Perched aquifers in Mountain Home area.



Source: Lindholm et al. (1988)

Figure 15. Regional groundwater flow directions (1980 conditions).

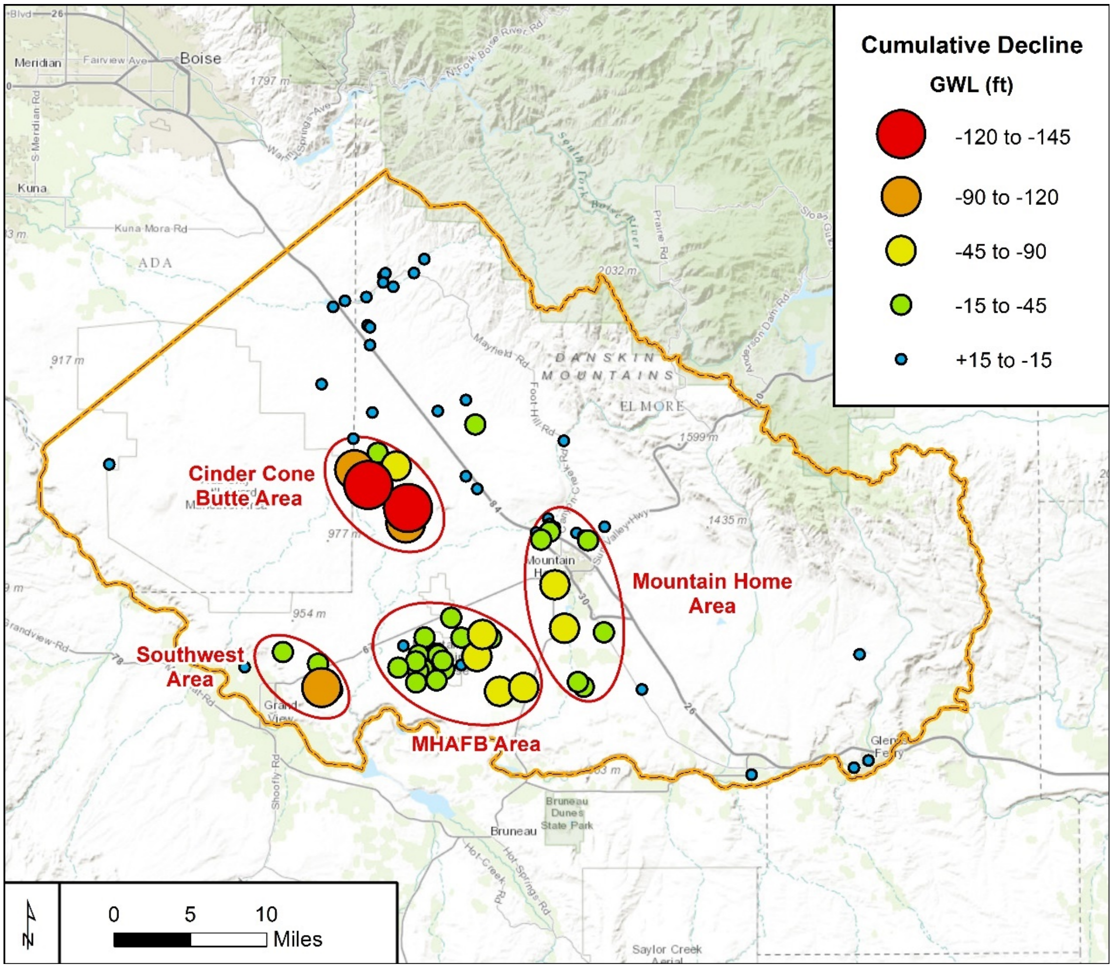


Figure 16. Composite groundwater-level trends (1960 – 2016).

(Note that many of the wells shown in Figure 15 have incomplete periods of record, which result in underestimation of cumulative decline.)

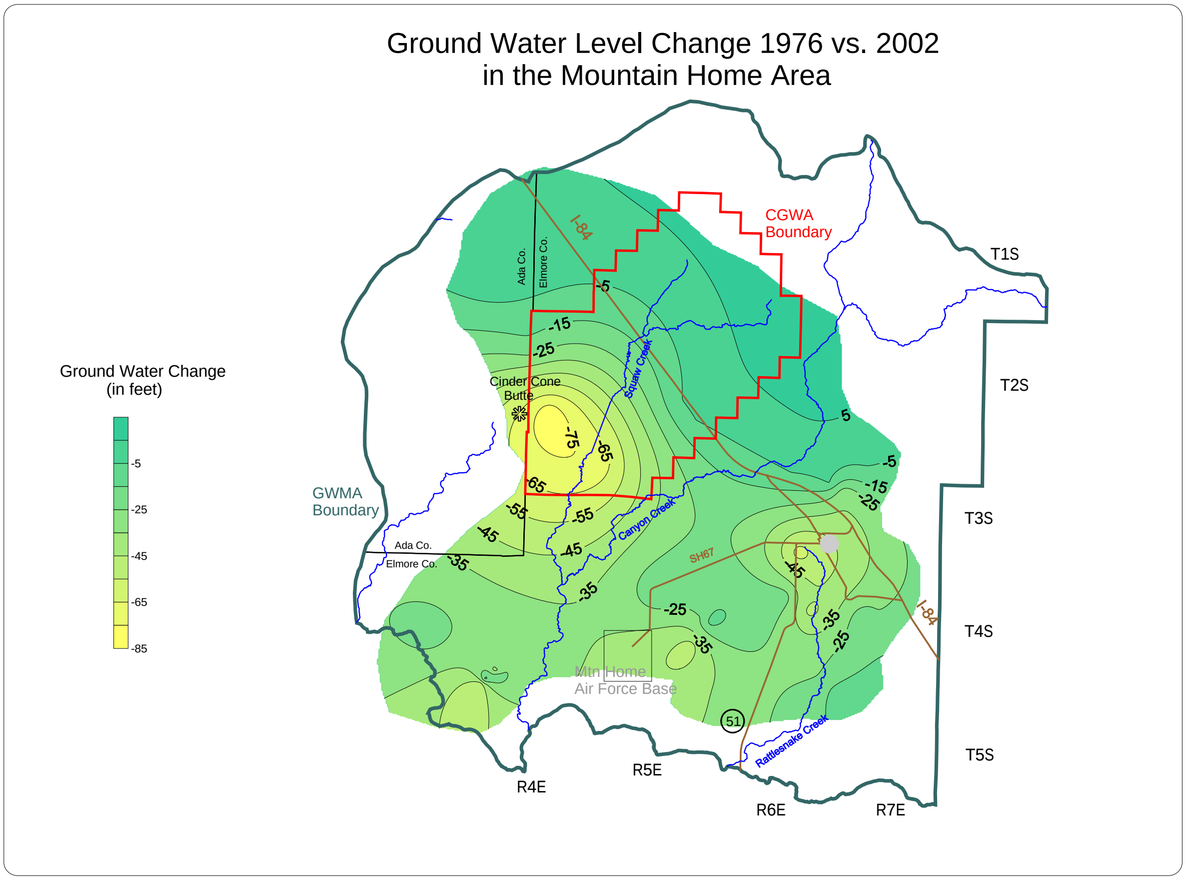


Figure 17. Groundwater-level declines in the Cinder Cone Butte and Mountain Home areas (Harrington, 2004).

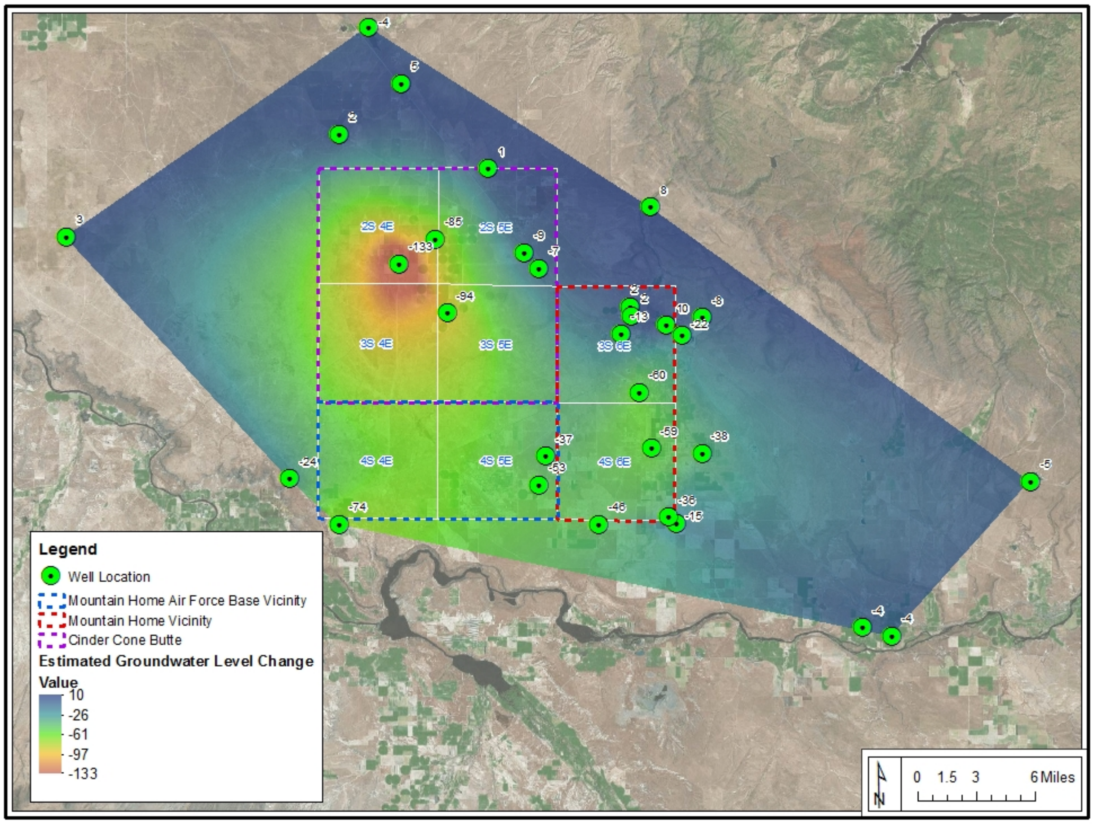


Figure 18. Interpolated groundwater-level change, feet (1970-1979 to 2000-2016)

Estimated Depletion Volumes and Pumping Deficits				
Subarea	**Townships**	**Approximate Area (acres)**	**Estimated Groundwater Depletion Volume[1] (AF)**	**Estimated Average Annual Pumping Deficit[2] (AF/yr)**
Cinder Cone Butte vicinity	2S4E, 2S5E, 3S4E, 3S5E	92,800	1,116,800	24,300
City of Mountain Home and vicinity	3S6E, 4S6E	46,100	319,800	7,000
MHAFB and vicinity	4S4E, 4S5E	46,500	547,300	11,900
Total		185,400	1,983,900	43,200

Notes:
(1) Total volume estimated for the period between 1970-1979 and 2000-2016.
(2) Based on the total deficit divided by the 46 years between 1970 and 2016.

Table 22. Estimate of groundwater volume depletion by subarea.

4. WATER-SUPPLY ALTERNATIVES

4.1. Introduction

This section describes potential surface-water and groundwater sources available for use within the Elmore County study area.[33] The surface-water sources closest to the study area (Figure 19) are the Snake River (next section) and Boise River (Section 4.3). In addition, appropriation of modest amounts groundwater may be available in some areas (Section 4.4). Surface-water sources that discharge to the Mountain Home Plateau, such as Indian Creek and Canyon Creek, are generally ephemeral and considered fully appropriated for all intents and purposes, although there may be limited potential for enhanced aquifer recharge during times of flood flows (Section 4.5).

4.2. Snake River

Water from the Snake River is potentially available by (1) obtaining new appropriations or (2) acquiring and transferring existing water rights. New appropriations from the Snake River are likely available under certain conditions, depending on river flows, the amount of water needed, the nature of use, and administrative constraints.

4.2.1. New Appropriations above Swan Falls Dam

IDWR administers diversions from the Snake River based on decreed hydropower and minimum streamflow rights at Swan Falls Dam.[34] These rights collectively provide for an "adjusted average daily flow" of 3,900 cfs from April 1 through October 31, and 5,600 cfs from November 1 through March 31 as measured at the Murphy Gaging Station (Figure 20).[35] The "adjusted average daily flow" accounts for fluctuations resulting from the operation of upstream Idaho Power Company facilities.

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[33] This section includes several general statements about physical and legal water availability, potential administrative constraints, and approaches for acquiring existing rights or developing new appropriations. Any actions to implement such measures should be based on thorough legal review and consultation.

[34] These rights include hydropower water rights 02-100, 02-2001A, 02-2001B, 02-2032A, 02-2032B, 02-2036, 02-2056, 02-2057, 02-2059, 02-2060, 02-2064, 02-2065, 02-4000A, 02-4000B, 02-4001A, 02-4001B, 02-10135, 36-2013, 36-2018, 36-2026, 37-2128, 37-2471, 37-2472, 37-20709, and 37-20710 and minimum streamflow water rights 02-201, 02-223 and 02-224.

[35] The Murphy Gaging Station, located 4.2 miles below Swan Falls Dam, is currently being replaced by a new gage located closer to Swan Falls Dam.

The adjusted average daily Snake River flows are generally above established minimum flows during most of the year (Figure 20). In recent years, the adjusted average daily flows have approached (and on 2 days, fallen below[36]) established minimum flows at the end of March and during times of peak summer irrigation (e.g., July).

Snake River flows in excess of 8,400 cfs (the maximum instantaneous diversion rate listed for Idaho Power water rights at Swan Falls Dam) are available for appropriation. Average historical Snake River flows exceed 8,400 cfs in all but summer months (Figure 20), although flows may remain less than 8,400 cfs for entire years during low-precipitation years.

In the context of water-right administration, Snake River flows greater than the Swan Falls established minimum flows, but less than the decreed water rights at Idaho power facilities (i.e., 8,400 cfs), is often referred to as “trust water.” Most water rights within the “trust area” (Figure 21) having priority dates senior to October 25, 1984 are considered trust-water rights, and are subject to administration (e.g., curtailment) if the adjusted average daily Snake River flow drops below establish minimum flows at Swan Falls Dam (as measured at the Murphy gage immediately downstream of the dam).

IDWR has the authority to grant new water rights authorizing diversions of trust water. According to IDWR,[37] applications proposing trust-water diversions are reviewed under Idaho Code § 42-203A and Idaho Code § 42-203C. Idaho Code § 42-203C requires a determination of whether or not the proposed use will “significantly reduce trust water availability.” A significant reduction is defined as a reduction in flow of 2 AF/day. If so, the application will be reviewed under the public-interest criteria in Idaho Code § 42-203C(2).

In general, applications for new, large-scale agricultural irrigation using trust water are presumed as not being in the public-interest,[38] and therefore would likely not be approved.[39] IDAPA 37.03.08.45.03k states:

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[36] The 3-day rolling average of the adjusted average daily flow was 5541 cfs on March 28, 2015 and 5563 cfs on March 29, 2015. Both of these flow values were below below the established minimum of 5,600 cfs.

[37] Jeff Peppersack, IDWR, *written communication*, October 21, 2016.

[38] *Ibid*.

[39] Although the 2012 Idaho State Water Plan (pg.57) does note that "development of *supplemental* water supplies to sustain existing agricultural development is in the public interest" (italics added).

Applications or permits to be reprocessed proposing a direct diversion of water for irrigation purposes from the Snake River between Milner Dam and Swan Falls Dam or from tributary springs in this reach are presumed not to be in the public interest as defined by Section 42-203C, Idaho Code. Such proposals, are presumed to prevent the full economic and multiple use of water in the Snake River Basin and to adversely affect hydropower availability and electrical energy rates in the state of Idaho.

The rule does not differentiate between primary and supplemental irrigation.

Applications for DCMI uses that exceed 2 AF/day would require "sufficient information for the Director to determine if the use is in the public interest."[40]

The 2012 State Water Plan seems to provide some support for the notion that appropriation of trust water for DCMI and supplemental irrigation are in the public interest. Specific policies include the following.

- Policy 4A (Snake River Minimum Stream Flows) states *"The main stem Snake River above Hells Canyon Dam will be managed to meet or exceed... minimum average daily flows…."* This policy supports new appropriations, provided that diversions can be immediately regulated or curtailed to protection minimum stream flow rights. Direct diversions from the Snake River are more easily controlled to protect minimum flows than distant groundwater diversions or diversions from tributary streams.
- Policy 4C states *"Water made available for reallocation to new uses in the Snake River trust water area pursuant to Idaho Code § 42-203B shall be allocated in accordance with criteria established by Idaho Code §§ 42-203A and 42-203C."* This policy supports the concept that appropriations can occur while protecting minimum flows.
- Policy 4D states *"The Eastern Snake Plain Aquifer and the Snake River below Milner Dam should be conjunctively managed to provide a sustainable water supply for all existing and future beneficial uses within and downstream of the ESPA."* Providing a Snake River water supply, when available, to supplement groundwater on to the Mountain Home Plateau, promotes conjunctive use of surface and groundwater supplies. Use of Snake River water can help sustain existing beneficial uses, achieve aquifer stabilization, provide a more sustainable overall water supply, and reduce conflict among water users.

[40] Jeff Peppersack, IDWR, *written communication*, October 21, 2016.

- Policy 4E states *"Development of new on-stream, off-stream, and aquifer storage is in the public interest; provided, however, applications for large surface storage projects in the Milner to Murphy reach of the Snake River should be required to mitigate for impacts on hydropower generation".* This policy supports appropriation of trust water for aquifer recharge purposes.
- Policy 4G states *"It is in the public interest to ensure the availability of water for future DCMI uses in the Snake River Basin".* This policy explicitly states that appropriation of water for municipal uses is in the public interest.
- Finally, Policy 4F states that *"Development of supplemental water supplies to sustain existing agricultural development is in the public interest."* This State Water Plan policy appears to support direct diversion of Snake River water for supplemental irrigation purposes. Lands currently irrigated with groundwater could be irrigated with new appropriations of Snake River trust water, at times when the Snake River flows exceed minimum streamflows.

Although the State Water Plan may provide some support for use of trust water, a finding that appropriation of trust water is in the public interest will be necessary to support a large-scale Snake River project for Elmore County aquifer stabilization and economic development. Determination that a new appropriation is in the public interest should consider (1) compliance with the State Water Plan, (2) impacts to other potential water uses, and (3) impacts to hydropower generation and utility rates. Factors that may favor a public interest finding might include (1) recently developed electrical generation projects utilizing solar and wind sources in the County that can offset losses in hydropower generation resulting from streamflow depletions, and (2) the economic benefits to citizens within the County that will result from maintaining an adequate water supply.

If approved, new appropriations of trust water would be subject to administration if the adjusted average daily Snake River flow drops below established minimum flows. A strategy for using trust water should have contingency plans for times during which the trust water may not be available. For example, a municipal supplier might plan to shift all diversions to groundwater (authorized by senior-priority groundwater rights) during times when surface water is not available. Alternatively, surface water might be used in an aquifer storage and recovery (ASR) strategy, in which surface water would be recovered from groundwater storage during times when Snake River water is not available.

A minimum Snake River streamflow at Weiser, Idaho[41] could also constrain diversions above Swan Falls Dam. Snake River flows at the Weiser gage are shown on Figure 22 for the period of 1970 to 2015. Since 1980, the average daily Snake River flow at Weiser, Idaho was below the minimum flow of 4,750 cfs on only 4 days (6/5/1992, 6/6/1992, 6/7/1992, and 6/25/1992). Upstream water rights with priority dates junior to 1976 could be curtailed if the Snake River flow at Weiser drops below 4,750 cfs, although, based on historical data, this would be a relatively infrequent and short-lived event. In general, the minimum flow at Swan Falls Dam will be a greater constraint for new appropriations in the Elmore County reach of the Snake River than the minimum flow at Weiser.

4.2.2. New Appropriations below Swan Falls Dam

Appropriation of water downstream of Swan Falls Dam does not have trust water restrictions; water is available for appropriation for all uses including irrigation. New appropriations are subject to the minimum stream flow at Weiser, but otherwise are unrestricted.

The distance from Swan Falls Dam to areas needing water limits the potential for utilizing this water source. A pipeline following a direct route would cross the Idaho National Guard Training and Maneuver Area, with a distance of approximately 25 miles to center of the Cinder Cone Butte irrigated area, and a distance of nearly 40 miles to Mountain Home. Thus, although water is available for appropriation, the pipeline distances to areas needing water are much greater than from locations on the Snake River upstream of Swan Falls Dam.

4.2.3. Existing Rights

The second option for using Snake River water would be to acquire and transfer existing Snake River water rights. The ideal acquisition target would be water rights with priority dates senior to October 25, 1984; these rights are not vulnerable curtailment.[42]

Most surface-water rights authorizing Snake River diversions are for agricultural irrigation. Use of such rights for irrigation purposes would require a transfer requesting a change in the authorized point of diversion (POD) and place of use (POU). Use of such rights for municipal purposes likely would also require a change

[41] Minimum streamflow water right 03-06, having a priority date of December 29, 1976, is held by the Idaho Water Resource Board.

[42] Some exceptions may apply.

in the nature of use. If a water right holder requests a change in the nature of use from agricultural irrigation to municipal uses, IDWR likely would require quantification of actual historical use, which could be used to help set a volume limit for the new DCMI uses under a transferred right.

Acquisition of existing rights is the strategy that the IWRB has taken to help supply water for the Mountain Home Air Force Base. In 2014 the IWRB acquired three Snake River water rights[43] from the J.R. Simplot Company that collectively authorize a maximum instantaneous diversion rate of 12.5 cfs (approximately 5,600 gpm) for irrigation on 625 acres under 1963 and 1965 priority dates. These priority dates are senior to minimum Snake River flows at Swan Falls Dam and Weiser, and therefore would not be curtailed based on these minimum streamflows.

The three Snake River IWRB-acquired water rights are currently limited to use only during the irrigation season. It is unlikely that IDWR will authorize a change in the season of use for a surface-water right from irrigation-season use to year-round[44]. As a result, water might need to be appropriated under a new water right permit for non-irrigation season use.

Costs for existing Snake River water rights are likely equivalent to costs for irrigated lands from the Snake River, minus non-irrigated land value and residual value of remaining improvements (e.g., irrigation system). As a result, it is unlikely to be economically practical to move Snake River rights to new land by drying up existing land, particularly after infrastructure costs for water delivery are considered. For cost estimation, purchase price for water rights from the Snake River are assumed to be approximately $1500/AF ($4500 per acre with a yield of 3 acre feet per acre); annualized costs are assumed to be approximately $75/AF.[45]

4.3. Boise River

A second potential surface-water source is the Boise River watershed, including the South Fork of the Boise River (and surface water tributary to the South Fork of the Boise River). By example, the Mountain Home Irrigation District already diverts water tributary to the Boise River basin from Little Camas Reservoir (water is conveyed from Little Camas Reservoir to Long Tom Creek, and then to Canyon Creek).

[43] The 3 water rights are 2-10300A, 2-10300B, and 2-10506.

[44] IDWR Administrator's Memorandum – Transfer Processing No. 24, December 21, 2009, Section 5d.(6)

[45] 40 years @ 4%

Water is available for appropriation from the lower Boise River in Canyon County during most of the year because the River gains flow from tributary streams, drains, and groundwater in this reach. Further upstream in Ada and Elmore counties, however, the river is considered to be fully appropriated on a year-round basis. As a result, except during periods of very high flow, the Boise River is closed to new appropriations upstream from the town of Star.[46] However, potential options for developing an increased supply from the Boise River drainage include appropriation of water during high flows in years of above average supply, increased surface storage, short-term rentals from the Boise River Rental Pool or Idaho Water Supply Bank, or acquisition of existing rights.

During the winter, sufficient water is released from Lucky Peak Reservoir to maintain a flow of approximately 240 cfs. Flows greater than approximately 400 cfs at Glenwood Bridge (Figure 19) between November 1 and February 29 are typically released only for flood-control purposes. Similarly, flows greater than approximately 1,500 cfs between March 1 and October 31 can be considered flood-control releases, unless "flow augmentation" water is being conveyed from Boise River basin reservoirs to the lower Snake River flow (below Hells Canyon) during times of anadromous fish migration.

4.3.1. Availability of High Flows for Appropriation

Water for new appropriations from the upper Boise River is typically only in priority during times of flood releases from the Boise River reservoir system. Boise River flood releases, while occasionally substantial, generally do not last for an extended period of time, nor do they occur every year. Flood releases with the duration of more than 30 days have occurred in 16 of the past 34 years; flood releases with the duration of more than 20 days of occurred in 20 of the past 34 years (Figure 23 and Table 23). No flood releases have occurred in 10 of the last 34 years. There were several multi-year periods in the last 34 years with no flood releases, such as 1987 through 1988, 1990 through 1992, and 2001 through 2005.

This flood-release analysis is cursory in nature, and is based on a number of simplifying assumptions. First, depending on water delivery requirements in the lower Boise River, some flows less than 1,500 cfs may represent flood releases. Second, a portion of the flows that appear to be flood releases may be water being conveyed by Idaho Power, anadromous fishery flow augmentation, or other special releases, and therefore not available for appropriation. Third, the resolution of current litigation may

[46] IDWR Amended Moratorium Order in the Matter of Applications for Permits for the Diversion and Use of Surface and Ground Water within the Boise River Drainage Area, dated May 3, 1995.

influence the availability of flood releases. Nonetheless, the point remains that – absent some form of increased storage – diversions of water from the South Fork of the Boise River drainage during times of lower Boise River flood releases would not be a consistent or highly reliable source of water.

4.3.2. Increased Storage

Increased storage, designed so as to capture high flows and store them for low-water years, could be used to bolster water supplies in the Elmore County study area. The Idaho Water Resource Board (IWRB), U.S. Army Corps of Engineers (USACE), and U.S. Bureau of Reclamation (USBR) have begun looking at options for increasing storage in the Boise River basin.

- An initial USACE assessment suggested that raising Arrowrock Dam was economically infeasible, but efforts to evaluate this option continue.
- USBR is contemplating a feasibility study to raise Anderson Dam by 6 feet to create an additional 29,000 AF of storage. A preliminary estimate of construction costs is $1,070/AF[47]. Based on a 40-year loan, with 4% interest, estimated annual costs for storage contracts would be approximately $54/AF. Adding required operation and maintenance costs, and considering that this junior-priority space would fill only 46% of the time given current hydrologic conditions and 68% of the time under 2080s Median Climate Change (USBR, 2016b), costs for stored water might be $100 to $160/AF. USBR is now contemplating an expanded study, which would include not only a 6-foot raise of Anderson Ranch Dam, but also increased storage opportunities at Lucky Peak and Arrowrock Dams.[48]

The IWRB has also discussed the possibility of constructing a new reservoir (such as Galloway Reservoir on the Weiser River). Some of the water storage in Galloway Reservoir could be used to supply flow-augmentation requirements in the lower Snake River, possibly freeing up currently "uncontracted" storage in Boise River reservoirs for other uses. The USBR holds 40,932 acre feet of uncontracted storage in the Boise system that is utilized for flow augmentation. USBR also uses an additional 20,000 acre feet of powerhead/inactive space in Anderson Ranch for flow augmentation (USBR, 2016a) that could potentially be made available.

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[47] Anderson Ranch Dam Raise Informational Meeting, May 10, 2016 powerpoint presentation

[48] USBR open letter regarding Review of Answers to Questions on the Anderson Ranch Dam Raise Feasibility Study, Arrowrock Division, Boise Project, Idaho, dated September 27, 2016.

If the flow augmentation program ends, uncontracted storage might become available for other uses, including new Elmore County diversions.

4.3.3. Leased Water

Leased water, consisting of either storage water through the Basin 63 rental pool or natural flow water rights through the IWRB water supply bank can be considered as a potential source of water supply.

Storage water is available on a year-to-year rental basis through the Basin 63 rental pool. The rental pool allows storage contract holders to share their water during years when they have adequate supplies. As a result, it is likely that the County could rent substantial volumes of storage water during good water years when users are willing to rent out water. Current rental cost is $17/AF. For discussion purposes, it might be assumed that at least a few thousand acre feet could be rented annually during good water years. Competition for rental pool water is more intense during low-water years, and it is possible that available rental volumes would be less than 1,000 AF during low-water years. Under current rental pool rules, any water that is leased for out-of-basin purposes becomes the last to fill in subsequent years, thus further reducing the reliability and availability of leased storage water.

Finally, natural flow water rights may be available for lease from the IWRB water supply bank. However, the volume of natural flow water right available for lease is typically a few hundred acre feet or less.

4.3.4. Acquisition of Existing Water Rights

It may be possible to acquire existing Boise River water rights, either natural flow or storage. However, the quantities of water rights available on the market has been minimal over the past two decades. Based on transactions involving private Boise River water rights in recent years, purchase prices are expected to be high, generally on the order of $1000 to $2000/AF (annualized cost of approximately $50 to $100 per year[49]). Annualized costs for canal company water shares (including both purchase price and annual assessments) are typically somewhat less, but canal companies generally prohibit transfer outside of existing service areas.

4.4. Groundwater

It may also be possible to appropriate modest amounts of groundwater in some areas. For example, portions of the Elmore County study area overlie aquifers with stable

[49] 40 years @ 4%

groundwater levels (Section 3.4). New groundwater development in these areas may be sufficient for local domestic, small commercial, and small DCMI uses. However, potential well interference, administration within groundwater management areas, and other constraints will likely limit broad increases in groundwater diversions. Furthermore, new, large, concentrated groundwater diversions may result in some of the same groundwater declines experienced in other portions of the study area.

4.5. Mountain Home Plateau Streams

Streams discharging onto the Mountain Home Plateau have very limited potential as additional water supply sources. These streams are fully appropriated during the irrigation season, and generally equipped with storage facilities to capture most non-irrigation season flows. Examples of streams with storage facilities include Indian Creek, Canyon/Rattlesnake Creek, and Bennett/Hot Springs Creek.

Although fully appropriated during the irrigation season, Canyon Creek and tributaries downstream from the MHID diversion to Mountain Home Reservoir will occasionally flow during periods of high runoff in the winter or spring. Although most of the flow in these streams infiltrates through the stream beds prior to reaching the Snake River, those flows that do reach the River are a lost opportunity for groundwater recharge. The amount of flow that reaches the river has not been quantified, but may be on the order of a few thousand acre feet during high runoff years. Capture of these “lost flows” might be accomplished through construction of check structures on the creeks to slow and spread runoff, and diversion of water to gravel existing gravel pits (located northwest of Mountain Home); some of these actions are already occurring. Additional options that have been identified include reconstruction of Fraser Reservoir and diversion of flows to the Crater Rings.

- Fraser Reservoir was formed by a low dam located on Canyon Creek between Cinder Cone Butte and Mountain Home AFB (Figure 24). The dam was apparently constructed in approximately 1916 had a reported capacity of 505 acre feet[50]. The dam was breached in the 1970s or 1980s. It is possible that the dam could be reconstructed as an aquifer recharge facility.

- The Crater Rings are located north of Canyon Creek, approximately midway between Cinder Cone Butte and the City of Mountain Home. The two pit craters were formed by collapse of the summit of a shield volcano. The

[50] Statutory water right claim 61-4144

craters are 200 to 250 feet deep, with a total surface area of approximately 200 acres. In combination, the two craters have a storage volume of more than 40,000 acre feet. The low points on the crater rims are at elevations 3150 feet and 3195 feet for the west and east craters, respectively. These elevations do not allow for gravity diversion from Canyon Creek in the near vicinity of the Crater Rings, so any water delivered for aquifer recharge or surface storage within the craters would need to be pumped. The Crater Rings are located on federal land and were designated National Natural Landmarks in 1980; this designation may restrict use of the crater rings for recharge or water storage.

4.6. Conservation

Although not a source of additional water supply, conservation is one means to reduce net groundwater use. Conservation can take many forms, and a full discussion is outside the scope of this study. However, a few observations are appropriate.

Increased efficiency is one form of conservation. To the extent that water use efficiency is increased, less water can be pumped for the same benefit. For agricultural irrigation within the study area, most groundwater use involves high pumping lifts with resultant high power costs. The power costs are already a powerful incentive to maximize efficiency, and most irrigation using groundwater sources is by efficient center-pivot sprinklers. As a result, opportunities for substantial improvements in efficiency for agricultural irrigation from groundwater sources may be limited.

There may be opportunities for increased efficiency of surface water use by MHID. Efficiency can be gained through piping or lining of canals and laterals; however, reduction of losses from delivery facilities within the study area reduces incidental groundwater recharge. Therefore, efficiency improvements to the gravity irrigation water delivery system within the Mountain Home area might not have a net benefit to the aquifer. Outside of the study area, lining of the MHID canal between Camas Reservoir and Long Tom Creek, within the Boise River basin, would have a net benefit to water use within the study area.

A switch to less water consumptive crops is another conservation method to reduce water use. However, such a change will likely result in decreased economic output by irrigators, as low consumption crops generally have lower value.

Conservation can be an effective means of reducing water use by municipal customers. Water use reductions can be achieved through use of water efficient plumbing fixtures and low-water use landscaping. Conservation can be achieved both by ordinance and by rates. A 15% decrease in water use through municipal conservation would reduce groundwater use by approximately 1000 acre feet annually within the study area.

4.7. Tables and Figures

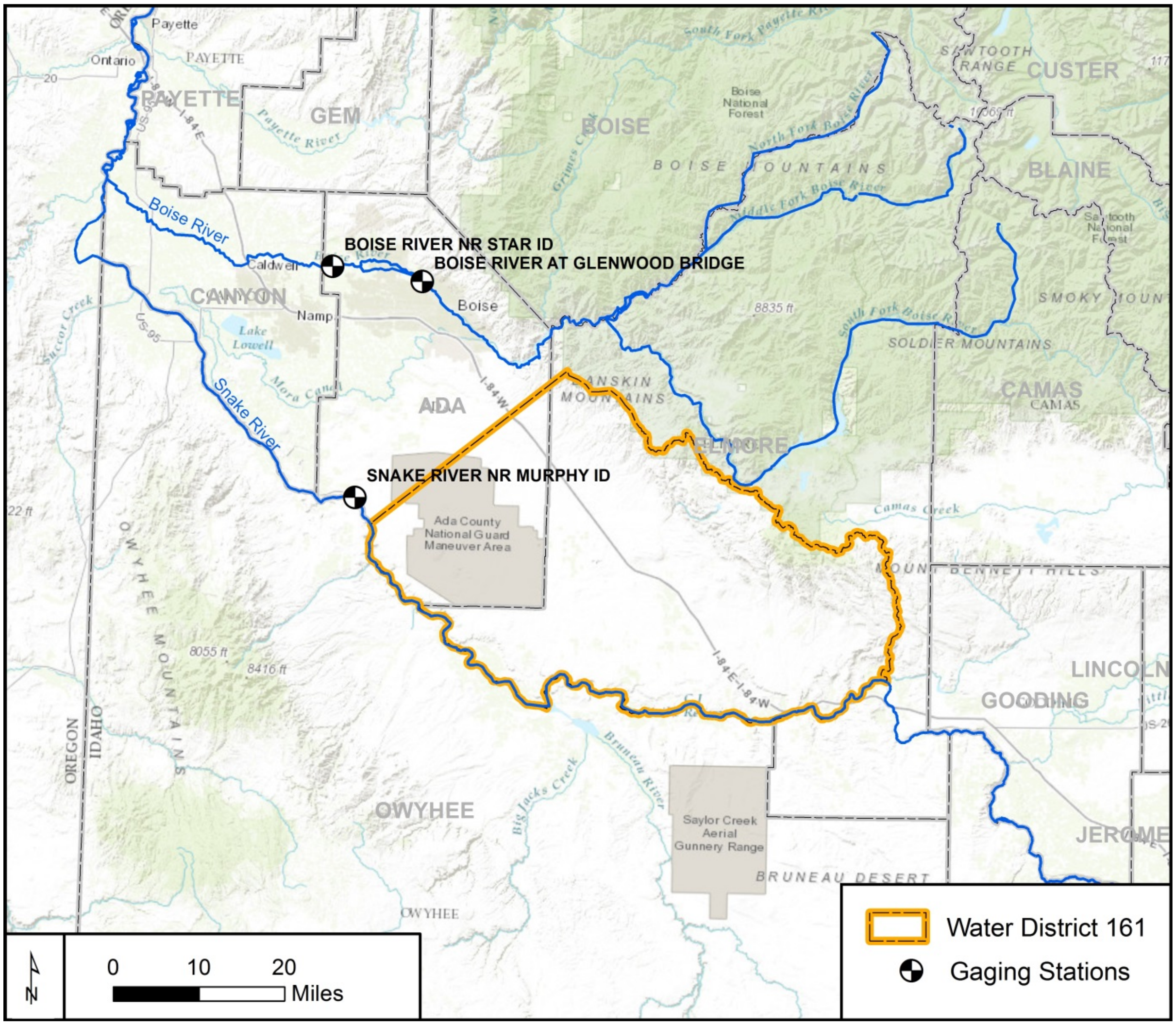


Figure 19. Project area and Boise and Snake Rivers.

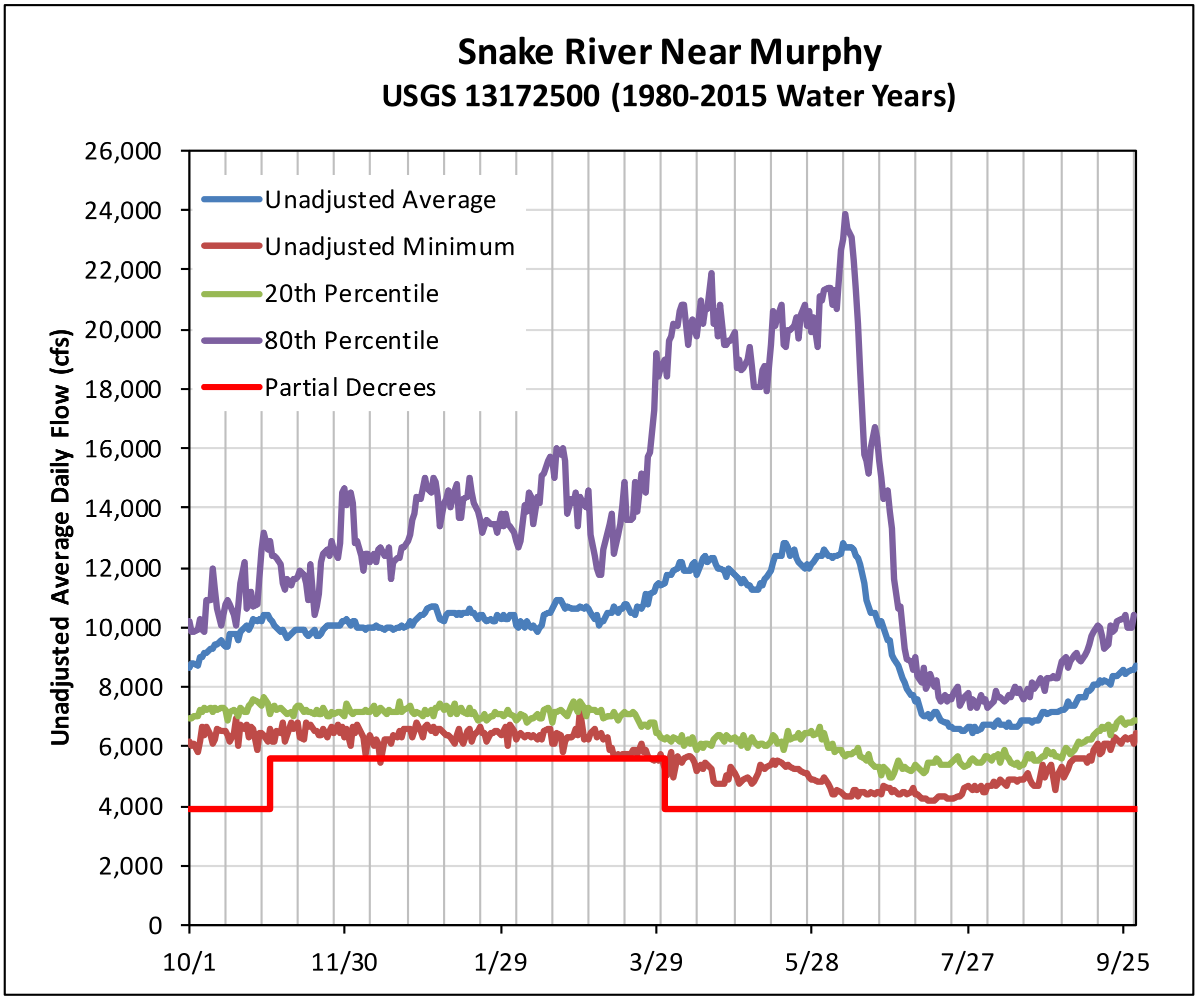
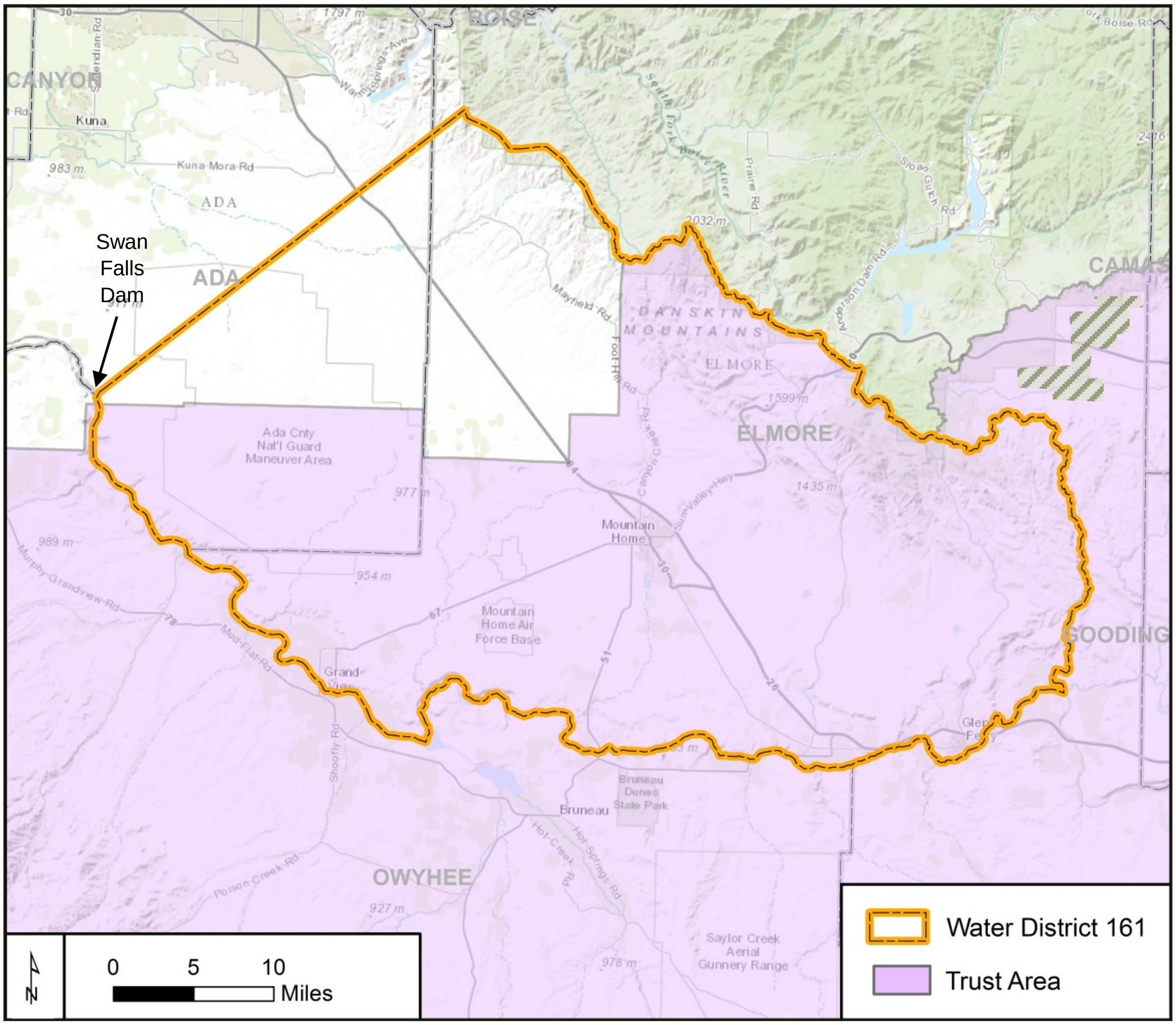


Figure 20. Snake River hydrograph.



Source: IDAPA 37.03.08.030 and IDWR GIS shapefiles.

Figure 21. Trust Area.

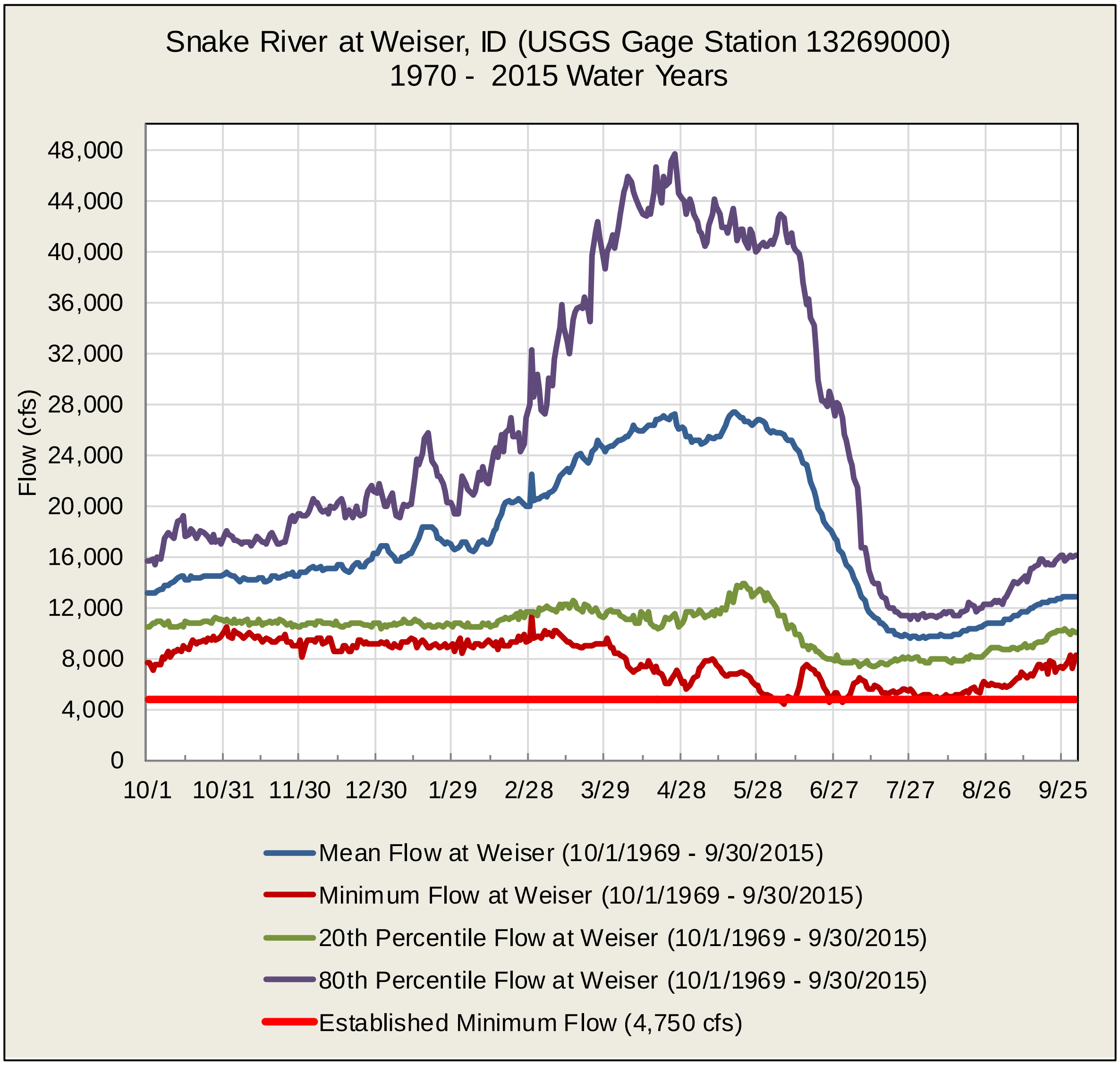


Figure 22. Snake River flows at Weiser, Idaho, WY 1970-2015.

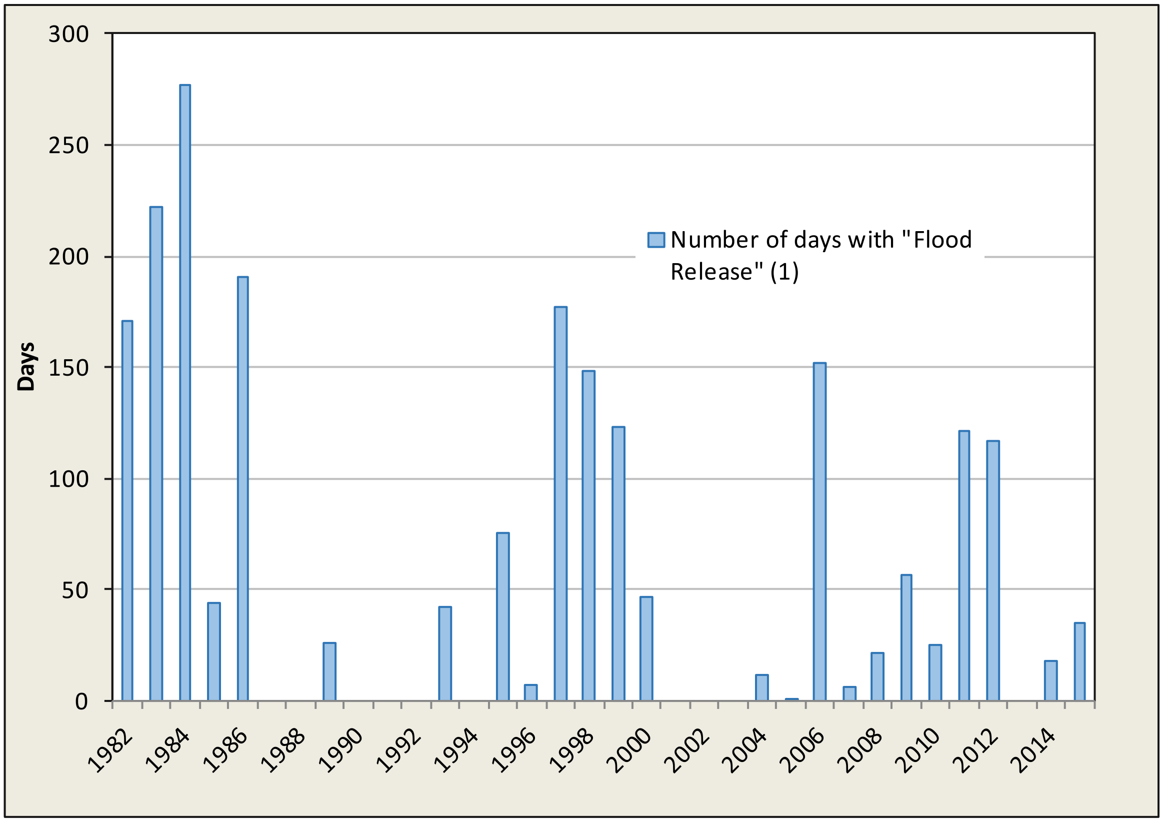
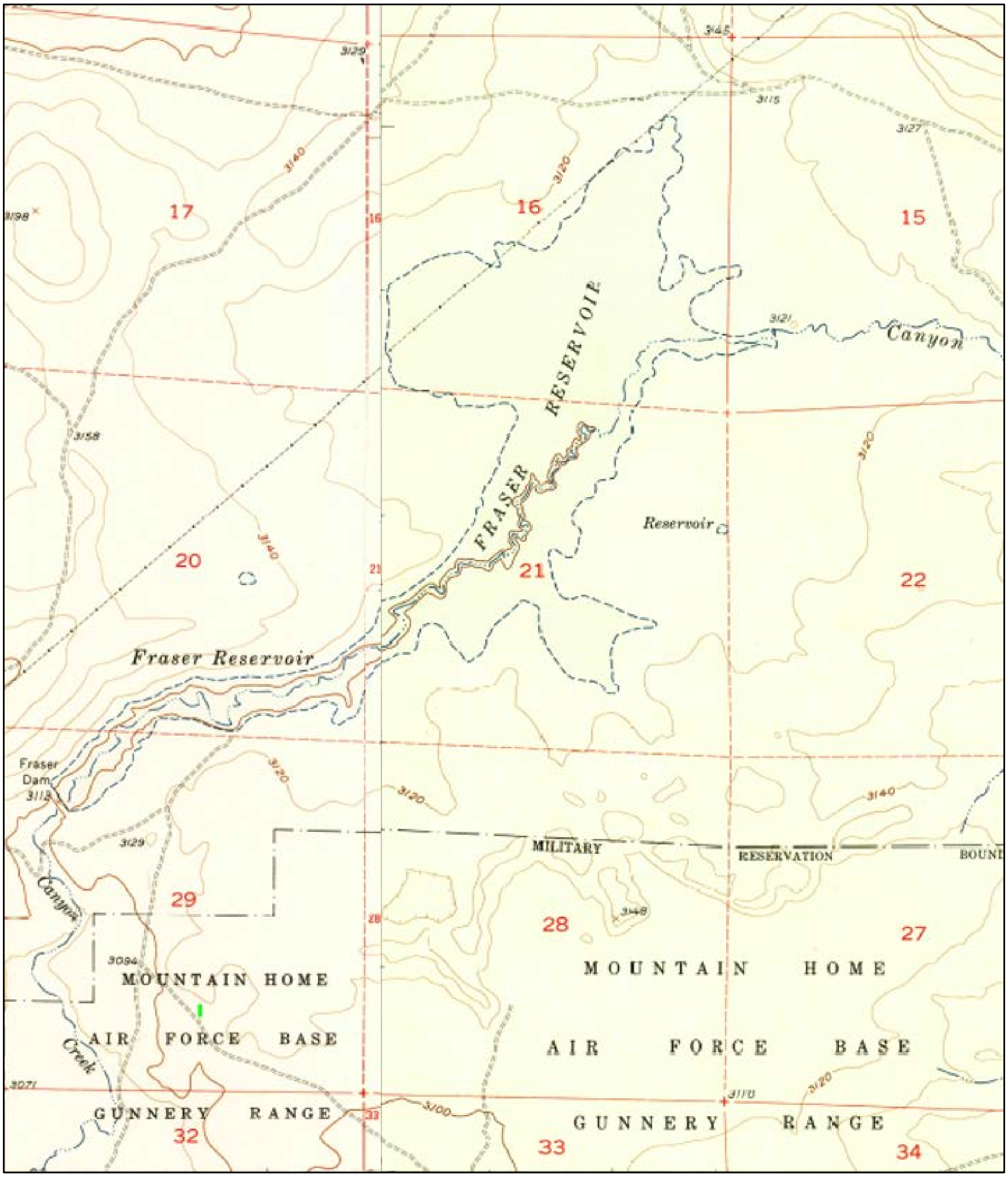


Figure 23. Approximate days of Boise River flood releases.

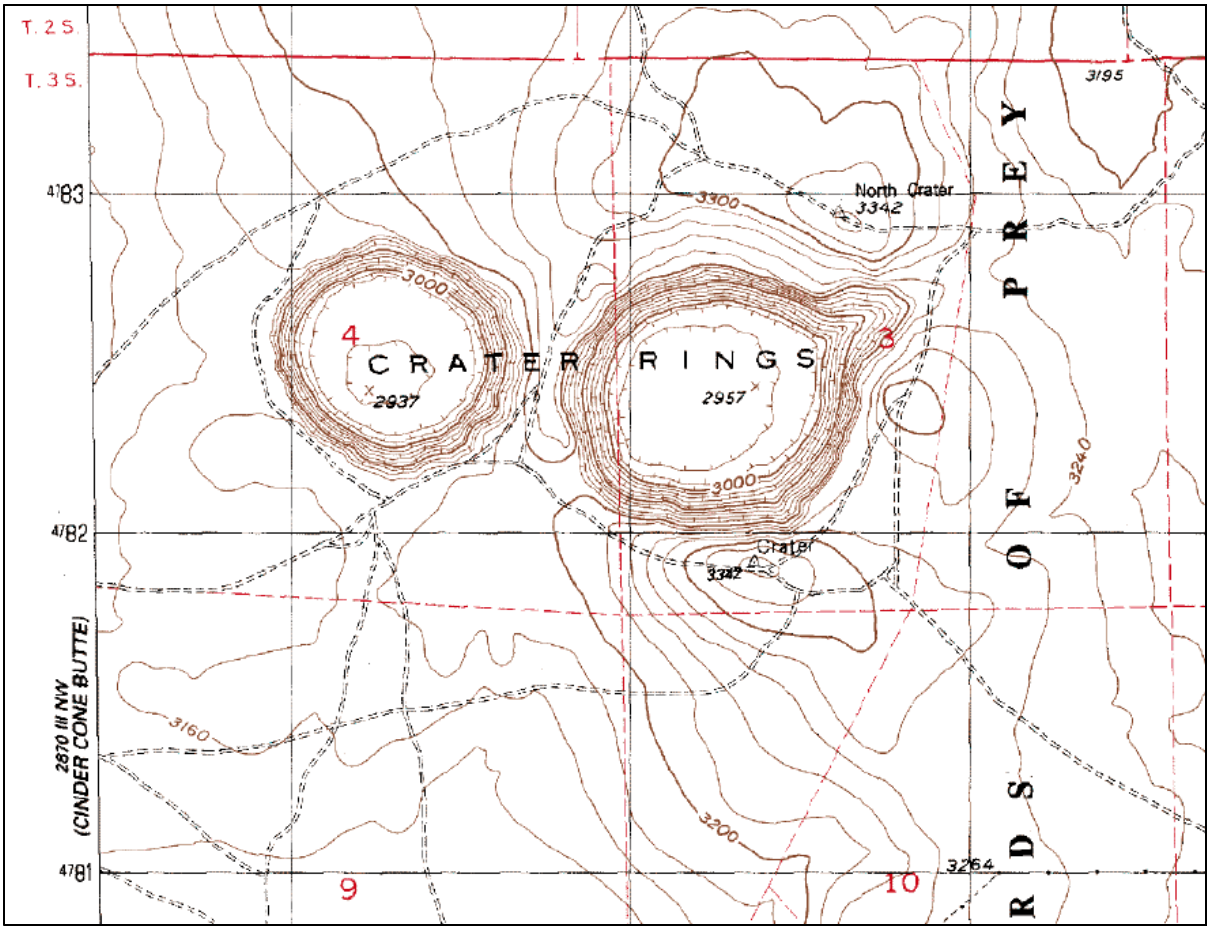
"Flood Release" Summary	
Year	Number of days with "Flood Release" (1)
1982	171
1983	222
1984	277
1985	44
1986	191
1987	
1988	
1989	26
1990	
1991	
1992	
1993	42
1994	
1995	76
1996	7
1997	177
1998	148
1999	123
2000	47
2001	
2002	
2003	
2004	12
2005	1
2006	152
2007	6
2008	22
2009	57
2010	25
2011	121
2012	117
2013	
2014	18
2015	35
(1) See text for explanation.	

Table 23. Approximate days of Boise River flood releases.



Source: 1956 USGS 1:24,000 Scale Maps - Cinder Cone Butte and Crater Rings

Figure 24. Extent of former Fraser Reservoir



Source: 1992 USGS 1:24,000 Scale Map - Crater Rings

Figure 25. Crater Rings

5. INFRASTRUCTURE REQUIREMENTS FOR INCREASED WATER SUPPLY

5.1. Introduction

Water from the Boise River drainage or Snake River could (1) replace current groundwater diversions (to reduce or eliminate deficit pumping) or (2) be used in an Aquifer Storage and Recovery (ASR) program to stabilize currently-declining groundwater levels. In each of these cases, importing water to the study area would involve a range of water conveyance infrastructures, including pump stations, pipelines, reservoirs, and open channels. This section presents thirteen water-supply alternatives that would deliver surface water from either the Boise River (Table 23) or the Snake River (Table 24) to the Elmore County study area.

The annual conveyance volumes contemplated in this analysis range from 10,000 to 25,000 acre feet per year, which are consistent with irrigation and recharge uses, but greater than anticipated municipal demands. These volumes are also consistent with estimated groundwater deficits within areas of the study area.

5.2. Preliminary Cost Opinions

The alternatives discussed below provide conceptual-level cost estimates for delivery of assumed volumes and rates from the Boise River and Snake River to various locations and uses within Elmore County, and are intended to provide a rough estimate of developing various options. The following should be noted.

Costs per acre foot delivered will

1. increase or decrease based on the annual volume delivered (per acre foot costs go down with increasing annual volume),
2. increase or decrease based on days of pumping (per acre foot costs go down with increasing days of operation),
3. increase or decrease based on capacity (per acre foot costs go down with increasing capacity).

The conceptual cost estimates are for the diversion and conveyance of raw water only; potential treatment to drinking water standards for municipal use was not evaluated. However, a portion of the water supplied under various alternatives could serve future municipal demands if desired, with appropriate treatment to meet regulatory standards. Alternatively, supplied water could be exchanged for groundwater currently being utilized for irrigation purposes, or supplied water could be recharged to the aquifer for later diversion from municipal wells.

Preliminary opinions of probable cost were developed at a conceptual level, or Class 5 as defined by the Association for the Advancement of Cost Engineering International (AACEI). The estimates were based on material quotes, actual costs of recently completed similar projects, and capacity factored parametric models. Cost estimates at this level have an expected accuracy range of -30% to +50%. The cost estimates were prepared following standard industry practice to provide a defensible basis for concept evaluation and planning decisions.

The cost opinions include costs for design, construction, operation, maintenance, and power.

- Power costs were derived from Idaho Power Company Schedule 19 secondary service for commercial and industrial users. An annual average power cost of $0.0553/KWH was used in all the cost opinions. Power costs during summer will be higher and power costs during non-summer will be lower than the average power cost. Other rate schedules may apply, that may raise or lower rates. Incentive programs, such as the irrigation peak rewards program, may also influence rates. Allowing for incentives and alternative rate schedules, actual energy cost might vary by up to 20% from the assumed $0.0553/KWH rate. Also, some Boise River alternatives may have potential for partial power cost offset through power regeneration; regeneration infrastructure costs and power benefits were not considered.
- Idaho State Sales Tax of 6% is included in line item estimates for all equipment and materials.
- Costs for land acquisition, easements, water rights, and legal work are not included in the estimates. Depending on the source, the costs to acquire water rights can be substantial, and may exceed the costs for pumping and infrastructure. As a result, the overall cost for water delivery must consider water acquisition in addition to construction and operation.

Table 26 summarizes the cost opinions for each alternative and provides the estimated unit cost of water in dollars per acre foot. Detailed opinions of probable cost are included in Appendix C.

5.3. Description of Boise River Infrastructure Alternatives

The Boise River system, including Anderson Ranch and Lucky Peak Reservoirs, could serve as a potential source of surface water supply for the Elmore County study area. Although the Boise River above Star is fully appropriated under normal conditions, limited water may be available during times of high flows (Section 4); Boise River water might also be obtained through purchase or lease of existing water rights or storage; or through creation of additional storage space. Five water supply alternatives were evaluated with supply from the Boise River as shown in **Error! Reference source not found.**.

The unit cost of water from the Boise River depends on the anticipated number of years in which water will be available, and the duration of water availability each year. For example, Boise River flows of 50 cfs authorized under a junior priority (i.e., new appropriation) right might be available for 90 days during 1 out of every 3 years. In contrast, increased storage (such as would be provided with a raise of Anderson Ranch Dam) would still be dependent on water that is currently released as flood flows, but reservoir storage allows for a longer season of use and carryover capacity could yield a more reliable water-supply source from year to year (although even water from storage may not be a completely reliable source during a prolonged multi-year drought period).

The nature of supply (i.e., natural flow or water from storage) influences the time during which Boise River water would be available. Junior-priority natural flow water is available primarily during the winter, spring, and early summer, and as such could be diverted for aquifer recharge or municipal purposes, but not used directly for late-summer irrigation. Water from storage, stored during winter, spring, and early summer high flows, could be used during the summer, and would thus be available for direct irrigation use, aquifer recharge, or municipal use (with treatment).

For the sake of initial comparisons, the unit cost of Boise River junior-priority natural flow water delivered in this analysis was based on assumed availability for 90 days per year every other year. The unit cost of water would be greater if this flow rate were available only every third year. However, the unit cost would be less if diversions exceed 90 days in the years during which Boise River junior-priority natural flow is available.

The unit cost of diverting and conveying stored water would be less if the water is consistently available from storage. However, the cost of constructing the storage (which is not included in this analysis) would raise the unit costs of water presented here.

The infrastructure to divert water from the Boise River may be smaller if designed to divert stored water over 180 days instead of, for example, diverting for 90 days during times of high flows. This reduces the initial capital costs (because pumping and conveyance infrastructure is smaller), but power costs would remain the same for a given volume.

5.3.1. Alternative B1 – Anderson Ranch Reservoir to Little Camas Reservoir

Alternative B1 contemplates a water supply system pumping from Anderson Ranch Reservoir to Little Camas Reservoir, which in turn supplies the Mountain Home Irrigation District (MHID) conveyance system (Figure 26). Water pumped to Little Camas Reservoir would be conveyed via existing canals and creeks to Mountain

Home Reservoir for irrigation supply or possibly to Canyon Creek for potential aquifer recharge. A portion of the water could also be used for DCMI purposes, potentially in or near the City of Mountain Home, with appropriate treatment.

Infrastructure required for Alternative B1 includes a high-lift pump station on Anderson Ranch Reservoir and a 2.3-mile pipeline to Little Camas Reservoir. The pump station would be constructed to draw supply from a range of water surface elevations to accommodate water-level fluctuations in the reservoir. However, because junior-priority water would likely not be available during dry years, it might not be necessary to provide the ability to pump from the lowest reservoir water surface elevations. Alternatively, diversions of water from carry-over storage may require pumping from low reservoir levels.

Conceptual facilities are sized to deliver 10,000 AF over a 90-day period to take advantage of junior-priority water availability, resulting in a capacity of 56 cfs (25,000 gpm). Total dynamic head for the pumping station, including both lift and friction headloss in the pipeline, is 810 feet, and the total power requirement is approximately 6,500 hp.

A conceptual cost estimate including costs for construction, operation, and maintenance is provided in Appendix C. The capital cost for this alternative is estimated to be approximately $6.5 million, and operation and maintenance costs are estimated to be about $600,000 per year. The unit cost of water is estimated to be about $93/AF if water is available every year. If, however, water supply is available 50% of the years, the average cost would increase by approximately 45%, and the average annual delivery volume would be 5,000 AF. Note that if water were available 180 days every year, the unit cost of water would fall to $68/AF, and the annual delivery volume would increase to 20,000 AF.

The costs above assume adequate downstream conveyance capacity for this water from Little Camas Reservoir. Such conveyance capacity may not be available for the entire potential pumping period during water years when junior-priority water is available, as the Camas Reservoir system may fill during such years, so that canal conveyance capacity would be fully utilized by existing sources at times when Little Camas Reservoir is spilling. However, to the extent that storage capacity can be carried over in Little Camas Reservoir, there could be benefits to pumping available Boise River water.

5.3.2. Alternative B2 – South Fork Boise River to MHID Canal

Under Alternative B2, water could be delivered from the South Fork Boise River with an intake located approximately 3.5 river miles downstream of Anderson Ranch Dam as shown in Figure 27. Water would be pumped via pipeline to the MHID canal upstream of the existing tunnel. From this point, water would be conveyed via existing canals and creeks to Mountain Home Reservoir for irrigation supply or to Canyon

Creek for potential aquifer recharge, similar to Alternative B1. A portion of the water could also be used for municipal purposes, potentially in or near the City of Mountain Home.

Infrastructure required for Alternative B2 includes a river intake and pump station on the South Fork Boise River and a 3,500-linear foot (0.7-mile) pipeline to the MHID canal that delivers Little Camas Reservoir water to the Long Tom Creek drainage. Conceptual facilities are sized to deliver 10,000 acre feet over a 90-day period to take advantage of junior-priority water availability, resulting in a capacity of 56 cfs (25,000 gpm). Total dynamic head for the pumping station, including both lift and headloss, is estimated to be 1,030 feet, and the total power requirement is approximately 8,200 hp. Note that if there were insufficient capacity in the existing tunnel, the water could be conveyed over the top of the ridge above the tunnel, which would increase the lift by 50 feet, the horsepower by 400 hp, and the pipeline length by approximately 1500 feet.

A conceptual cost estimate including costs for construction, operation, and maintenance is provided in Appendix C. The capital cost is estimated to be approximately $5.7 million, and operation and maintenance costs are estimated to be about $580,000 per year. Costs assume adequate capacity to convey the water through the existing tunnel and downstream through the MHID delivery system. Costs to upgrade the tunnel capacity, or to increase the horsepower if the tunnel were bypassed, would be additional. The unit cost of water is estimated to be about $87/AF, assuming water supply is available every year. If water is only available 50% of the time, the average cost would increase by approximately 57%, and average annual delivery volume would be 5,000 AF. If water were available 180 days every year, the unit cost of water would fall to $80/AF, and the annual delivery volume would increase to 20,000 AF.

5.3.3. Alternative B3 – Cat Creek Reservoir to Little Camas Reservoir

Alternative B3 involves a proposed pumped-storage energy project that would use Anderson Ranch Reservoir as a source of supply. The proposed Cat Creek Energy project consists of pumping water from Anderson Ranch Reservoir to a new reservoir at Cat Creek. Hydropower would be generated by water flowing back to Anderson Ranch Reservoir when desired.

If the Cat Creek Energy project were to move forward, it might be possible to use the infrastructure to also deliver water to Little Camas Reservoir. Water would be pumped from the proposed Cat Creek Reservoir to Little Camas Reservoir via a 1.6-mile pipeline and low-lift pump station (Figure 28). Alternatively, water could be pumped to Little Camas Reservoir directly using the proposed Anderson Ranch pump station and a longer pipeline, although this would preclude pumping to Little Camas Reservoir when the energy project was either pumping for themselves or generating power. For simplicity, this evaluation includes a low lift pump station at Cat Creek Reservoir and the shorter pipeline.

Conceptual facilities were sized to deliver 10,000 acre feet over a 90-day period to take advantage of junior-priority water availability, resulting in a capacity of 56 cfs (25,000 gpm). Total dynamic head, including both lift from Anderson Ranch Reservoir to Cat Creek Reservoir, lift from Cat Creek Reservoir to Little Camas Reservoir, and headloss, is estimated to be 860 feet, and the total power requirement is approximately 7,300 hp.

A conceptual cost estimate including costs for construction, operation, and maintenance is provided in Appendix C. Capital cost is estimated to be $9.0 million, including assumed costs for a proportionate share of the pumped-storage infrastructure. Operation and maintenance costs are estimated to be $710,000 per year. The unit cost of water is estimated to be $116/AF, assuming a full annual volume of 10,000 AF is available every year. If water is available 50% of the time, the unit cost would increase by approximately 49%, and average annual delivery volume would be 5,000 AF. If water were available 180 days every year, the unit cost of water would fall to $81/AF, and the annual delivery volume would increase to 20,000 AF.

5.3.4. Alternative B4 – South Fork Boise River via Long Tom Tunnel

During the 1950s and 1960s, the U.S. Bureau of Reclamation contemplated a water supply project from the South Fork Boise River to East Fork Long Tom Creek via tunnel under the Danskin Mountains divide (Figure 29). Alternative B4 adopts this concept with an intake located approximately 4.8 river miles downstream of Anderson Ranch Dam.

Water would be pumped to a 2,000 LF tunnel at an elevation of approximately 4,860. After the tunnel, water would be conveyed another 0.8 miles via pipeline to East Fork Long Tom Creek. From this point, water would be conveyed via existing canals and creeks to Mountain Home Reservoir for irrigation supply or to Canyon Creek for potential aquifer recharge, similar to Alternative B1. A portion of the water could also be used for municipal purposes, potentially in or near the City of Mountain Home, with appropriate treatment.

Infrastructure required for Alternative B4 includes a river intake and pump station on the South Fork Boise River, 2,400 LF pipeline to the tunnel, 2,000 LF tunnel, and 4,200 LF pipeline to East Fork Long Tom Creek. Conceptual facilities are sized to deliver 10,000 acre feet over a 90-day period to take advantage of junior-priority water availability, resulting in a capacity of 56 cfs (25,000 gpm). Total dynamic head for the pumping station, including lift and headloss, is estimated to be 1,060 feet, and the total power requirement is approximately 8,400 hp.

A conceptual cost estimate including costs for construction, operation, and maintenance is provided in Appendix C. Capital cost is estimated to be $13.3 million, and operation and maintenance costs are estimated to be $880,000 per year. The unit cost of water is estimated to be $155/AF, assuming a full 10,000 AF is available every year. If water supply was available 50% of the time, the unit cost would increase by approximately 56%, and the average annual delivery volume would be 5,000 AF. If water were available 180 days every year, the unit cost of water would fall to $101/AF, and the annual delivery volume would increase to 20,000 AF.

5.3.5. Alternative B5 – Lucky Peak Reservoir to Cinder Cone Butte Area

Alternative B5 would involve pumping water from Lucky Peak Reservoir and conveying it via pipeline to the Cinder Cone Butte area (Figure 30). Water could be used for irrigation and/or aquifer recharge.

Infrastructure required for Alternative B5 includes a pump station at Lucky Peak Reservoir and a 27-mile pipeline. The pump station would be constructed to draw supply from a range of water surface elevations to accommodate water-level fluctuation in the reservoir. However, because water might not be available during dry years, it might not be necessary to provide the ability to pump from the lowest water surface elevations.

Conceptual facilities are sized to deliver 25,000 acre feet over a 180-day period, resulting in a capacity of 70 cfs (31,400 gpm). Total dynamic head for the pumping station, including both lift and headloss, is estimated to be 580 feet, and the total power requirement is approximately 5,800 hp.

Elevations along the proposed pipeline alignment generally increase to a high point of 3,460 feet above mean sea level at 13.3 miles, and then decrease gradually to 3,090 feet at 27 miles. This portion of the pipeline could potentially be used for hydropower generation, which could reduce operating costs. However, analysis of hydropower generation is not included in the scope of this evaluation.

A conceptual cost estimate including costs for construction, operation, and maintenance is provided in Appendix C. Capital cost is estimated to be $57 million, and operation and maintenance costs are estimated to be $2.0 million per year. The unit cost of water is estimated to be $195/AF, assuming water supply is available every year. If water were available 50% of the time, the average unit cost of water would increase by approximately 80%, and the average annual delivery volume would be 12,500 AF. If water were available every year for 180 days, the unit cost of water would fall to $122/AF, and the average annual delivery volume would be 25,000 AF.

5.4. Description of Snake River Infrastructure Alternatives

The Snake River runs along the southern boundary of the Elmore County study area and could serve as a potential source of additional water supply. Although water rights are along this stretch are constrained, water could potentially be available as described in Section 4. Eight water supply alternatives were evaluated using supply from the Snake River as shown in **Error! Reference source not found.**.

5.4.1. Alternative S1 – Mountain Home AFB to City of Mountain Home

The Idaho Water Resource Board is developing a water supply project to deliver Snake River water to the Mountain Home Air Force Base (MHAFB). As part of the project, the Board has reached out to outside parties that may be interested in participating in the project, including Elmore County and the City of Mountain Home. Participants would be expected to pay a proportionate share of infrastructure costs.

Either raw water or treated water could be delivered from MHAFB to the City or outlying areas as part of the project. For this evaluation, delivery of raw water to the City was evaluated. The City could use raw water for irrigation or recharge, or treat the water to drinking water standards for potable supply.

Infrastructure required for Alternative S1 includes a pump station at MHAFB and 9-mile pipeline (Figure 31). In addition, the capacity of the river intake pump station and pipeline to deliver Snake River water to MHAFB would need to be increased from 9.3 cfs to 23 cfs.

Conceptual facilities are sized to deliver 10,000 acre feet over a 365-day period, resulting in a capacity of 13.8 cfs (6,200 gpm). Total dynamic head for the intake pump station is either 730 feet or 800 feet, depending upon the intake location selected, and total dynamic head to pump water from MHAFB to the City is approximately 270 feet. The total combined power requirement is approximately 2,100 hp.

A conceptual cost estimate including costs for construction, operation, and maintenance is provided in Appendix C. Capital cost is estimated to be $13.6 million including approximately $9.3 million for a proportionate share of the intake pump station and pipeline from C.J. Strike Reservoir to MHAFB (approximately 60% of $15 million). These facilities would be constructed to municipal standards and the capital cost estimate reflects the higher standard. Operation and maintenance costs are estimated to be $1.0 million per year. The unit cost of water is estimated to be $171/AF, assuming water is delivered at capacity 100% of the time.

5.4.2. Alternative S2 – South Elmore County Irrigation Company Reservoir to Canyon Creek

Alternative S2 would involve pumping water from an existing reservoir in South Elmore County and conveying it via pipeline to Canyon Creek north of the City of Mountain Home (Figure 32). Water could be used for aquifer recharge along Canyon Creek or could be delivered to Mountain Home Reservoir for irrigation supply. In addition, a portion of the water could be treated to drinking water standards for potable supply.

The concept behind this alternative is to use an existing Snake River pump station to deliver water to the South Elmore Irrigation Company (SEIC) reservoir, primarily during the non-irrigation season. New infrastructure would include a pump station at the reservoir and a 16.7-mile pipeline to Canyon Creek.

Conceptual facilities are sized to deliver 10,000 acre feet over a 180-day period, resulting in a capacity of 28 cfs (12,600 gpm). Total dynamic head for the pumping station, including both lift and headloss, is 470 feet, and the total power requirement is approximately 1,900 hp. In addition, the existing Snake River pump station has a total dynamic head of approximately 485 feet, resulting in a combined TDH of approximately 955 feet. The total combined power for the two pump stations would be approximately 3,800 hp.

A conceptual cost estimate including costs for construction, operation, and maintenance is provided in Appendix C. Capital cost is estimated to be $24.5 million, and operation and maintenance costs are estimated to be $1.7 million per year. The SEIC would need to be compensated for delivering water to the reservoir. This cost is estimated at twice the power cost, or approximately $50/AF, to account for both power, maintenance, and facilities. The total unit cost of water is estimated to be $290/AF, assuming delivery of 10,000 AF per year during the non-irrigation season.

5.4.3. Alternative S3 – Bennett Creek to Mountain Home Reservoir

Five existing reservoirs currently impound water from Bennett Creek in eastern Elmore County. Water could be pumped from the Snake River to augment Bennett Creek supplies. In turn, water could be pumped from Bennett Creek to Mountain Home Reservoir (Figure 33).

Conceptual facilities are sized to deliver 10,000 acre feet over a 90-day period, resulting in a capacity of 56 cfs (25,000 gpm). The pipeline alignment is 13.3 miles long, and pipe diameter would be 48 inch. Total dynamic head for the pumping station from Bennett Creek Reservoir to Mountain Home Reservoir, including both lift and headloss, is 270 feet, and the total power requirement is approximately 2,000 hp. In addition, a Snake River pump station pumping to Bennett Creek would have a total dynamic head of approximately 720 feet, resulting in a combined TDH of approximately 990 feet. The total combined power for the two pump stations would be approximately 8,000 hp.

A conceptual cost estimate including costs for construction, operation, and maintenance is provided in Appendix C. Capital cost is estimated to be $18.1 million, and operation and maintenance costs are estimated to be $1.6 million per year. Capital costs could potentially be shared with Bennett Creek Reservoir water users. The unit cost of water is estimated to be $249/AF, based on delivery of 10,000 AF per year.

5.4.4. Alternative S4 – Snake River to Mountain Home Reservoir

Alternative S4 would involve pumping water from the Snake River at River Mile 517 via pipeline to Mountain Home Reservoir as shown in Figure 34. Water could be used for irrigation and/or aquifer recharge. In addition, a portion of the water could be treated to drinking water standards for municipal supply.

Conceptual facilities are sized to deliver 10,000 acre feet over a 180-day period, resulting in a capacity of 28 cfs (12,600 gpm). The pipeline alignment is 15.7 miles long, and pipe diameter would be 36 inch. Total dynamic head for the pumping station, including both lift and headloss, is 940 feet, and the total power requirement is approximately 940 hp.

A conceptual cost estimate including costs for construction, operation, and maintenance is provided in Appendix C. Capital cost is estimated to be $28.4 million, and operation and maintenance costs are estimated to be $1.2 million per year. The unit cost of water is estimated to be $267/AF, assuming delivery of 10,000 AF per year. Diversions over a longer time period (assuming winter groundwater recharge) could serve to reduce this estimated unit cost of delivered water.

5.4.5. Alternative S4B – Snake River to Mountain Home and Areas South

A permutation of alternative S4 would be to supply existing groundwater users east of MHAFB, on either side of Highway 51, with pressurized irrigation water from the pipeline extending to Mountain Reservoir (Figure 35). For example, the pipeline could branch to the west at Beet Dump Road to supply 28 cfs of Snake River water to the currently groundwater-irrigated area east of MHAFB (on both sides of Highway 51) during the irrigation season when MHID water supplies are adequate. When MHID supplies are inadequate, the groundwater users could revert to well water and the Snake River water could be used as a supplemental source for MHID. Water could be delivered directly to the MHID canal(s) on the south side of Mountain Home, or boosted to Mountain Home Reservoir. During the non-irrigation season, the water could be used for recharge purposes. Year-round, the water could be treated and used for municipal or industrial purposes. This plan would maximize the use of the pumping and pipeline capacity, and conjunctively use surface water and groundwater supplies for the greatest potential benefit. Year-round pumping at 28 cfs would deliver 20,000 acre feet annually.

A cost estimate for this alternative S4B is provided in Appendix C. The estimated unit cost for water under this scenario is $131/AF, assuming delivery of 20,000 AF per year.

5.4.6. Alternative S5 –CJ Strike Reservoir to Cinder Cone Butte Area

Snake River water could be pumped from CJ Strike Reservoir to the Cinder Cone Butte area for irrigation and/or aquifer recharge (Figure 36.). Conceptual facilities are sized to deliver 25,000 acre feet over a 180-day period, resulting in a capacity of 70 cfs (31,400 gpm). The pipeline alignment is 15 miles long, and pipe diameter would be 48 inches. Total dynamic head for the pumping station, including both lift and headloss, is 825 feet, and the total power requirement is approximately 8,200 hp.

A conceptual cost estimate including costs for construction, operation, and maintenance is provided in Appendix C. Capital cost is estimated to be $25.8 million, and operation and maintenance costs are estimated to be $2.0 million per year. The unit cost of water is estimated to be $131/AF, assuming delivery of 25,000 AF per year. Diversions over a longer time period (such as winter diversions authorized under new appropriations) could serve to reduce this estimated unit cost of delivered water.

5.4.7. Alternative S6 – Snake River to Irrigation East of MHAFB

Under Alternative S6, Snake River water would be pumped to south Elmore County, east of MHAFB for irrigation as shown in . This area includes several dairies, and current irrigation is predominately supplied by ground water. There are approximately 5000 acres of groundwater irrigated lands in this vicinity

Conceptual facilities are sized to deliver 10,000 acre feet over a 180-day period, resulting in a capacity of 28 cfs (12,600 gpm). The pipeline alignment is 5.0 miles long, and pipe diameter would be 36 inches. The pipeline ends at the intersection of Beet Dump Road and Highway 51. From the end of the pipeline, water could be distributed to irrigated lands by a combination of pipe and open canals. The water would need to be boosted for use in sprinkler irrigation systems. Total dynamic head for the pumping station, including both lift and headloss, is 625 feet, and the total power requirement is approximately 2,500 hp.

A conceptual cost estimate including costs for construction, operation, and maintenance is provided in Appendix C. Capital cost is estimated to be $6.4 million, and operation and maintenance costs are estimated to be $570,000 per year. The unit cost of water is estimated to be $90/AF, assuming delivery of 10,000 AF per year. The distribution system and booster pumping costs are not included in the conceptual cost estimate.

5.4.8. Alternative S7 – Snake River Below Swan Falls to Cinder Cone Butte Area

Snake River water from below Swan Falls Dam could be pumped to the Cinder Cone Butte area for irrigation and/or aquifer recharge (Figure 37). Diversion from below Swan Falls Dam might be considered in the event that trust water from upstream of Swan Falls Dam could not be appropriated. Conceptual facilities are sized to deliver 25,000 acre feet over a 180-day period, resulting in a capacity of 70 cfs (31,400 gpm). The pipeline alignment is 25 miles long, and pipe diameter would be 48 inches. Total dynamic head for the pumping station, including both lift and headloss, is 1185 feet, and the total power requirement is approximately 11,750 hp.

A conceptual cost estimate including costs for construction, operation, and maintenance is provided in Appendix C. Capital cost is estimated to be $47 million, and operation and maintenance costs are estimated to be $3.0 million per year. The unit cost of water is estimated to be $217/AF, assuming delivery of 25,000 AF per year. Diversions over a longer time period could serve to reduce this estimated unit cost of delivered water.

5.5. Operational and Administrative Considerations

5.5.1. Goal of Water Supply Importation Projects

The primary goal of a water supply importation project from the Snake River or Boise River is to stabilize aquifer water levels in areas of water-level decline. A secondary goal of water importation is to provide water supply for expanded domestic, commercial, municipal, and industrial growth; in some cases, new agricultural irrigation may also be possible.

5.5.2. Aquifer Stabilization Efforts

Aquifer stabilization will provide the following benefits:

1. Prevent curtailment of existing groundwater rights due to water-level decline,
2. Reduce costly well deepening or well replacement necessary to maintain groundwater diversions,
3. Stabilize pumping water levels and associated pumping costs,
4. Increase water-supply certainty, which improves land value and promotes future investment,
5. Maintain economic benefit of existing groundwater-supplied irrigated lands and businesses.

Aquifer stabilization can be achieved by reducing the net use of groundwater from a declining aquifer. Net groundwater use can be reduced by either increasing groundwater recharge or by reducing groundwater pumping. Groundwater pumping can be reduced by directly using imported water for a use that was formerly supplied from groundwater.

5.5.3. Aquifer Recharge and Direct Use of Imported Groundwater

Both aquifer recharge and reduced groundwater pumping provide benefits, and the choice of which action is appropriate depends on a number of factors including (1) seasonal availability of water supply, (2) costs of aquifer recharge and subsequent groundwater diversion, (3) measurement and apportionment of costs and benefits, and (4) regulatory constraints. These factors are discussed briefly below.

5.5.3.1. Seasonal Availability of Imported Water Supply

The seasonal availability of imported water supply is a determining factor of whether to use imported water for recharge or for direct use.

As previously noted, approximately 85% of groundwater use in the study area is for agricultural irrigation. It is likely that of the remaining 15% of groundwater use, approximately half is used for municipal-supplied irrigation and at least one quarter of the remaining 15% is used for non-irrigation uses (domestic, municipal, stock, and industrial) during the irrigation season. Thus, less than 5% of the annual groundwater use occurs during the non-irrigation season. As such, the best way of using imported water during the non-irrigation season is probably aquifer recharge (because demand for groundwater is minimal).

Conversely, direct use of imported water would be feasible during the irrigation season. Direct use of imported water for irrigation does not require water treatment (if not delivered through a drinking water system) and does not incur the costs of re-pumping from a well (as required for recharged water).

5.5.3.2. Costs of Aquifer Recharge and Recovery

Recharge of groundwater may incur costs in addition to the cost of diversion and conveyance, depending on the recharge method utilized. For surface recharge, such as release to the normally dry bed of Canyon Creek or adjacent gravel pits, recharge costs are minimal. For direct injection to the aquifer through wells, recharge may be expensive if pretreatment is required. More significant, in some cases, are costs for recovery of recharged water. In areas of water-level decline within the study area, pumping water levels may exceed 500 feet. In such areas, the costs of water importation for aquifer recharge, coupled with the cost of re-pumping the recharged and stored water from the aquifer, may be infeasible for irrigation purposes. Therefore, recharge is best utilized (1) where the water can be delivered into aquifer storage without treatment, (2) where subsequent pumping water levels are not excessive, and (3) where recharge is needed for aquifer stabilization. Identification of specific locations with all three of these characteristics were beyond the scope of this study. However, recharge is known to occur at Mountain Home Reservoir (through reservoir losses), in the bed of Canyon Creek downstream of the MHID diversion, and in gravel pits adjacent to Canyon Creek. Elsewhere within the study area, recharge can likely be accomplished through direct injection through wells provided that groundwater quality is not impaired for other beneficial uses.

5.5.3.3. Measurement and Apportionment of Costs and Benefit

Given the high cost of water importation, it is necessary that the costs and benefits of an action can be identified and quantified.

For direct use, water can be measured and costs can be apportioned to a user on a unit-price basis. It may also be possible to assess a portion of the costs to non-users that benefit from aquifer stabilization that results from groundwater to surface water conversions.

For aquifer recharge, the benefits may or may not be direct, which can complicate apportionment of costs. As an example, if groundwater is recharged within an area of decline to prevent water right curtailment, then those water right holders that were at risk of curtailment could be assessed the costs for importation and recharge in exchange for allowing them to continue to pump groundwater. Alternatively, if groundwater is recharged in an area where water users do not face curtailment, then it becomes more difficult to assess the costs to the users.

Regulatory Constraints

Regulatory constraints may or may not favor aquifer recharge. For example, if water can be appropriated from the Snake River for recharge, but cannot be appropriated for irrigation, then recharge may be the only feasible use. Other regulatory constraints can include treatment requirements to meet water quality requirements prior to recharge through injection wells.

5.5.4. Recommended Water Utilization Strategy

Given the high cost of surface-water importation from the Snake River or Boise River, the preferred water strategy should be direct use of imported water for irrigation purposes. Two modes of irrigation are anticipated.

- First, irrigation with imported water can occur on lands currently irrigated with groundwater. Use of imported water will reduce the net use of groundwater from declining aquifers, and preserve high-quality groundwater for domestic, commercial, municipal, and industrial uses.
- Second, imported water could be used to supplement existing surface water supplies to the extent that such supplies are insufficient to raise high value crops. For example, willing landowners within MHID could participate in a program to obtain supplemental irrigation supplies so that a full water supply can be assured each year.

Where possible, both modes of irrigation can be combined in a conjunctive-use strategy. Using such a strategy, imported water can be used to reduce groundwater pumping in good water years when local surface water supplies are sufficient for irrigation purposes. In drought years, when local surface water supplies are limited, imported water could be used for supplemental irrigation of the surface-water irrigated lands. In those years, groundwater users can resume pumping from wells.

Although perhaps not as economically feasible as direct use of imported water, aquifer recharge should be encouraged to extent economically feasible. For example, non-irrigation season aquifer recharge near the City of Mountain Home could be a strategy to allow development of new water rights from groundwater sources.

5.5.5. Administration of Water Supply Improvement Projects

To the extent that feasible water supply improvement projects can be identified, a significant question is "Who will build and operate the project?". Potential entities could include the following.

- Groundwater District
- Irrigation District
- Municipality
- Idaho Water Resource Board
- Water & Sewer District
- Local Improvement District
- Community Infrastructure District
- Private, For-Profit Entity
- Private, Non-Profit Entity
- Public-Private Partnership

Each entity type likely has attributes for specific projects, and the choice of an appropriate entity for constructing and operating a water supply improvement project may depend on the beneficiaries of the project. For projects strictly benefiting agricultural irrigators that currently rely on diminishing groundwater sources, a groundwater district or private non-profit entity might be most logical. However, if benefits are provided to a larger segment of the community, then a different entity might be appropriate. The County could serve as the controlling entity (potentially by forming a county irrigation district) or as a facilitator for a water supply project.

5.6. Tables and Figures

Boise River Water Supply Alternatives										
ALTERNATIVE		WATER SUPPLY				PIPELINE		PUMP STATION	
		Annual Vol (AF)	Duration (Days)	Flowrate (gpm)	Flowrate (cfs)	Length (mi)	Dia (in)	TDH[1] (ft)	Power (hp)
B1	Anderson Ranch to Little Camas	10,000	90	25,100	55.9	2.3	48	810	6,420
B2	South Fork Boise R. to Long Tom Cr.	10,000	90	25,100	55.9	0.65	48	1030	8,160
B3	Cat Creek Reservoir to Little Camas	10,000	90	25,100	55.9	1.6	48	860	7,270
B4	Long Tom Tunnel to Long Tom Creek	10,000	90	25,100	55.9	1.7	48	1060	8,400
B5	Lucky Peak to Cinder Cone Area	25,000	180	31,400	70.0	27	48	580	5,750

[1] TDH is total dynamic head.

Table 24. Boise River Water Supply Alternatives.

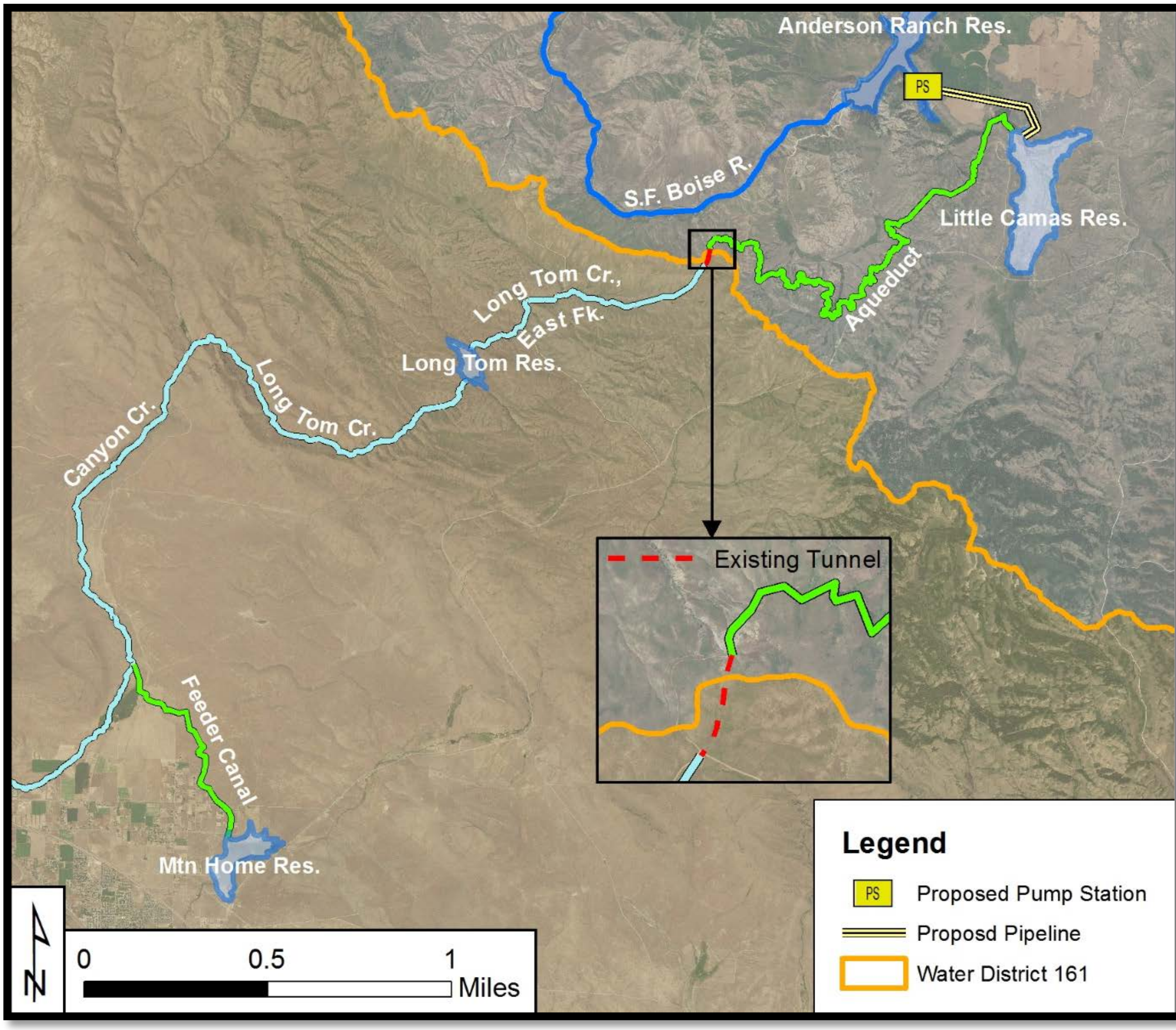


Figure 26. Alternative B1 – Anderson Ranch Reservoir to Little Camas Reservoir.

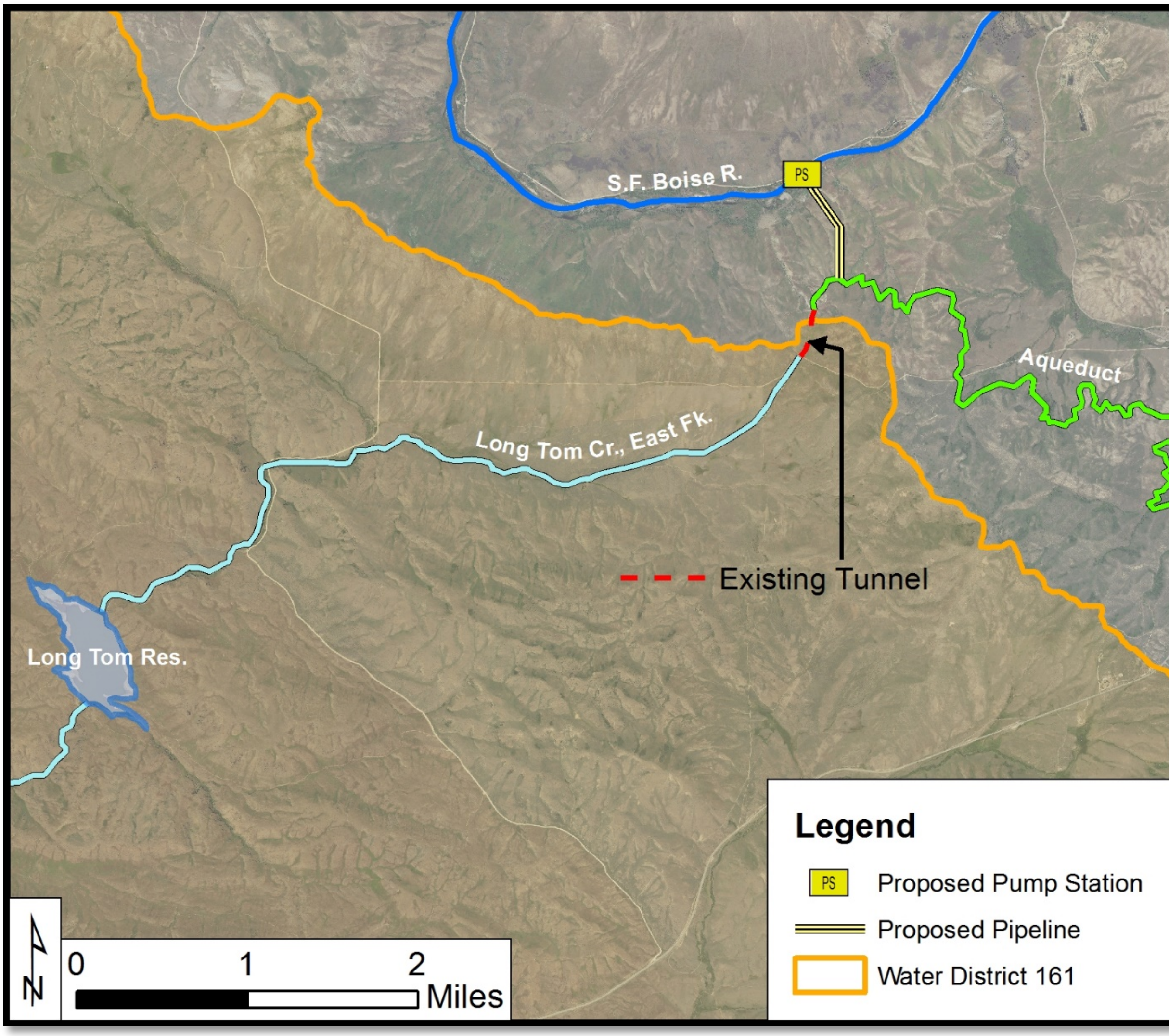


Figure 27. Alternative B2 – South Fork Boise River to MHID Canal.

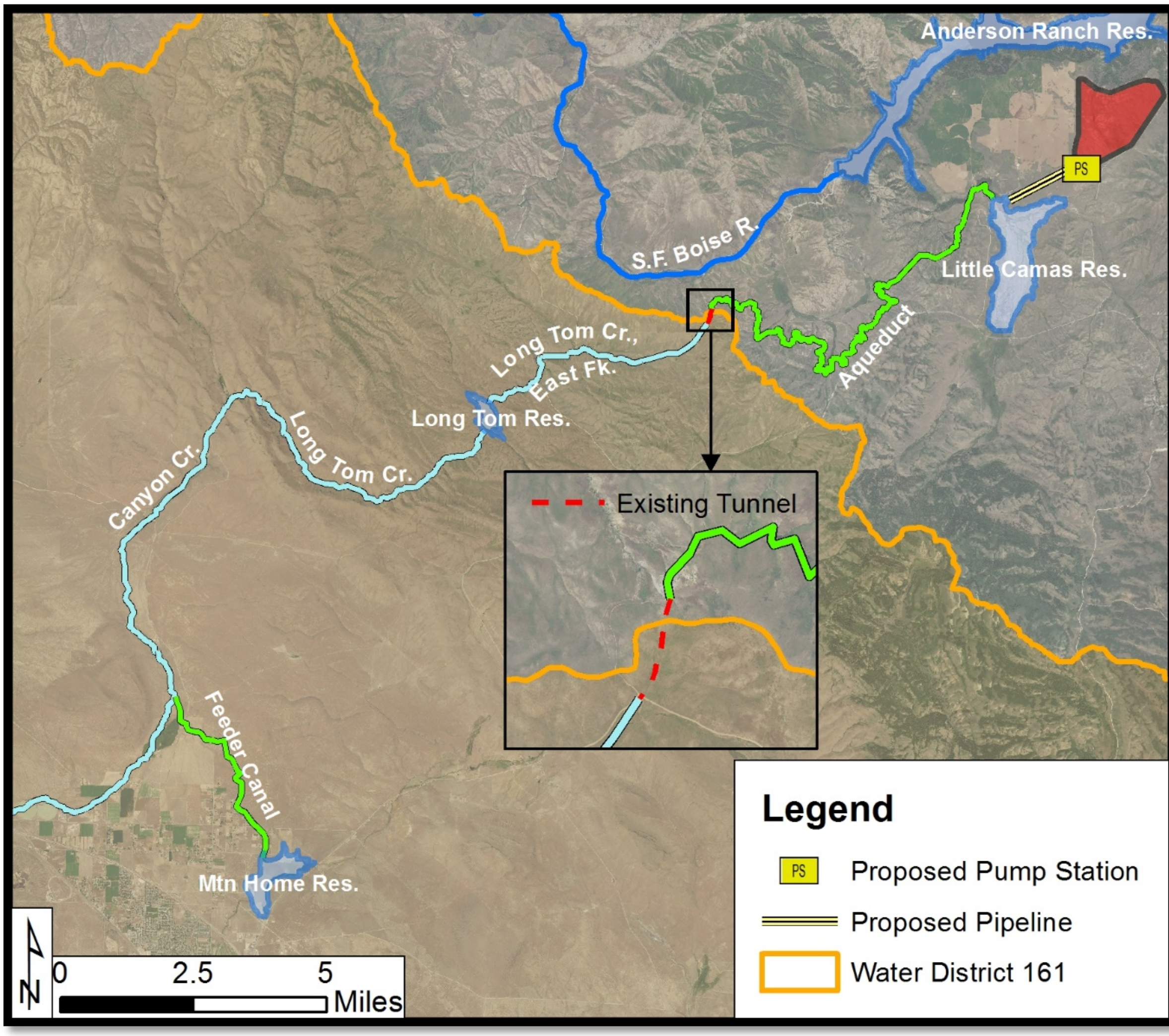


Figure 28. Alternative B3 – Proposed Cat Creek Reservoir to Little Camas Reservoir.

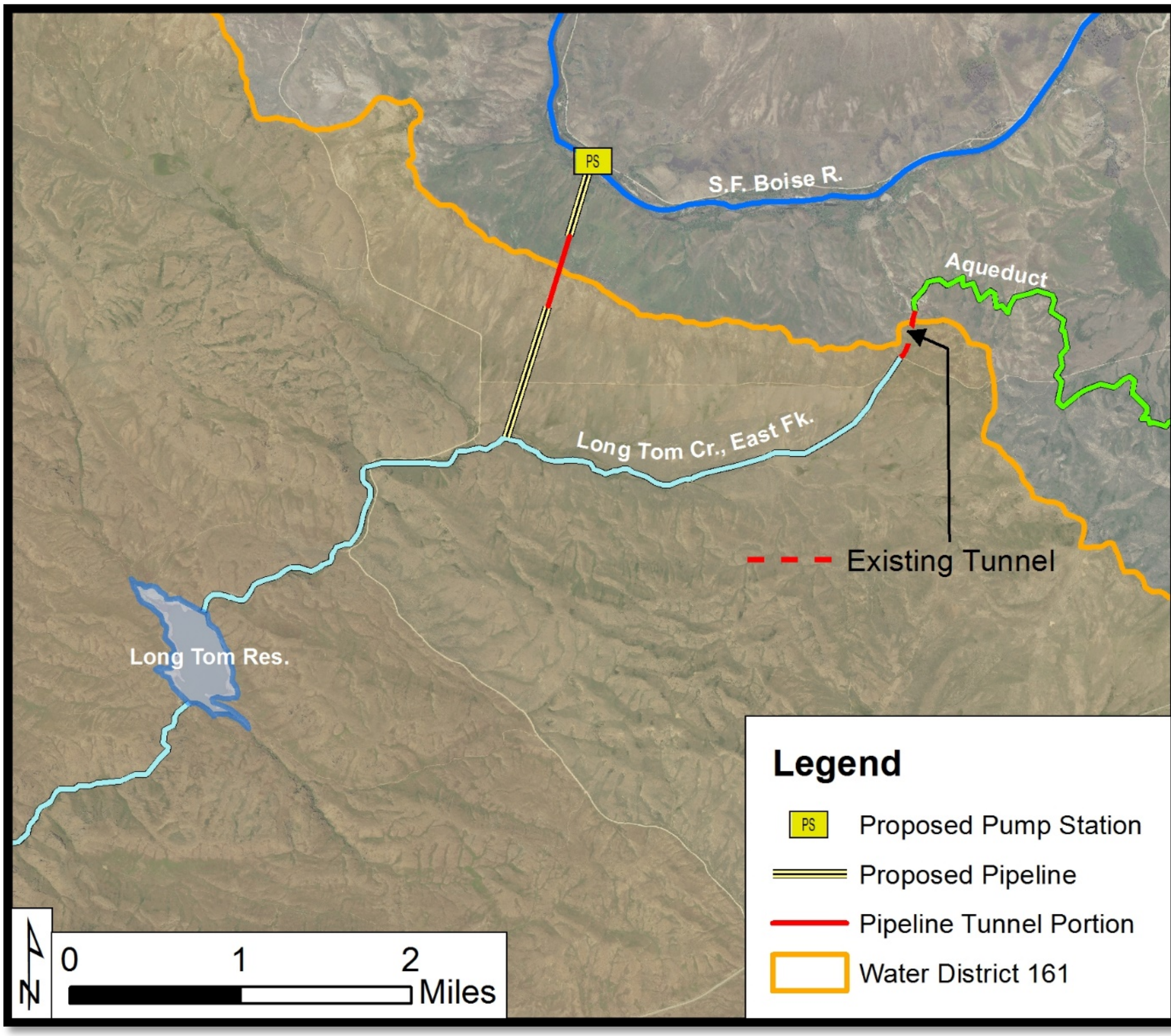


Figure 29. Alternative B4 – South Fork Boise River via Long Tom Tunnel.

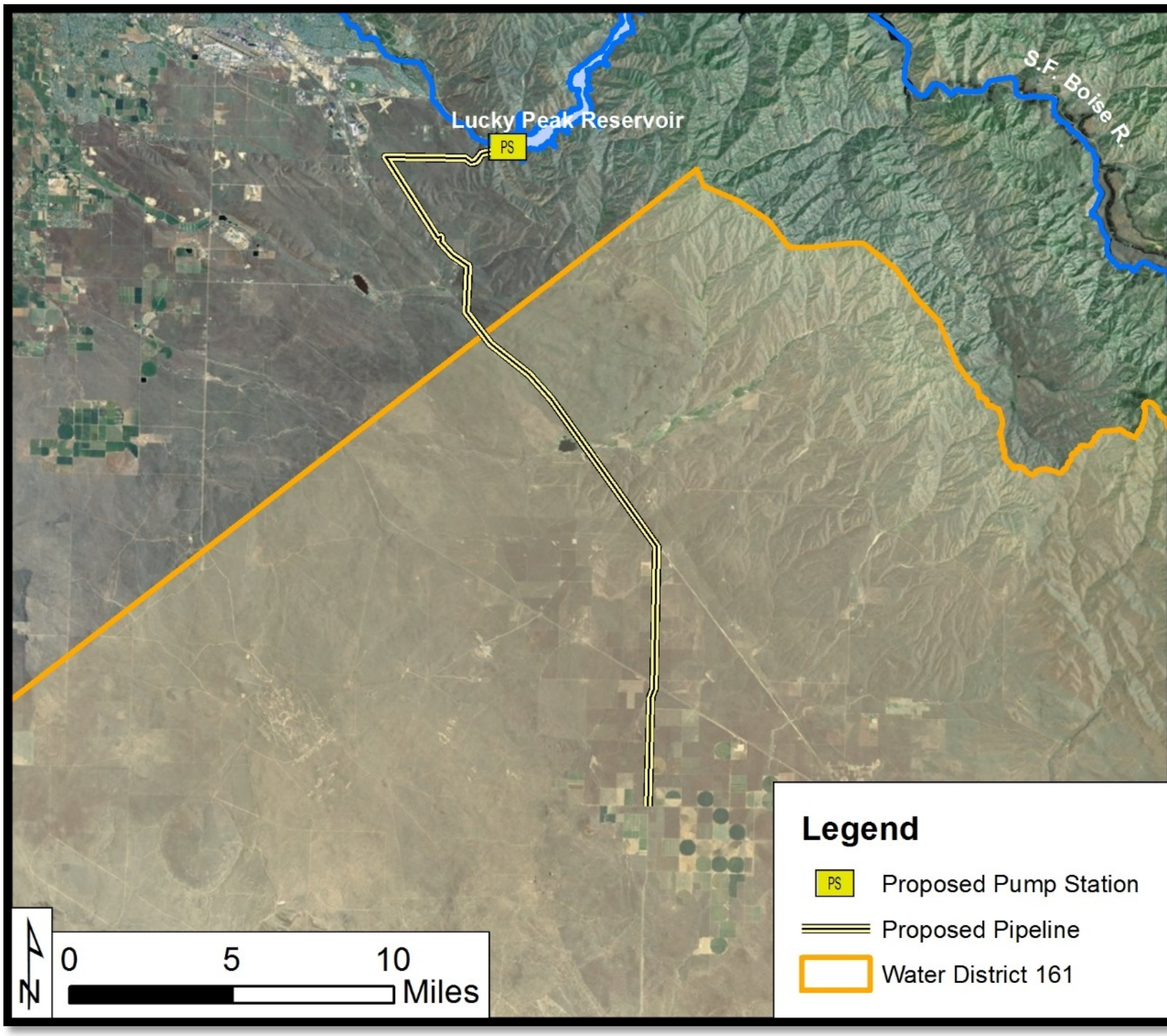


Figure 30. Alternative B5 – Lucky Peak Reservoir to Cinder Cone Area.

Snake River Water Supply Alternatives									
ALTERNATIVE		WATER SUPPLY				PIPELINE		PUMP STATION	
		Annual Vol (AF)	Duration (Days)	Flowrate (gpm)	Flowrate (cfs)	Length (mi)	Dia (in)	TDH[1] (ft)	Power (hp)
S1	MHAFB to Mountain Home	10,000	365	6,200	13.8	9.0	24	1070	2,090
S2	S. Elmore I.D. Res. to Canyon Cr.	10,000	180	12,600	28.1	16.7	36	955	3,800
S3	Bennett Creek to Mtn Home Reservoir	10,000	90	25,100	55.9	13.3	48	990	7,840
S4	RM517 to Mtn Home Reservoir	10,000	180	12,600	28.1	15.7	36	940	3,740
S4B	RM517 to Mtn Home and Areas South	20,000	365	12,400	27.6	19.5	36	970	3,800
S5	CJ Strike to Cinder Cone Area	25,000	180	31,400	70.0	15.0	48	825	8,180
S6	RM510 to East of MHAFB	10,000	180	12,600	28.1	5.0	36	625	2,490
S7	Below Swan Falls to Cinder Cone Area	25,000	180	31,400	70.0	25.0	48	1185	11,750

[1] TDH is total dynamic head.

Table 25. Snake River Water Supply Alternatives.

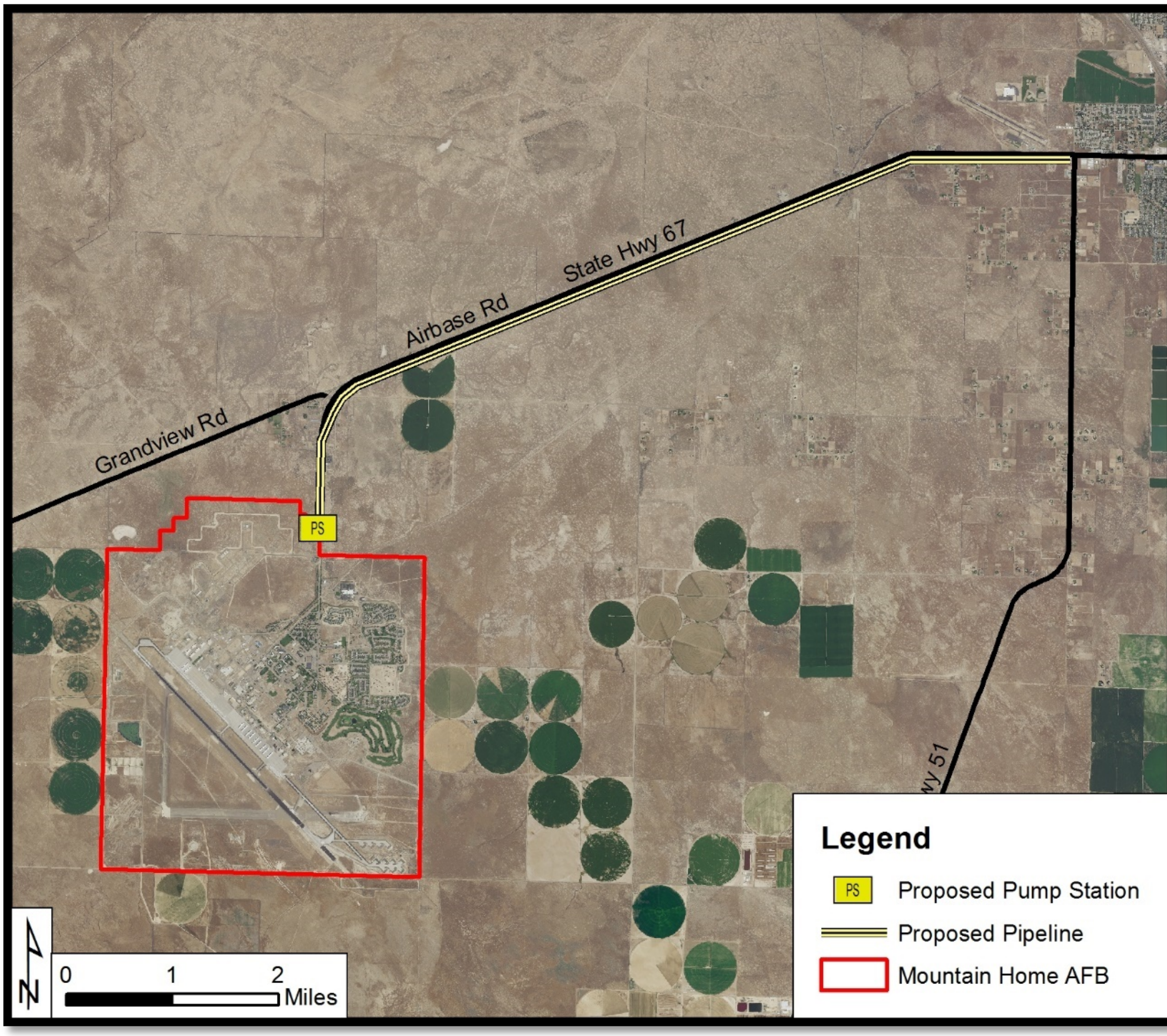


Figure 31. Alternative S1 – Mountain Home AFB to City of Mountain Home.

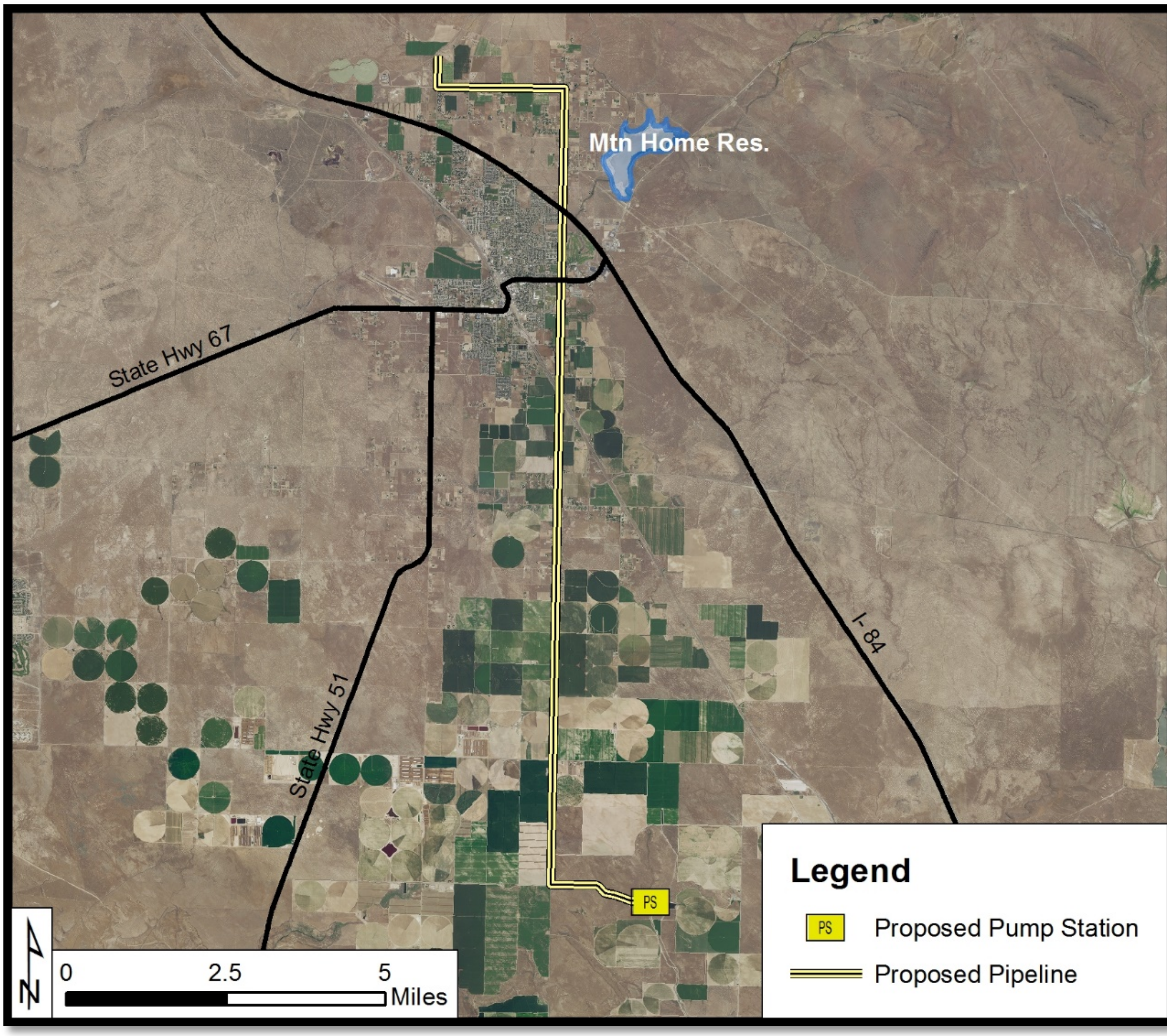


Figure 32. Alternative S2 – South Elmore County Irrigation Company reservoir to Canyon Creek.

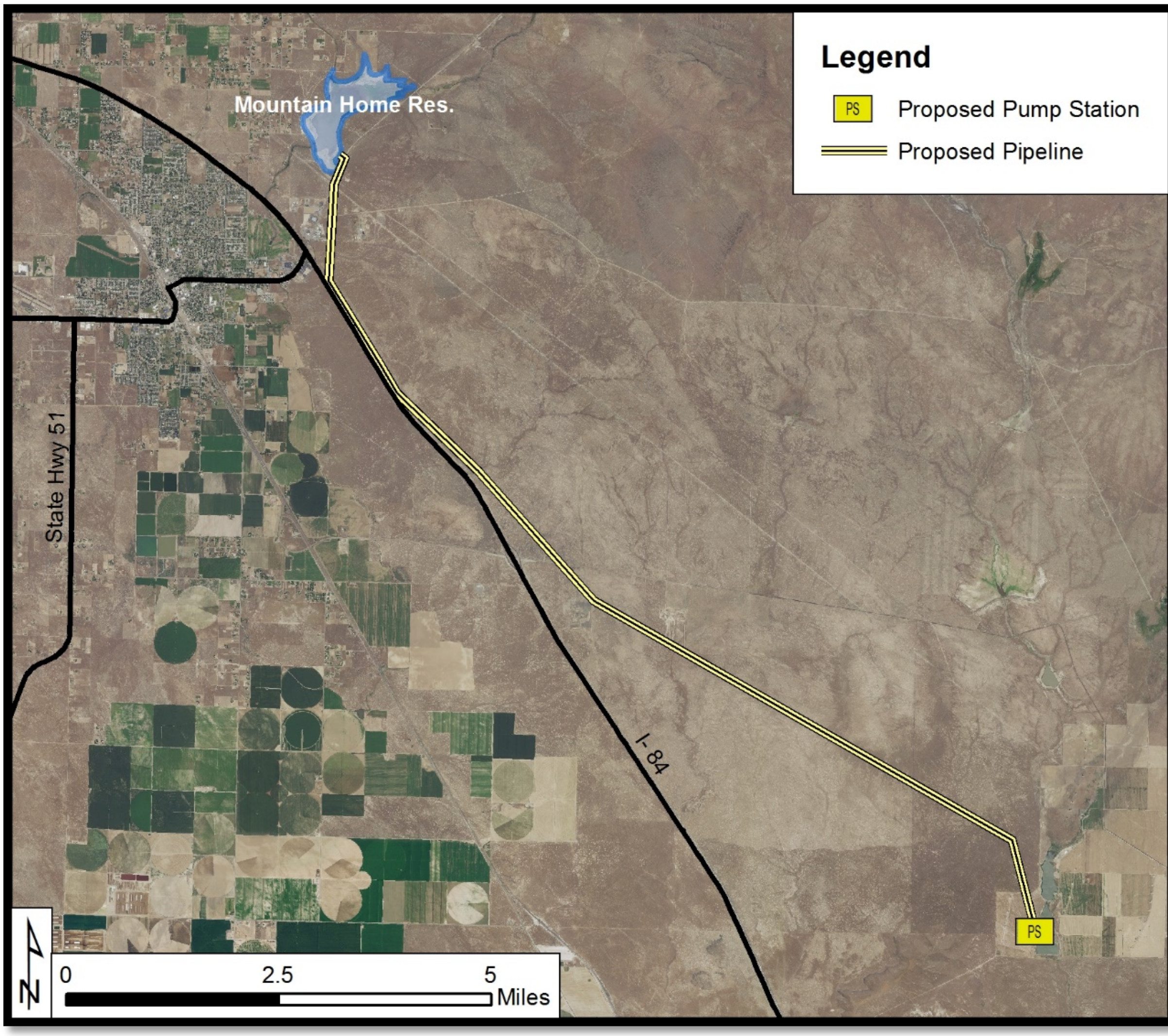


Figure 33. Alternative S3 – Bennett Creek Reservoir to Mountain Home Reservoir.

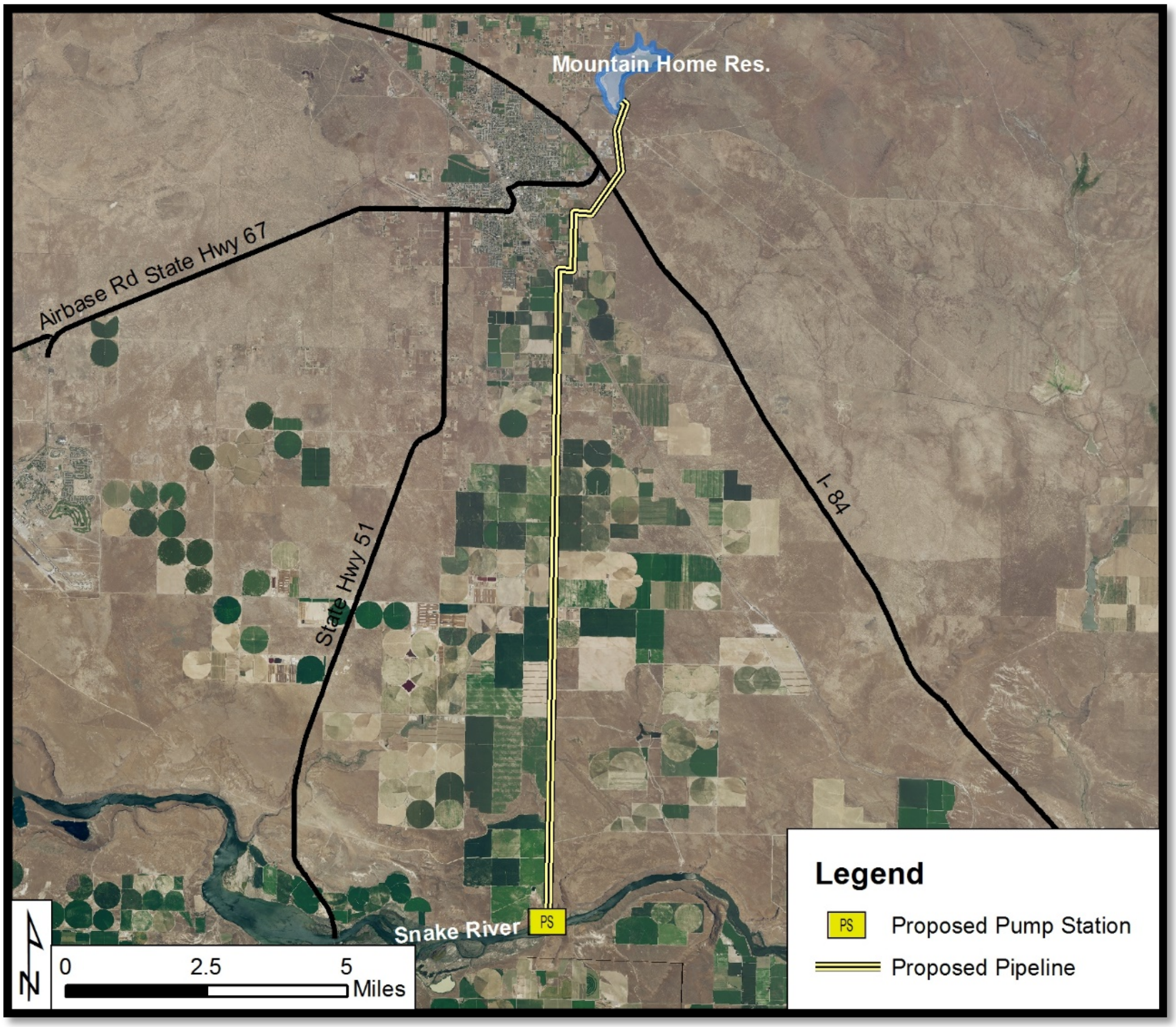


Figure 34. Alternative S4 – Snake River to City of Mountain Home.

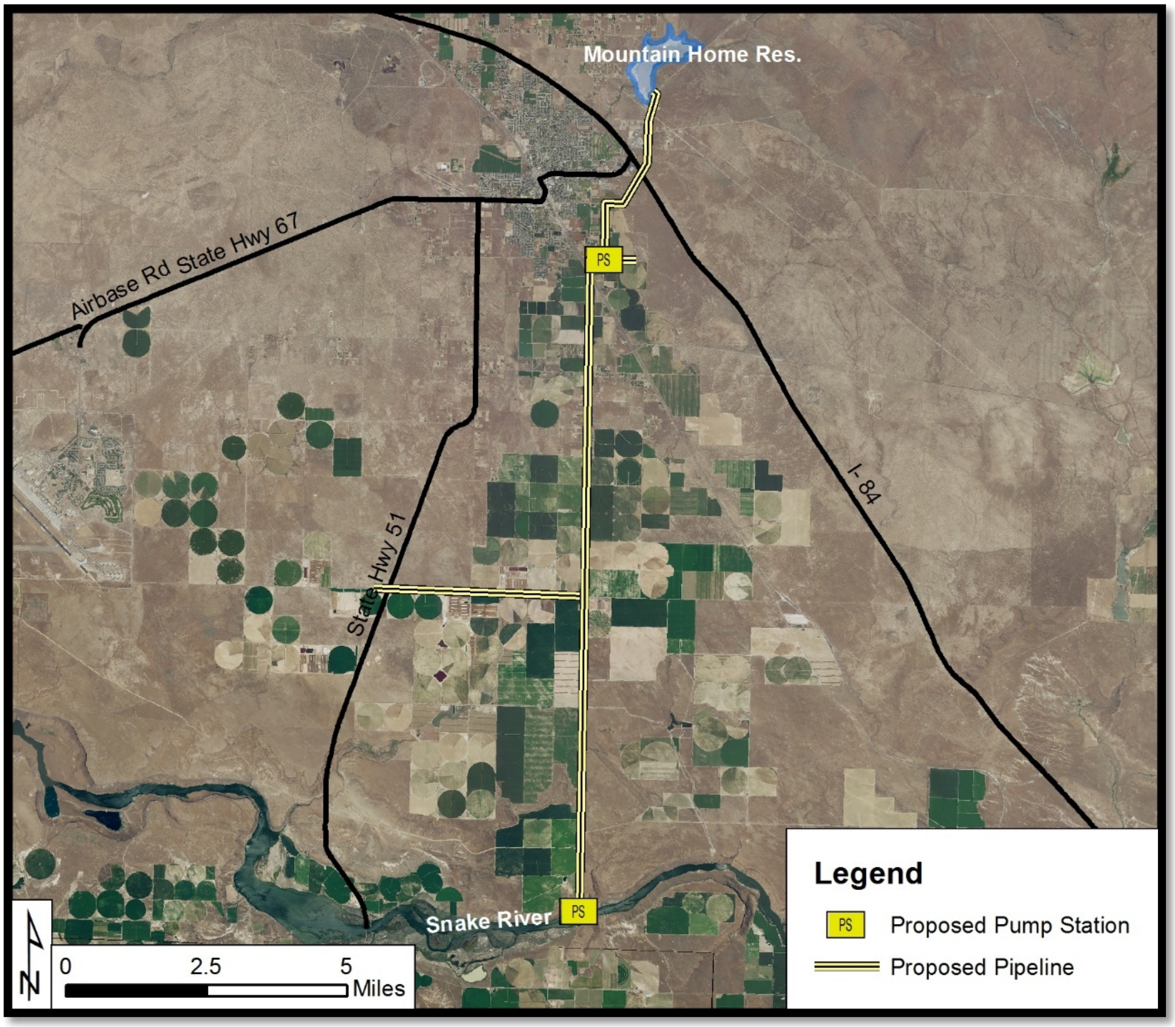


Figure 35. Alternative S4B – Snake River to Mountain Home and Areas South.

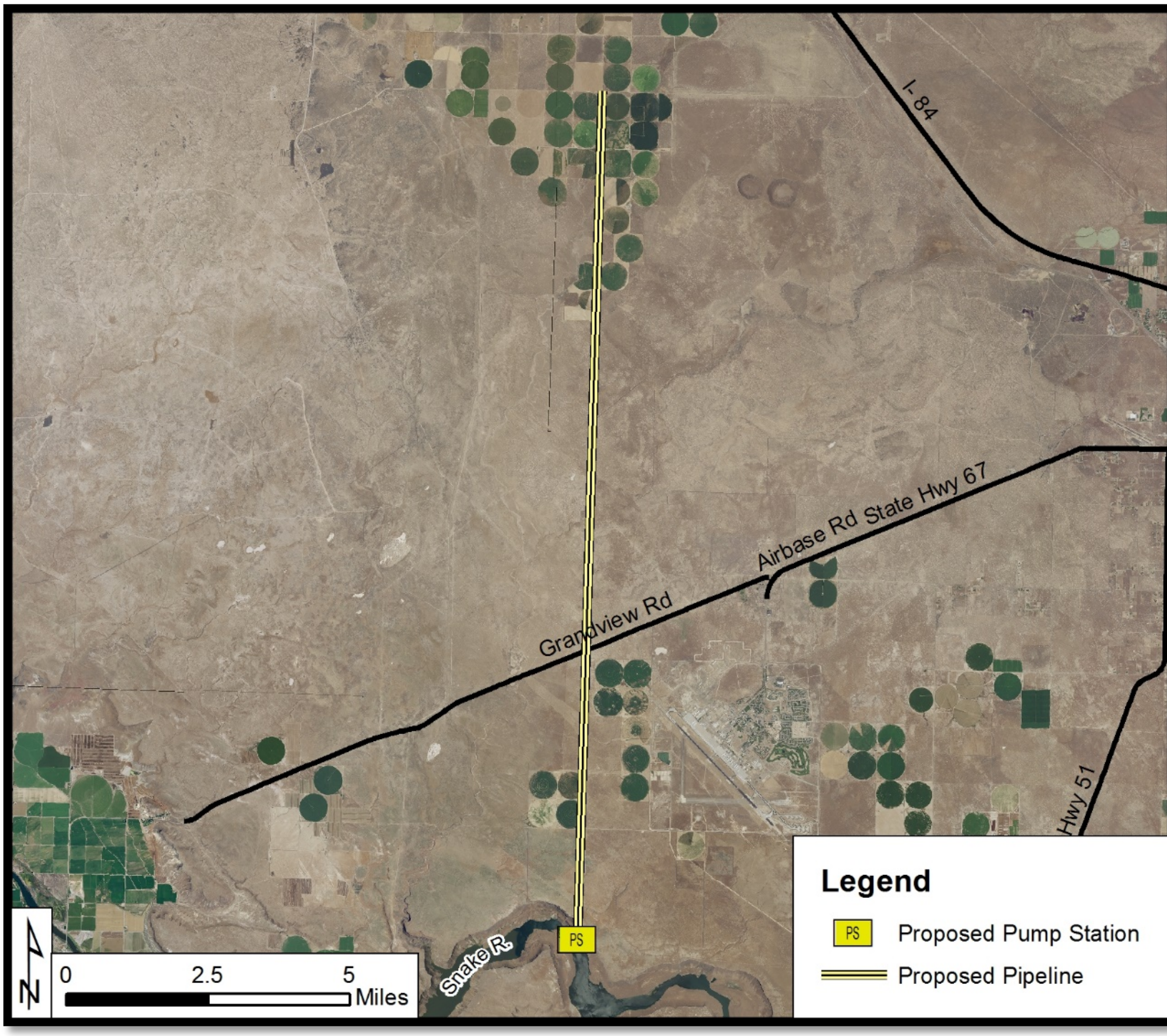


Figure 36. Alternative S5 – C.J. Strike Reservoir to Cinder Cone Area.

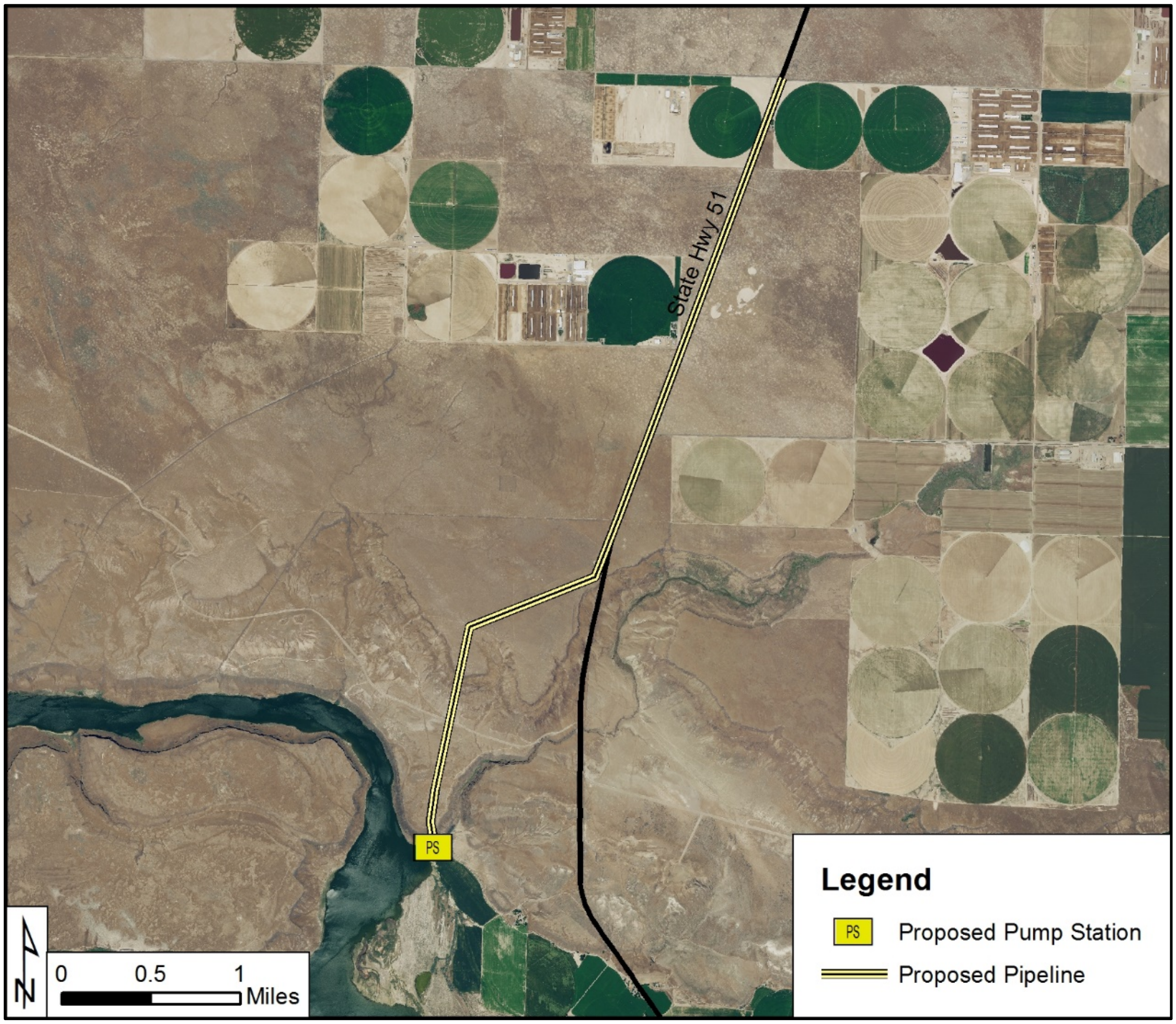


Figure 36. Alternative S6 – Snake River to Irrigation East of MHAFB

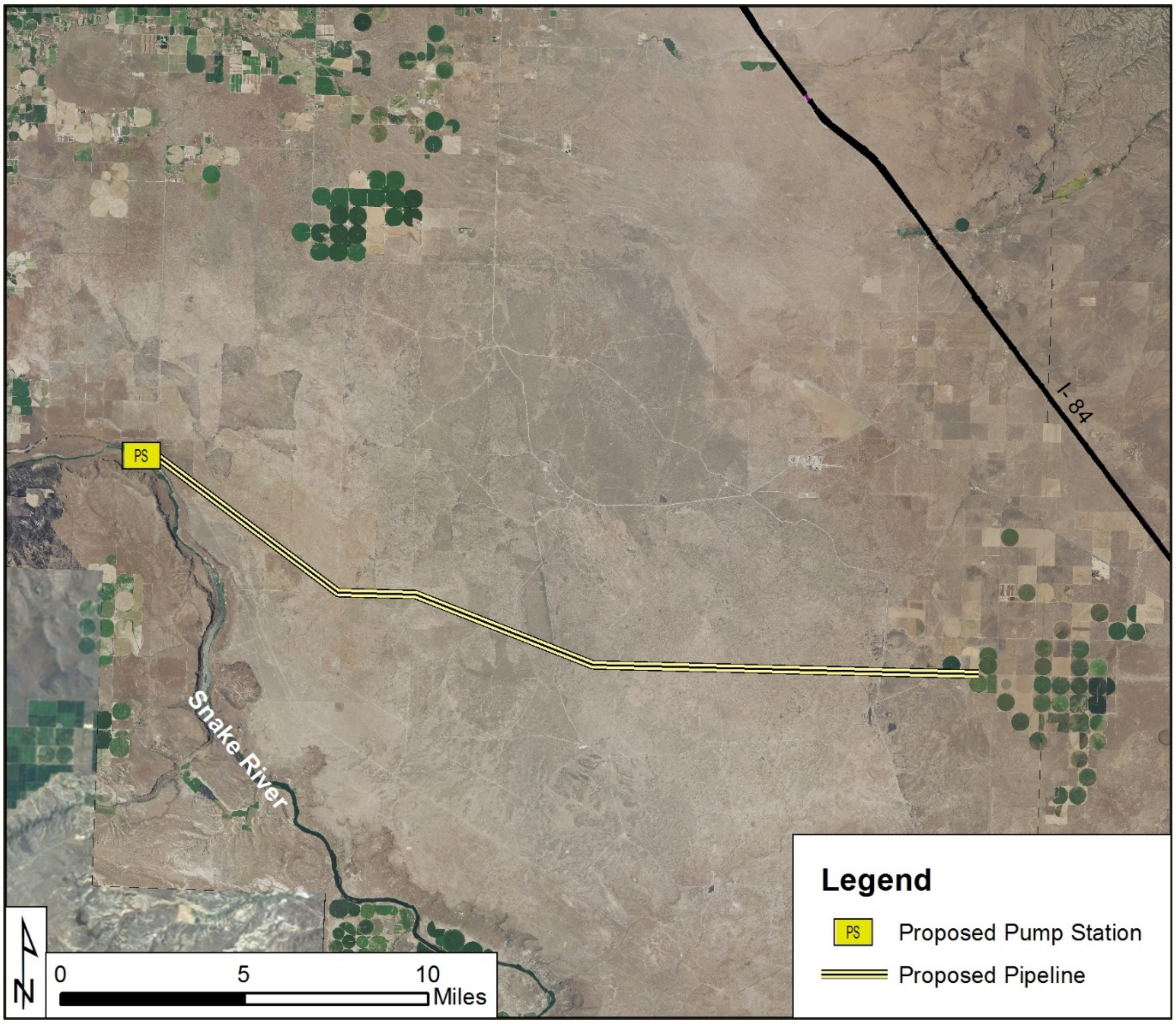


Figure 37. Alternative S7 – Below Swan Falls to Cinder Cone Area

Opinion of Costs for Water Supply Alternatives*						
Alternative		CAPITAL COST	ANNUALIZED CAPITAL COST	ANNUAL O&M COST	ANNUAL POWER COST	UNIT COST OF WATER ($/AF)
BOISE RIVER ALTERNATIVES						
B1	Anderson Ranch to Little Camas	$6,510,000	$329,000	$130,000	$572,100	$103
B2	South Fork Boise R. to Long Tom Cr.	$5,710,000	$288,000	$114,000	$727,100	$113
B3	Cat Creek Reservoir to Little Camas	$8,960,000	$453,000	$179,000	$647,800	$128
B4	Long Tom Tunnel to Long Tom Creek	$13,270,000	$670,000	$265,000	$748,500	$168
B5	Lucky Peak to Cinder Cone Area	$56,960,000	$2,878,000	$1,139,000	$1,024,700	$202
SNAKE RIVER ALTERNATIVES						
S1	MHAFB to Mountain Home	$13,600,000	$687,000	$272,000	$755,300	$171
S2	S. Elmore I.D. Res. to Canyon Cr.	$24,510,000	$1,238,000	$986,000	$677,200	$290
S3	Bennett Creek to Mtn Home Reservoir	$18,050,000	$912,000	$1,396,000	$178,100	$249
S4	RM517 to Mtn Home Reservoir	$28,410,000	$1,435,000	$568,000	$666,500	$267
S4B	RM517 to Mtn Home and Areas South	$19,730,000	$997,000	$395,000	$1,228,700	$131
S5	CJ Strike to Cinder Cone Area	$25,750,000	$1,301,000	$515,000	$1,457,800	$131
S6	RM510 to East of MHAFB	$6,430,000	$325,000	$129,000	$443,800	$90
S7	Below Swan Falls to Cinder Cone Area	$47,140,000	$2,382,000	$943,000	$2,094,000	$217
*Costs do not include land, easements, water rights, environmental, or legal costs						

Table 26. Opinion of Costs for Water Supply Alternatives.

6. ECONOMICS OF ADDITIONAL WATER SUPPLY

6.1. Introduction

This section explores the (1) the economic impact of the current water-supply deficit in the Elmore County study area and (2) the degree to which water users within the study area may be able to afford increased water rates associated with the alternative water supplies. The economics of current water-supply constraints and alternatives for increasing supply was investigated by Isaac Castellano, Ph.D., of Boise State University.

6.2. Approach

This economic analysis addressed two specific questions:

1. How might agricultural operators in Elmore County alter production strategies given increased and more reliable water flows?
2. Would current water users be able to afford the cost of large-scale water-supply increases?

These questions were answered through use of a survey instrument, semi-structured interviews, secondary data, and published reports. The survey instrument and semi-structured interviews were deployed under Boise State University Office of Research Compliance Protocol (Number 025-SB16-172). The survey instrument was distributed by the Elmore County Extension Office to 250 farmers and ranchers in Elmore County on October 5, 2016 via email.

Interviews were conducted with 25 individual agricultural firms in Elmore County. Respondents were either identified by using publicly available recipients of United States Department of Agriculture (USDA) farm subsidies in the 2005-2014 period or responded to the Elmore County Extension Office email.[51] Further, manufacturing operation, government agencies and other individuals and businesses in the County that were believed to possess information that would help in the economic assessment of new water flows in the County were also interviewed using a semi-structured interview protocol.

The secondary data utilized included the 2007 and 2012 USDA Agricultural Censuses, the 2015 Economic Impact of Agriculture in Elmore County report, conducted by the

[51] See https://farm.ewg.org/top_recips.php?fips=16039&progcode=totalfarm

University of Idaho Elmore County Extension Office, and water-research reports.[52] Footnotes detail specific calculations estimating economic impact and production costs throughout the document.

6.3. Agricultural Outputs and Economic Benefits

Agricultural workers account for 6.3% of the total Elmore County workforce. There are 381 farms and 346,550 acres in operation, generating a total revenue of $220.1 million dollars in 2015.[53] Crops include potatoes, sugar beets, alfalfa, beans, grain cereals, and a range of other crops with smaller outputs (Table 27). By and large, Elmore County is a very productive agricultural county, and ranks 8th in the state for total value of agricultural products sold, and 220th in the U.S.

A high percentage of the agriculture in Elmore County relies on irrigation. The total USDA-census reported irrigated acreage in Elmore County in 2012 was 89,940 acres, down from 97,857 in 2007.[54] This reported acreage includes lands outside of the study area near Glenns Ferry and King Hill (including Grindstone Butte, Pasadena Valley, Black Mesa, and Cottonwood), on the western Camas Prairie, and at Little Camas Prairie. The harvested cropland for 2012 is slightly higher, at 95,241 acres. The total cropland in 2012 was estimated to be 117,855 acres,[55] while 344,820 acres are reported to be land in farms and ranches.[56] Seventy six percent of the acreage irrigated in 2012 was managed by 31 farms that claim more than 2,000 acres per operation. Most of the reduction in irrigated acres was in land controlled by these larger farms between 2007 and 2012.[57]

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[52] 2015 Economic Impact of Agriculture in Elmore County. University of Idaho Extension, Elmore County and USDA Agricultural 2012 Census.

[53] 2015 Economic Impact of Agriculture in Elmore County. University of Idaho Extension, Elmore County.

[54] USDA Agricultural 2012 Census

[55] USDA Agricultural 2012 Census

[56] A discussion with a USDA data manager produced several warnings about using the FSA data to report on irrigated acres. One issue is that some of the largest growers no longer report to FSA. If their income is high enough, they are ineligible for payments from any programs. Second, irrigated acre counts, which is the data point most important for this analysis, can often be inflated if the same acre is counted twice when multiple crops were grown in the same year. The 2012 Census data is considered the most reliable data source. With that said, the October 1, 2016 FSA data for Elmore County lists 98,000 irrigated acres for 2016, which would make sense if 10,000 or so acres are used in winter production and summer. (https://www.fsa.usda.gov/news-room/efoia/electronic-reading-room/frequently-requested-information/crop-acreage-data/index)

[57] USDA Agricultural 2012 Census

The 2015 total market value of Elmore County agricultural production was $221.1 million,[58] compared to $350.5 million in 2012,[59] $284 million in 2007,[60] and $292 million in 2002.[61] This is particularly noteworthy given the growth of the dairy industry in the County.[62]

The USDA census data reports a nearly 9,000-acre decline in irrigated acres in the County between 2007 and 2012. MHID delivery volumes have declined in recent years; lower delivery rates and other water-supply constraints likely contributed to recent decreases in irrigated agriculture. Other factors, such as market forces, could have contributed to decreases in active agricultural land, but survey respondents reported one of their primary concerns was a lack of water availability.[63]

Further analysis would be needed to confirm relationship between water supply and reported decreases in agricultural acres. However, a preliminary conclusion of this study is that there is a direct link between additional water supplies and economic output in the County, and that this relationship has worsened in recent years. This supports the notion that new water supplies, if affordable, would greatly benefit economic productivity of Elmore County's agricultural sector.

Agricultural production in the County is not limited to crops. According to 2012 data from the USDA Agricultural Census, Elmore County is home to over 155,000 head of cattle, of which approximately 21,000 are dairy cows, and the remainder are assumed to be non-milking cows and beef cattle (Table 28). Dairy cows are known to drink the most water of the two groups.[64] Based on an estimated average of 35 gallons of water a day per cow, the dairy cows in Elmore County require an estimated 1,000 acre feet of water per year. Beef cattle typically consume less than half the water of lactating dairy cows, resulting in the consumption of roughly 2,000 acre feet in the

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58 2015 Economic Impact of Agriculture in Elmore County. University of Idaho Extension, Elmore County and USDA Agricultural 2012 Census.

59 USDA Agricultural 2012 Census

60 USDA Agricultural 2007 Census

61 USDA Agricultural 2002 Census

62 Support for this position comes from respondent comments on increased dairy operations in the County. In addition, between 2002 and 2012 there was a 13% rise in the number of cattle located in the County. USDA Agricultural 2012 Census

63 This figure differs from the U of Idaho Extension Office which reports over 300,000 acres of farmland in the County.

64 Pierce, Megan. "Drinking Water for Dairy Cattle: Part 1." Dairy Herd Management.

County annually. Therefore, roughly 3,000 acre feet are consumed by animal husbandry in the County each year.

As noted above, the economic output of agriculture in Elmore County has declined in recent years. USDA Agricultural Censuses have documented an 8% reduction in the number of farms operating in the County between 2007 and 2012, as the number dropped from 349 to 281. The declining number of farms and reduction in surface and groundwater availability is a potential factor in explaining the declining market value of the County's agricultural sector.[65]

6.4. Cost of Water for Agriculture in Elmore County

The current cost of water in Elmore County remains largely under $50 an acre foot for both surface and groundwater sources. MHID reports that shares were assessed roughly $43 in 2016; each share authorizes delivery of 3 acre feet, bringing the price below $14/AF of delivered water (when available). Other survey respondents reported costs averaging $20/AF. For groundwater sources, the price per acre foot varies largely based in part on pumping costs, which are dependent largely on well depth. According to respondents the price for most well operation remains at or below $50/AF.[66] While the supplies of water have declined both in available groundwater and surface water, the costs have remained constant, aside from small fluctuations in electricity prices for groundwater well pump operators.[67]

6.5. Water Changes and Willingness to Pay

To gather information regarding willingness to pay for changes in agricultural water supply in Elmore County, 25 interviews were conducted with 3 dairy operators, 6 ranchers/farmers, 15 farmers, and 1 winery.

Respondents were asked the following questions:

1. How reliable is your water supply?
2. If new water rights came to you, could you put them to use?

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65 Clearly there are many other factors that influence the overall market value of the agricultural products produced in Elmore County, primary among them commodity prices. This study does not investigate the overall causal relationship between water supplies in the previous 15 years and agricultural production, but market share is not growing based on the three USDA census years (2002, 2007, 2012), and the 2015 data compiled by the Elmore County Extension Office.

66 This does not include well drilling costs, rather just electricity costs for operating pumps.

67 This is dependent on well depth and well location.

3. At what price point would water need to be at for you to use it?
4. How much water would be needed for you to make a change in your operation?

The questions were designed to allow for open ended responses, and thus no parameters were provided for respondents.[68] On Question 1, 23 out of 25 survey respondents reported that they did not believe that their operations had a reliable water supply.[69] Respondents understood the reasons behind this (e.g., low water years for surface supply; well depths too shallow for declining water table) and had already integrated this dynamic into their operations. The answers provided indicate that respondents view water shortages as a problem. However, survey respondents appeared to have adapted to the difficulty of making a living in agriculture in Elmore County, which is to say there was not surprise or shock in their descriptions of their situation.

When asked in Question 2 (i.e., “If new water rights came to you, could you put them to use?”), responses were all positive. Farmers responded that they would grow more of what they were growing, and grow more row crops, likely moving from forage to row crops. The consensus that emerges from the respondents is that they would grow more profitable crops if they had reliable water. Even the winery, a low water user, asserted that they could put new water rights to use.

Several respondents made specific claims about lack of water supply limiting their expansion, including several that have fallow fields due to lack of water rights and sufficient flow. Respondents with farming operations reported that they currently undertake a range of approaches to mitigate for constrained water supplies, including rotation strategies. However, these mitigation strategies can only go so far in terms of addressing the water shortages that agricultural operators are currently experiencing.

When asked Question 3 (i.e., “At what price point would water need to be at for you to use it?”), most respondents worked backwards, calculating prices they currently paid; everyone reported prices below $50/AF. All but three reported that they could not afford prices to rise above $50/AF. Dr. Castellano followed up with phone interviews, asking “What could you do if water was $200 /AF?” Responses were all negative, and several respondents claimed such a price would render their operations unsustainable under current commodity prices.

[68] For example, many surveys use terms such as “somewhat agree”, “somewhat disagree”, “neutral”, etc.

[69] A winery and a rancher/farmer reported that they had sufficient water resources.

Those with mid-sized operations (defined as 100-1,000 acres) were unanimous in their rebuke of the idea of increasing water prices. Two larger operations with acreage above 1,000 acres suggested that they might be able to operate with water costs at $200/AF under the right conditions,[70] but it would not be ideal. Generally, respondents were dismayed at the notion of water going above $50/AF, and they were very clear that they would not be able to sustain their operations. Several responded to the question with their own question. For example, a number of respondents asked, "What could be grown in Elmore County with water at that price?" Generally, respondents were concerned at the predicted base price required under new water infrastructure, and were unclear why such a project would be under consideration. One respondent remarked that they would have rather seen the County purchase new meters for the water district then pay for the study. Additionally, several respondents were dismayed at the notion that there were water rights that were available, and expressed sincere doubt at the overall viability of a project that brought water from the Snake or Boise basins into the Mountain Home area.

Regarding Question 4 (i.e., "How much water would be needed for you to make a change in your operation?"), 20 of the 25 respondents said they would need at least an additional acre foot per acre, if not more, dependent on the crop they would transition to, or introduce. In response, most respondents began to describe the size and scope of their operations and point out places where new water would augment their approach which varied. The general consensus was that farmers reevaluated their planting strategy based on water supply projections for the upcoming season, and that new water would simply feed into their strategic calculations. Which is to say, many did not have a very specific idea of the scope of the changes of their operation, and thus the question did not yield specific acre feet requirements from respondents.

Interview responses on water pricing are confirmed using a general estimation of crop price and production costs. Consider the estimated cost of producing an acre of potatoes. According to the Idaho Farm Bureau, the Idaho potato grower spends $1,650 to grow an acre of potatoes that sell for roughly $8 per hundredweight; each acre produces on average 30,000 lbs, thus they sell for $2,400.[71] The profit margin for each acre then is $750. If water costs increase from the current $50/AF to $100-$200/AF, then the profit margin shrinks or is eliminated. These numbers underscore the comments made by respondents that there is no crop that could produce profitable outcomes for growers. While these water costs are estimates, and commodity prices

[70] The 'right conditions' was a term used by one respondent, which he referred to commodity prices being high and a large enough operation to take on the burden the high costs.

[71] http://www.idahofb.org/index.php?action=commodities.potatoes

and economies of scale alter the estimated costs and value associated with the numbers presented here, the profit breakdown supports respondents' claims that significantly increasing water costs would make many agricultural operations insolvent.

6.6. The Impact of Increasing Water Availability in Elmore County

The analysis completed here suggests that Elmore County would benefit economically from additional water supply. The data collected across the agricultural, manufacturing, and housing sectors indicate that a range of development has been halted because of lack of reliable water in the County. The perception of agricultural water users was that water shortages were altering the market value of their operations, and that shortages were becoming more common.

Respondents' answers suggest that some portion of available farmland is left fallow because of water shortages. According to USDA 2012 Census data, there are 344,820 acres of farmland in the County, and only 89,940 of them were irrigated.[72] While not all acreage is suitable for irrigated operations, if only 28,000 additional acres were utilized for a crop such as potatoes the economic activity could generate $56 million in annual market value. However, this production would require 60,000 acre feet of additional water annually. This hypothetical scenario helps illustrate the potential economic benefits of increasing water availability, particularly for farmland that is currently without sufficient water resources.[73] Despite the potential economic benefits of increasing water resources, however, it is not clear that the projects would be cost-effective, considering the estimated water price and the ability of agricultural operators to pay the price increases. There are other industries that could receive economic benefits from increased water availability aside from the agriculture.

6.6.1. New Economic Opportunities

Manufacturing, especially agricultural processing, would be ideally located in Elmore County because of access to transportation networks, a large workforce in the Treasure Valley, affordable housing in the Mountain Home area, and established supply chains. Elmore County has been approached by several companies as a possible location for their operations. One such operation, named Project Falcon, would have come with a capital investment of $430 million and promised 450 full time

[72] USDA Agricultural 2012 Census

[73] This based on estimated water consumption for potatoes, which is roughly 2 acre feet a year.

jobs.[74] The building location, electricity needs, natural gas, transportation, telecommunications, and related infrastructure could all be satisfied. However, their water requirement of 3,500 gpm, which amounts to over 5,000 acre feet per year, was more than the City of Mountain Home could provide. Even if the employees for such new ventures resided outside of Elmore County, there would be a beneficial economic impact within the study area.[75] Thus, the current water infrastructure is limiting a range of economic development in the County. Because the Project Falcon proposal examined here masks the real firm behind it and any examination of its current business model and operations, it was difficult to estimate how high water prices could go for manufacturing operations to be successful. In conjunction with other economic factors in the County, it was not possible to assess the viability of alternative water sources on manufacturing in the County. However, it is clear that water availability has limited manufacturing expansion in the County.

Similarly, housing development in the area, particularly in Western Elmore County and Eastern Ada County (the I-84 corridor), also presents an opportunity to facilitate growth and generate economic benefits for the County. Water-right permits and approved transfer applications have been issued in this area for several projects over the past decade, including Mayfield Springs, Elk Creek Village, Mayfield Townsite, and Elk Creek Canyon, proposing a total of 10,176 new homes near the Ada/Elmore County line. Groundwater-level monitoring is required for each development, but the actual extent of development and the effect on the local aquifer is currently unknown. Three other permit and transfer applications are currently being held by IDWR, largely because of an anticipated lack of water supply. IDWR has estimated a net annual recharge for the area of 7,440 acre-feet.[76] Given that the average home with 5,000 square feet of irrigable area might use 1/2 of an acre foot annually for landscape irrigation and domestic purposes,[77] the groundwater allocation could supply over 14,000 homes.

The cost of new infrastructure to develop additional water supply could likely be born by municipal users. For example, an additional 2000 housing units could likely be

[74] The City of Mountain Home Economic Development office provided the Falcon.

[75] The exact estimated economic impact of the proposed operation was not provided.

[76] IDWR. 11/4/2013. “Final Order Regarding Water Sufficiency.”

[77] an average annual per household use of 0.5 AF is a commonly-used rule-of-thumb for new Treasure Valley subdivisions. This value is consistent with (1) 4.5 housing units per acre, (2) 40% irrigable area, 70% of which is turf, (3) precipitation deficit of 3.05 feet/acre, (4) per capita use of 80 gallons per day per person (Treasure Valley average), (5) and an average of 2.5 people per housing unit. Some subdivisions, especially those with water-efficient landscaping, use less water than 0.5 AF/household.

supported for each 1,000 acre-feet of surface water that can be brought to the I-84 corridor. If the cost of bringing water to the area, either from the Snake or Boise River, is around $350 million,[78] and 15,000 additional units are built, the resulting cost increase per house would be approximately $24,000. Given the more affordable land, new homes would easily compete with similar homes in the Boise suburb of Meridian, where the median home price is $259,000. Access to downtown Boise, shorter commutes, more affordable housing, and the rural setting would have to be weighed against the relative newness of the developments and the lack of established services, including businesses, schools, and other amenities. Regardless, those things would develop with time, leading to the conclusion that any water project in the County might be best used to facilitate new housing, with any additional water being used for aquifer recharge. There are clearly other pieces of information that factor into the economic benefit of any new housing development in the County, so the conclusion drawn here that current housing conditions could support the investment in a new water project is tentative.

6.7. Summary

The Elmore County 2014 Comprehensive Plan, a County government document required by state law that outlines expectations for future growth in the County, provides detailed predictions for the coming decade. Specifically, the report predicts the population will rise to 40,897 by 2024, that the total acres of active agriculturally-related operations will reach 400,000, and that cattle operations will grow to a total of 230,000 head.[79] Without the development of new water sources, these projections will not come to fruition.

Elmore County would economically benefit from additional water. Agricultural, manufacturing, and municipal development are all currently limited by lack of sufficient and reliable water in the County. Agricultural users limit planted acreage because of water constraints, and are also limited in the commodities they can produce. In addition, the County has lost potential manufacturing development (including a recent proposal that would bring 450 industrial jobs to the County). Furthermore, curtailment of existing water rights to stem current groundwater-level declines would have a significant impact on the Elmore County economy.

However, despite the potential benefits of increasing water availability in Elmore County, new water projects that are unable to maintain current pricing levels do not

[78] This figure is an undocumented estimate of what an alternative water supply construction would require.

[79] Elmore County 2014 Comprehensive Plan.

appear to offer viable solutions for the entire agricultural sector, as the projected water costs under the various current proposals for increasing water supply and stability in the County range from approximately $90-$270/AF. Data collected for this project suggests that water costs of more than $50 to $100/AF is beyond the means of most agricultural operations in Elmore County. These findings suggest that for these proposals to be viable, and for them to support agricultural operators in the County, the cost of water would need to be subsidized. Without a major subsidy accompanying the project, there will be few agricultural water users able to pay for the water.

This economic analysis suggests that new manufacturing might be able to afford the cost of water under the alternative plans, and that housing development is well suited for an alternative water project. Additional research is needed to fully examine the scope of possible manufacturing and housing development. Much of the information needed to produce an accurate projection of cost, demand, and supply factors for housing and manufacturing is proprietary, which undermines a more complete analysis.

6.8. Tables

Elmore County Crop Distribution		
Crop	**Acreage**	**Percentage**
Corn	8,575	10%
Wheat	17,022	21%
Winter	11,595	14%
Spring	5,427	7%
Sugar Beets	4,855	6%
Potatoes	7,842	10%
Dry Beans	1,815	2%
Forage	41,575	51%
Total	81,684	100%
Data from 2012 USDA Agricultural Census (not all irrigated acres are included in these data)		

Table 27. Elmore County crop distribution.

Elmore County Cattle Production (2012)	
Animal	**Number**
Dairy Cow	21,456
Beef Cattle	19,215
Other	115,293
Total	155,964
Data from 2012 agricultural census.	

Table 28. Elmore County cattle production.

7. Discussion and Summary

The current lack of adequate water supplies threatens existing and future economic activity in Elmore County. The purpose of this analysis was to explore additional sources of water supply for Water District 161 (the study area), especially in areas with decreasing groundwater levels. Several alternatives for supplying additional water were identified, but the infrastructure and operating costs required to develop these alternative sources of supply will be expensive. The cost of developing these supplies may be economically infeasible for some existing water users.

Specific conclusions from this analysis include the following:

<u>Water Use Characteristics</u>

1. Study-area water sources include groundwater and surface water. Surface water sources include local drainages within the study area, the Boise River drainage, and the Snake River.
2. Agricultural irrigation is the dominant surface-water and groundwater use in the study area. Surface water is used to irrigate approximately 52,000 acres. Groundwater is used for primary irrigation on approximately 18,000 acres and for supplemental irrigation on approximately 8,000 acres.
3. Groundwater pumping for agricultural use is concentrated in the Cinder Cone Butte area, the City of Mountain Home vicinity, east of MHAFB, and an area southwest of MHAFB. Groundwater is the only source of irrigation water in some of these areas, especially in the Cinder Cone Butte area.
4. Approximately 68,000 AF of groundwater is pumped for agricultural irrigation in an average year. Approximately 58,000 AF is used annually for primary irrigation and approximately 9,400 AF is supplemental to surface water deliveries. These volumes can vary substantially based on annual variations in surface-water availability, weather-conditions, cropping patterns, and associated irrigation requirements.
5. Municipal groundwater use by the City of Mountain Home averages approximately 4,720 AF per year. Groundwater use by MHAFB averages approximately 1,634 AF per year. The future municipal water demand will depend on actual population growth. Current projections, given current trends and barring a large increase in MHAFB activity or increased economic capture from the Boise area, suggest that future municipal demand will not grow substantially beyond current amounts. However, a greater water supply could lead to additional economic activity, which would lead to an increase in long-term municipal demand.
6. Total groundwater pumping for irrigation, municipal use, private commercial and industrial use, and stock water is approximately 80,000 AF/year. Agricultural and municipal irrigation account for approximately 90% of groundwater use.

Aquifer Characteristics

7. A regional aquifer is present in basalt and interbedded sediments beneath most of the study area.

8. Recharge to the regional aquifer occurs primarily from infiltration of precipitation, infiltration from agricultural irrigation, and seepage from surface features (rivers, streams, unlined channels, drains, and impoundments). In general, aquifer recharge is limited by relatively low precipitation rates in the Water District 161 area and tributary watersheds of the Danskin Mountains and Mount Bennett Hills.

9. Discharge from the regional aquifer is primarily from evapotranspiration, irrigation and non-irrigation consumptive uses, discharge to surface water features, and groundwater underflow components.

Groundwater Levels

10. Groundwater levels have declined over time in portions of the Elmore County study area, primarily in the vicinity of Cinder Cone Butte, MHAFB, and City of Mountain Home.

11. Groundwater-level declines in the Cinder Cone Butte area since the 1960s have extended over 100 feet, and may be approaching 200 feet in some locations. MHAFB and the City of Mountain Home have experienced water-level declines of 50 to 80 feet. Groundwater-level declines in the vicinity of the canyon rim above the Snake River, east and west of MHAFB, have ranged from about 60 to 80 feet. These groundwater-level declines reflect concentrated groundwater withdrawals in excess of local recharge rates.

12. Groundwater levels in large portions of the Mountain Home Plateau remain stable. Substantial groundwater withdrawals have not been developed in these areas, and water use for irrigation relies primarily on surface-water sources.

13. The localized nature of water-level declines may pose challenges for both aquifer stabilization projects and water right administration. Groundwater recharge or reductions in pumping in one area are unlikely to provide significant or timely benefits to areas of water-level decline located ten or more miles away. Similarly, curtailment of junior-priority water rights in one location might not provide any benefit to senior-priority groundwater rights at a distant location.

Water-Supply Deficit

14. The estimated aggregate groundwater depletion since the early 1970s is approximately 1.9 million AF. The aggregate depletion in the Cinder Cone Butte vicinity, City of Mountain Home vicinity, and MHAFB vicinity was estimated to be approximately 1.1 million AF, 320,000 AF, and 548,000 AF, respectively.

15. The current annual pumping deficit within the study area is estimated to be approximately 43,000 AF. The current annual pumping deficits in the Cinder Cone Butte vicinity, City of Mountain Home vicinity, and MHAFB vicinity are estimated to be approximately 24,000 AF, 7,000 AF, and 12,000 AF, respectively.

Alternative Sources of Supply

16. The water-supply deficits in various subareas could be eliminated by reducing pumping or increasing recharge by the annual deficit volume. These actions will require obtaining water supply from other sources if economic activities are to be maintained.
17. Alternative sources of supply include water from the Snake River, Boise River, or, in some areas, groundwater. Canyon Creek and other streams crossing the Mountain Home Plateau may have potential for increased aquifer recharge, but are not reliable sources for additional direct water supplies.
18. New appropriations for Snake River diversions upstream from Swan Falls Dam are likely available for municipal uses and possibly available for supplemental irrigation during times that Snake River flows at Swan Falls Dam are greater than established minimum flows. Snake River flows have approached (or dipped below) established minimum flows at the end of March and during July; such low-flow conditions are relatively rare (less than 1% of the time historically). Uses of the water must be determined to be “in the public interest” to be eligible for appropriation.
19. Below Swan Falls Dam, Snake River water is generally available for appropriation on a year-round basis for all uses with few restrictions. However, the significant distance from this reach of the river to areas in Elmore County needing water supply limits the feasibility of this source.
20. Existing water rights authorizing Snake River diversions under priority dates senior to the Swan Falls minimum flows (i.e., October 25, 1984) could be acquired and transferred for irrigation or municipal uses within Water District 161. However, costs for acquisition of water rights, coupled with infrastructure costs for water delivery, are unlikely to be economically feasible for irrigation purposes.
21. The Boise River is generally thought to be fully appropriated above Star, Idaho except for limited periods in years with above average water supply. A new junior-priority water right would likely be in priority only during times of flood releases. While the volume of water that would be in priority for a future junior water right is substantial, these high flows typically are not available for extended periods of time within a given year, and may not be available at all for years at a time.
22. Increased Boise River storage could store excess flows currently released for flood control purposes. Alternatives for increasing Boise River storage are currently under investigation, but even if shown to be economically feasible, will not be available for many years.

23. Increased storage in other drainages (e.g., Galloway Reservoir in the Weiser River drainage) could supply water for flow augmentation purposes in the lower Snake River, possibly freeing up some of the currently uncontracted storage in the Boise River reservoir system. Similarly, cessation of Snake River flow augmentation using water from southern Idaho could free up uncontracted Boise River storage water. Again, these alternatives will not be available for many years, at best.

24. Modest amounts of groundwater are likely available for appropriation in portions of the study area that experience stable groundwater levels. However, there is not a sufficient groundwater supply to meet current pumping deficits. Furthermore, administrative constraints may limit the amount of additional groundwater that can be appropriated.

25. Recharge facilities could be constructed to capture high flows in the Canyon Creek drainage that might otherwise discharge to the Snake River during years of above normal runoff. Due to the infrequent and short-term nature of such runoff events, Canyon Creek is not considered an alternative source of supply for direct use within the study area.

26. Conservation may play a role in reducing water use within the study area. Power costs are already a significant incentive for groundwater users to conserve water and maximize efficiency within the study area.

<u>Infrastructure Requirements</u>

27. Thirteen infrastructure alternatives for importation of water to the study area were evaluated, including five Boise River alternatives and eight Snake River alternatives.

28. The Boise River alternatives included four alternatives that would deliver water to the vicinity of Mountain Home through the Canyon Creek drainage. Two of these alternatives provided water from Anderson Ranch Reservoir to Little Camas Reservoir for delivery through MHID facilities to Canyon Creek. Two of these alternatives provided water from the South Fork of the Boise River to Long Tom Creek (tributary to Canyon Creek). Annual costs for water, based on conveyance of 10,000 acre feet to Mountain Home in a 90-day period, ranged from $103 to $168/AF. Increasing the pumping period to 180 days and annual volume to 20,000 AF lowered the costs to $80 to $122/AF. The fifth alternative provided 25,000 AF of water from Lucky Peak Reservoir to the Cinder Cone Butte vicinity over a 180-day pumping period at a cost of $202/AF.

29. Four of the Snake River alternatives each provide 10,000 AF annually of water to the vicinity of the City of Mountain Home for supplemental irrigation, municipal, and groundwater recharge uses. Two alternatives provide 25,000 AF to Cinder Cone Butte, and one alternative provides 10,000 AF to groundwater-irrigated lands located south of the City of Mountain Home and east of MHAFB. The final alternative provides 20,000 AF annually for replacement of groundwater diversions on lands located south of the

City of Mountain Home and east of MHAFB and for supplemental irrigation, municipal, and recharge uses near Mountain Home. Unit costs for delivery of Snake River water range from approximately $90 to $270/AF.

30. The unit costs for water importation do not include costs for water right or storage contract acquisition. Such costs may be high for the Boise River, where new appropriations are limited to infrequent high flows. Costs for acquisition of Snake River water will be low if the water can be appropriated because water is available on a consistent basis; however, appropriations must be determined to be in the public interest. Costs for acquisition of existing water rights from the Snake or Boise rivers, when coupled with water delivery costs, are likely infeasible for agricultural irrigation purposes.

Water Utilization Strategies

31. The preferred strategy for use of imported surface water is direct irrigation, as either a replacement for current groundwater sources and as a supplement to existing surface water sources.

32. Where possible, the two uses (replacement of groundwater sources and supplementation of surface water sources) can be combined in a conjunctive use strategy. For this purpose, the imported water is used to replace groundwater sources in years when local surface water supplies are fully available. In years when surface water supplies are limited, use of groundwater can be resumed as needed on historically groundwater-irrigated lands and the imported water can be used to supplement surface water supplies.

33. Use of imported water for groundwater recharge is less efficient than for direct irrigation use because the water would need to be re-lifted from wells, some of which have deep pumping water levels. Recharge may be effective when imported water supplies are available primarily during the non-irrigation season, or if administrative constraints prohibit direct use of imported water for irrigation, or if surface recharge allows a municipal water user to avoid surface water treatment.

Operational and Administrative Options

34. The choice of an appropriate entity for constructing and operating a water supply improvement project will depend on the beneficiaries of the project. A ground water district, irrigation district, municipality, or private entity could potentially own and operate a project. It may be possible for the County to act as an irrigation district to facilitate creation of water supply projects.

Economic Impact of Water-Supply Deficiency

35. Elmore County would economically benefit from a more robust water supply. Agricultural, manufacturing, and municipal development are all currently limited by lack

of sufficient and reliable water in the County. Agricultural users limit planted acreage because of water constraints, and are also limited in the commodities they can produce. In addition, the County has lost potential for manufacturing development (including a recent proposal that would bring 450 industrial jobs to the County).

36. Potential curtailment of groundwater pumping to stem declining groundwater levels would have a negative impact on the Elmore County economy.

37. New water projects that are unable to maintain current pricing levels may not be viable solutions for water shortages in the agricultural sector (projected water costs for various current proposals range from approximately $100 to $200/AF).

Recommendations

Elmore County can organize and work on behalf of water users to improve the water supply within the study area. The following five steps are recommended to initiate water supply improvements.

1. Development of projects seeking appropriation of Snake River water within Elmore County are predicated on a determination that such an appropriation is in the public interest. The County should seek a determination from the director of the Idaho Department of Water Resources, through a declaratory ruling or other means, that diversion of trust water from the Snake River in Elmore County for supplemental irrigation, aquifer recharge, and municipal purposes that results in Snake River depletions of more than 2 acre feet per day are in the public interest under the criteria of Idaho Code Section 42-203C(2). The public interest arguments could focus on aquifer stabilization and preservation of the local economy. The development of substantial electrical generation capacities from solar and wind sources within the County in recent years may offset impacts to electrical utility rates resulting from depletions to Snake River flows.

2. The County should conduct a value engineering study for a pumping station and pipeline from the Snake River directly north to Mountain Home (similar to alternative S4B). The study would seek ways to reduce water costs so that Snake River water supplies would be feasible for current agricultural irrigation. The pumping station and pipeline would supply the following uses.

    - A replacement supply for up to 4,000 acres that are currently irrigated with groundwater in this area. The Snake River water would be used when available to reduce groundwater diversions for aquifer stabilization purposes.
    - A supplemental supply for participating acres within MHID. The Snake River water would be used when MHID supplies are limited due to water supply conditions.
    - An available municipal supply for the City of Mountain Home. The water could be appropriated under a reasonably anticipated future needs application, and be made

available to support City growth. To the extent utilized, the water could be used as raw water in pressurized irrigation or be treated to support new industry and residential growth.

- An available supply for aquifer recharge to support municipal and existing irrigation uses. It may be possible to exchange Snake River water delivered to the southern end of MHID for Canyon Creek water used for aquifer recharge north and west of Mountain Home in the Canyon Creek streambed, gravel pits, or Mountain Home Reservoir.

3. The County should conduct a value engineering study for a pumping station and pipeline from the Snake River to Cinder Cone Butte. Use of this water would be for replacement of existing groundwater supplies, either by direct pumping or aquifer recharge.

4. The County should continue to participate in activities to obtain storage space within the Boise River reservoir system, either through development of additional storage space or through obtaining uncontracted storage.

5. Projects to increase aquifer recharge from Canyon Creek and tributary streams crossing the Mountain Home Plateau will reduce losses of streamflow to the Snake River during years of high runoff. Aquifer recharge can be enhanced through diversion to gravel pits and construction of check structures on stream channels (including reconstruction of Fraser Dam on Canyon Creek). The County should initiate or support such actions.

8. REFERENCES

Baker, S.J., 1988. Declining Water Levels in the Perched Aquifer System, Southwest Mountain Home, Idaho Department of Water Resources, June 1988.

Bendixsen, S., 1994. Summary of Hydrologic Conditions in the Mountain Home and Cinder Cone Butte Areas, report from the Idaho Department of Water Resources.

Bond and Wood, 1978. Geologic Map of Idaho. Idaho Bureau of Mines and Geology.

Driscoll, F.G., 1986. Groundwater and Wells. Johnson Division, St. Paul, MN.

Freeze, R.A., Cherry, J.A., 1979. Groundwater. Prentice-Hall, Englewood Cliffs, NJ, 604 pp.

Harrington, H., Bendixsen, S., 1999. Ground Water Management Areas in Idaho - Overview as of 1998, Idaho Department of Water Resources, Boise, ID.

Harrington, H. 2004. Mountain Home Plateau Groundwater Conditions and Management Activities. Presentation to the Idaho Legislature Natural Resources Interim Committee, August 5, 2004.

IWRB, 2012. Idaho State Water Plan, adopted by the Idaho Water Resource Board, November 2012.

Lindholm, G.F., Garbedian, S.P., Newton, G.D., Whitehead, R.L., 1988. Configuration of the Water Table and Depth to Water, Spring 1980, Water-Level Fluctuations, and Water Movement in the Snake River Plain Regional Aquifer System, Idaho and Eastern Oregon., U.S. Geologic Survey Hydrologic Investigations.

Mabey, D.R., 1982. Geophysics and tectonics of the Snake River Plain, Idaho. In: Bill Bonnichsen and R. M. Breckenridge, editors, Cenozoic Geology of Idaho. Idaho Bureau of Mines and Geology Bulletin 26: 193-153.

Maupin, M.A. et al., 2014. Estimated Use of Water in the United State in 2010, U.S. Geological Survey Circular 1405.

Norton, M.A., Ondrechen, W., Baggs, J.L., 1982. Ground Water Investigation of the Mountain Home Plateau, Idaho, Open-File Report, Idaho Department of Water Resources.

Ondrechen, B., 2004. Memorandum updating water budget for Mountain Home Ground Water Management Area, Idaho Department of Water Resources.

Shervais, J.W., Shroff, G., Vetter, S.K., Matthews, S., Hanan, B.B., and J.J. McGee, 2002. Origin and evolution of the western Snake River Plain: Implications from stratigraphy, faulting, and the geochemistry of basalts near Mountain Home, Idaho, in Bill Bonnichsen, C.M. White, and Michael McCurry, eds., Tectonic and Magmatic Evolution of the Snake River Plain Volcanic Province: Idaho Geological Survey Bulletin 30, P. 343-361.

SPF, 2016. Treasure Valley DCMI Water-Demand Projections (2015-2065), consulting report prepared for the Idaho Water Resource Board and the Idaho Department of Water Resources by SPF Water Engineering, LLC (dated August 8, 2016).

USBR, 2016a. 2015 Salmon Flow Augmentation Program and Other Activities Associated with the NOAA Fisheries Service 2008 Biological Opinion and Incidental Take Statement for Operations and Maintenance of Bureau of Reclamation Projects in the Snake River Basin above Brownlee Reservoir – Annual Progress Report, U.S. Bureau of Reclamation, April 5, 2016 (with Errata to supersede version dated December 3, 2015).

USBR, 2016b. Anderson Ranch Dam Raise Preliminary Hydrologic Evaluation, U.S. Bureau of Reclamation Technical Memorandum, April 2016Bureau

Whitehead, R.L., 1986. Geohydrologic framework of the Snake River Plain, Idaho and eastern Oregon. U.S. Geologic Survey Hydrologic Investigations Atlas HA-681, Scale 1:1,000,000.

Wood, S.H., Anderson, J.E., 1981. Part 11: Geological, hydrological, and geochemical and geophysical investigations of the Nampa-Caldwell and adjacent areas, southwestern Idaho. In: Mitchell, J.C. (Ed.), Geothermal investigations in Idaho. Idaho Department of Water Resources.

Wood, S.H., Clemens, D.M., 2004. Geologic and tectonic history of the western Snake River Plain, Idaho and Oregon. In: Bonnichsen, B., White, C.M., McCurry, M. (Eds.), Tectonic and Magmatic Evolution of the Snake River Plain Volcanic Province: Idaho Geologic Survey Bulletin 30, p. 69-103.

Appendix A:
Hydrographs

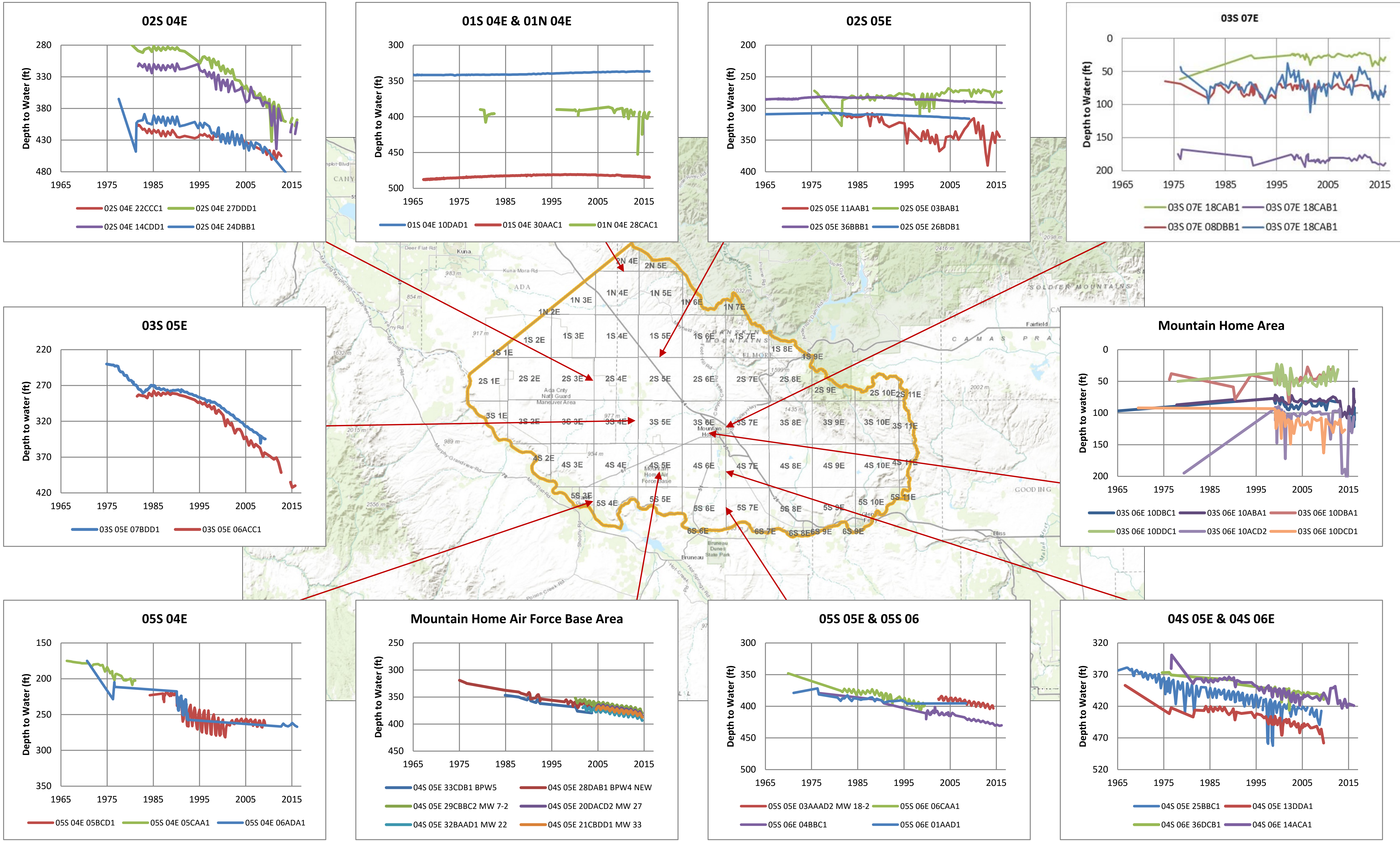

Figure A-1. Groundwater levels in the study area

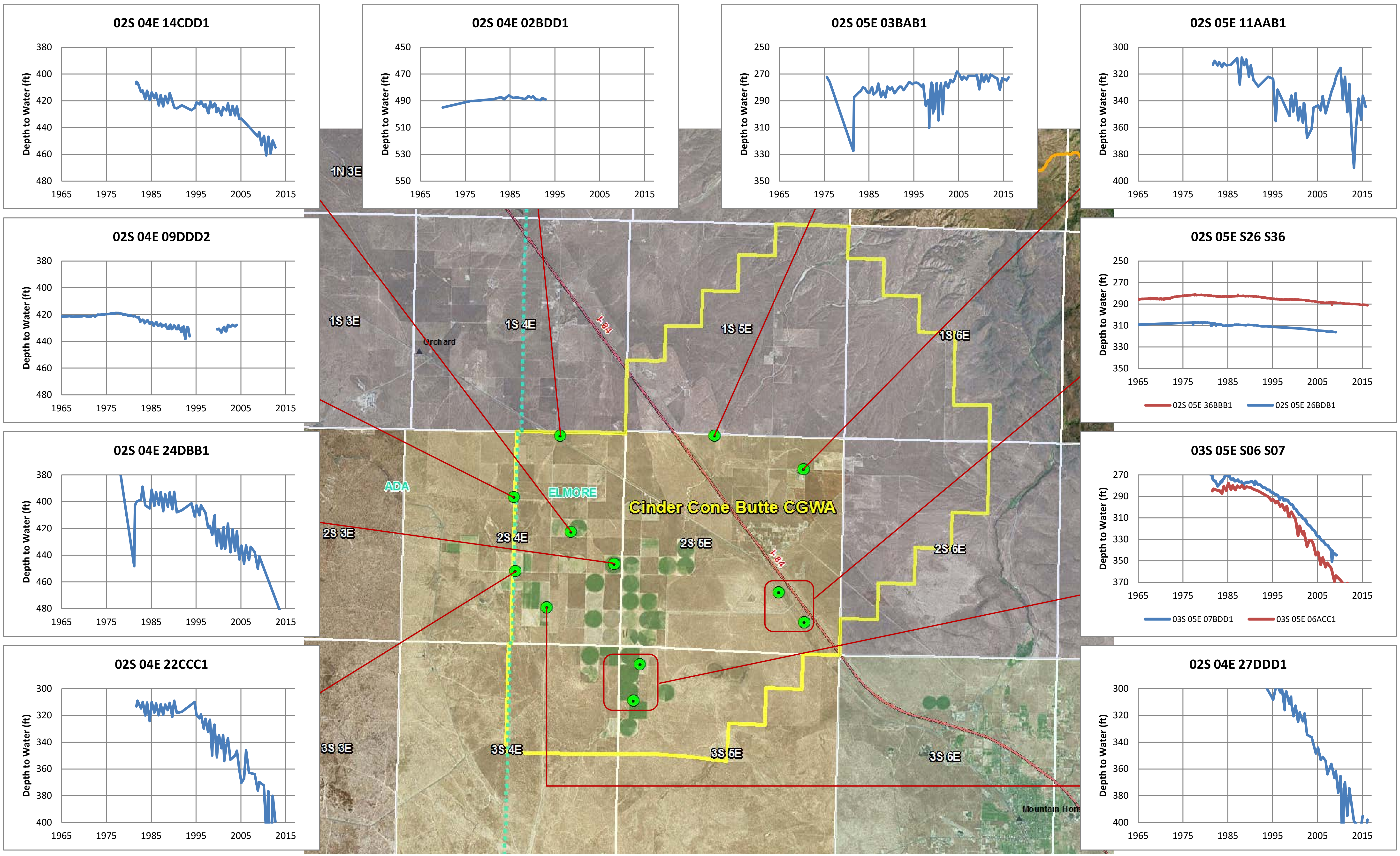

Figure A-2. Groundwater levels in Cinder Cone Butte CGWA

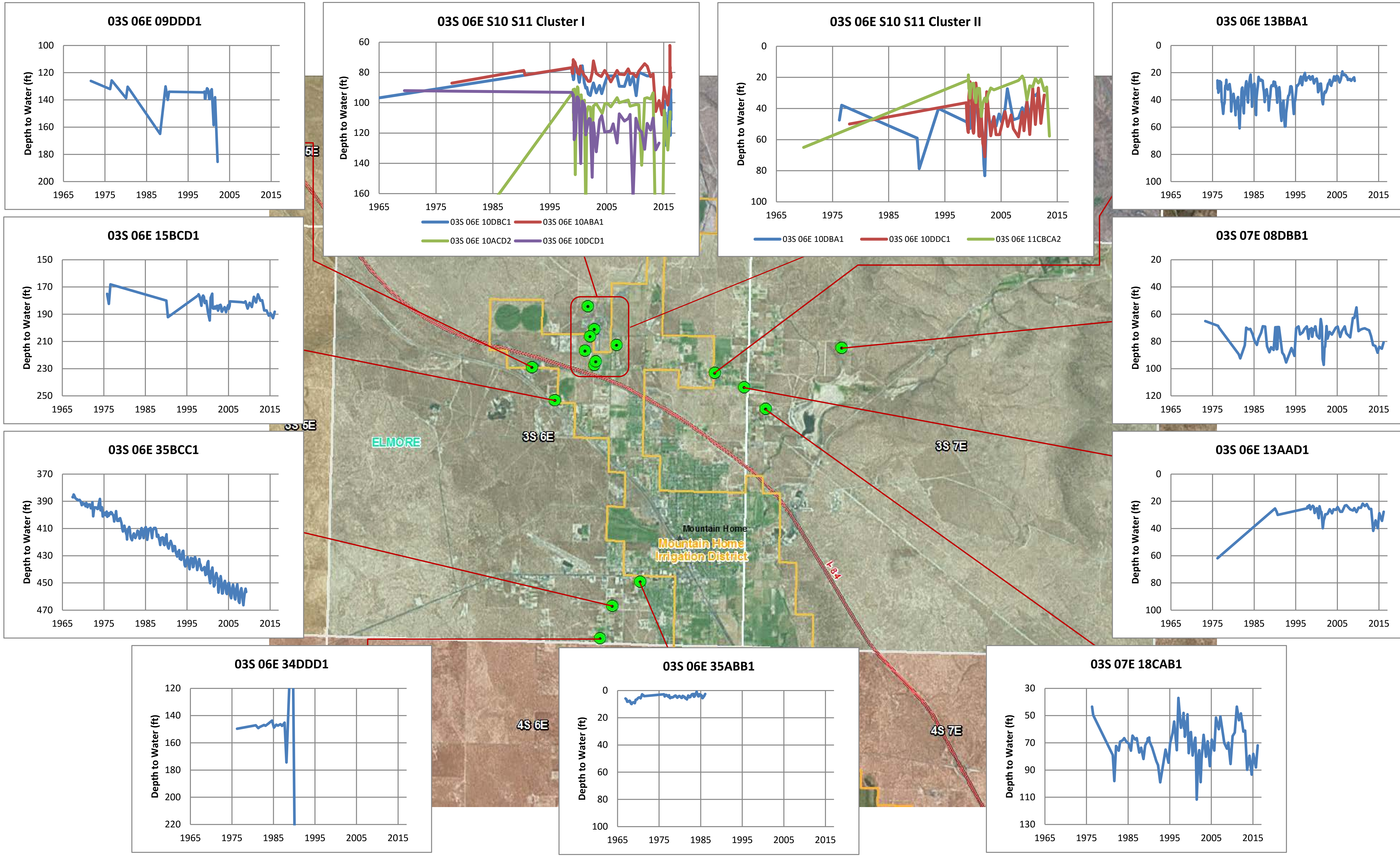

Figure A-3. Groundwater levels in the City of Mountain Home vicinity

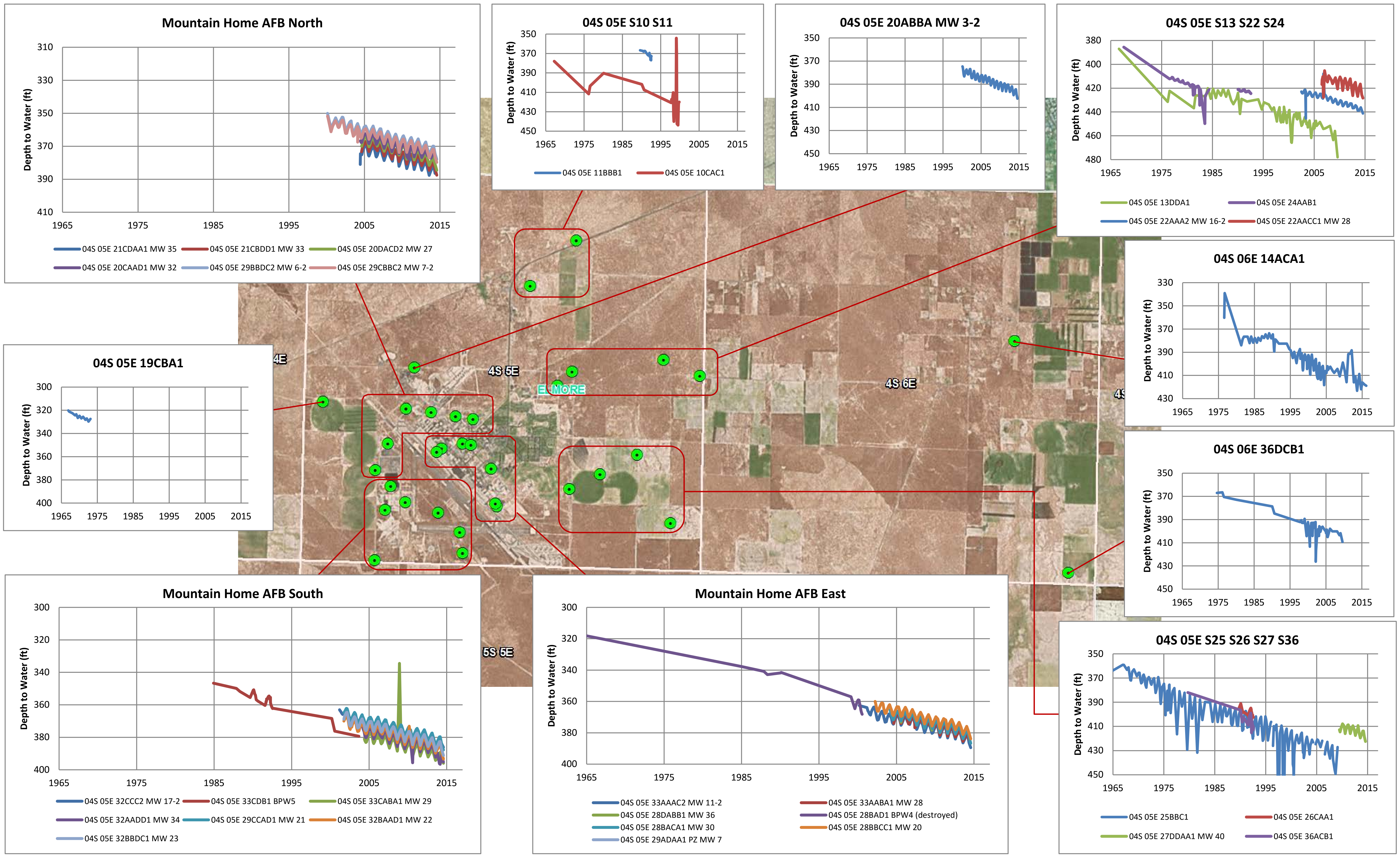

Figure A-4. Groundwater levels in the MHAFB vicinity

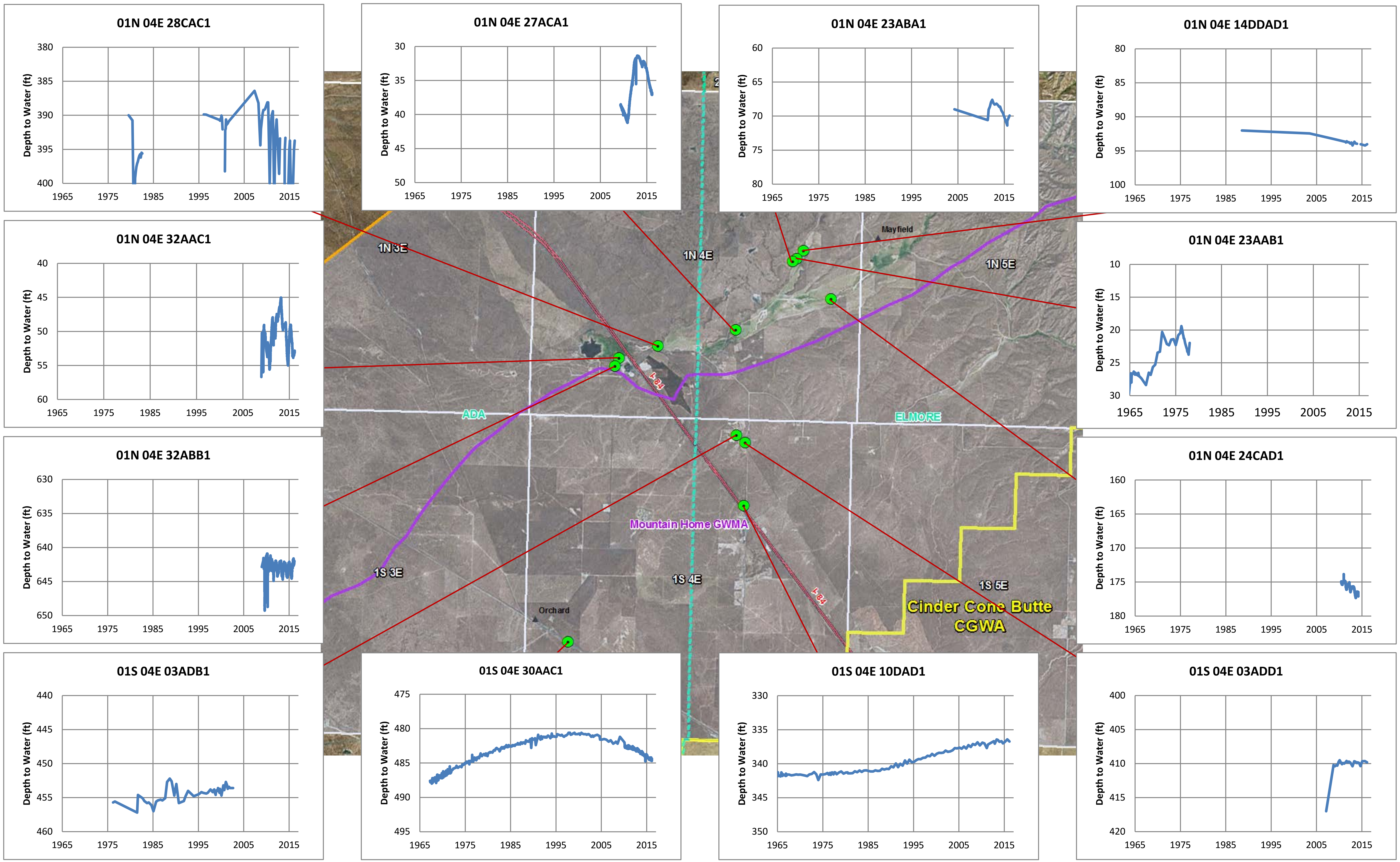

Figure A-5. Groundwater levels near the I-84 Corridor

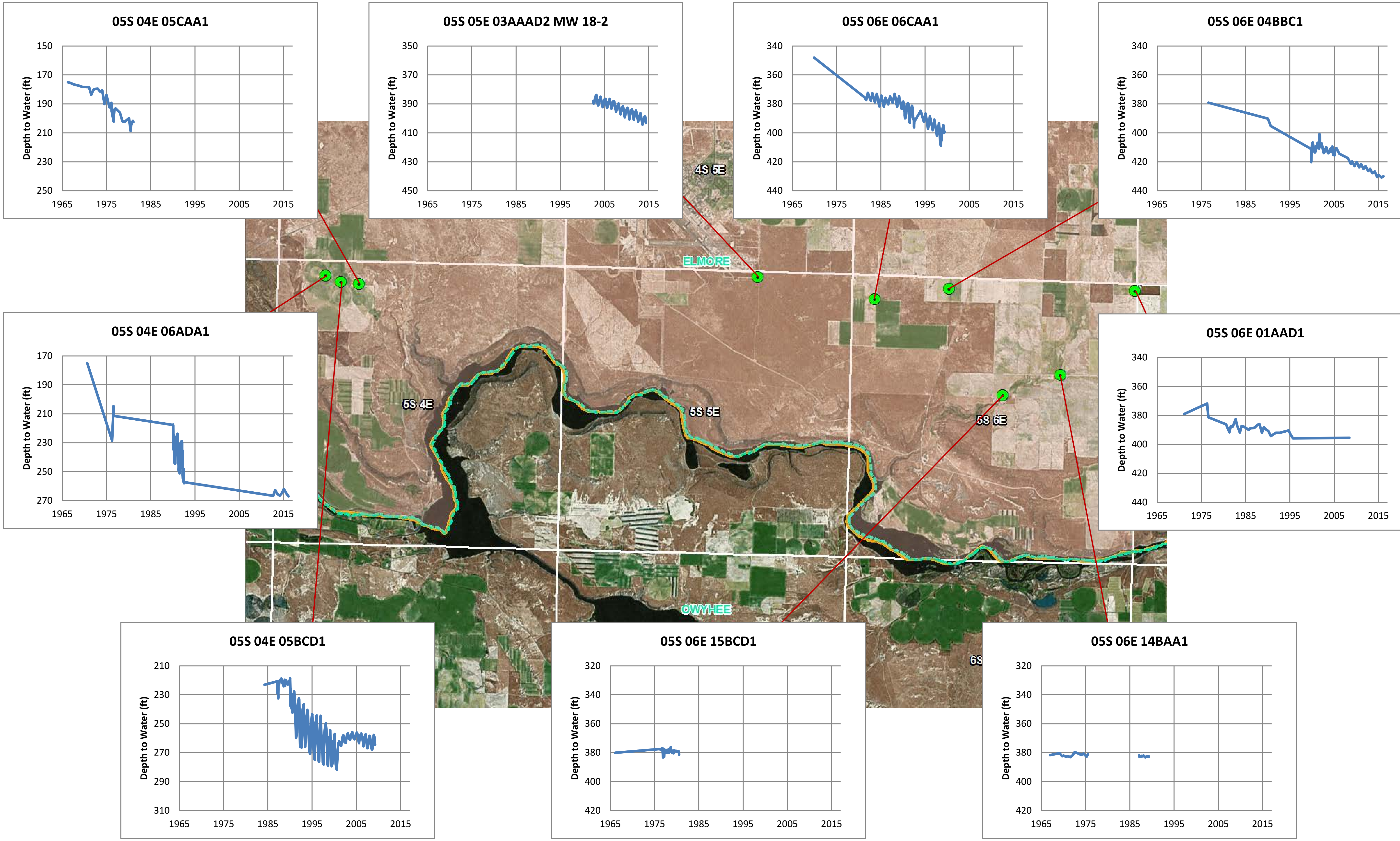

Figure A-6. Groundwater levels near the Snake River

Appendix B:

Groundwater-Level Surface Data

Water Level Surface Data for Deficit Calculations										
WellNumber	Total Depth (ft)	Open Min (ft)	Open Max (ft)	Completion Date	Well Elev (ft msl)	X (DTM)	Y (DTM)	Average Water Level (1970 - 1979) (ft msl)	Average Water Level (2000 - 2016) (ft msl)	Average Decline (1970s - 2016) (ft)
02S 01E 23ADD1	816	615	816	10/1/1968	3,155	2,313,682	1,339,556	2459.66	2462.30	2.64
05S 08E 36CCC1	90	--	--	1/1/1950	2,536	2,380,828	1,305,307	2475.22	2471.05	-4.17
05S 08E 34DBA1	75	--	--	1/20/1975	2,520	2,378,413	1,306,073	2479.00	2475.50	-3.50
05S 04E 06ADA1	354	280	354	10/24/1970	2,855	2,335,606	1,315,470	2663.48	2589.65	-73.82
05S 06E 04BBC1	495	167	492	8/23/1967	3,035	2,356,928	1,315,022	2655.85	2609.93	-45.92
04S 05E 25BBC1	530	--	--	1/1/1967	3,048	2,352,071	1,318,393	2669.78	2616.54	-53.23
04S 05E 13DDA1	578	10	578	10/20/1966	3,100	2,352,726	1,320,728	2677.67	2640.53	-37.14
04S 03E 23CDD1	600	66	600	9/5/1969	2,917	2,331,601	1,319,302	2672.33	2648.29	-24.04
04S 06E 36DCB1	615	347	615	10/16/1974	3,053	2,362,689	1,315,490	2685.25	2649.37	-35.88
01S 04E 30AAC1	750	550	750	9/1/1910	3,152	2,336,279	1,347,564	2666.75	2668.98	2.24
05S 06E 01AAD1	435	135	435	4/5/1971	3,065	2,363,290	1,314,959	2684.90	2669.58	-15.32
04S 06E 14ACA1	700	28	700	5/18/1976	3,084	2,361,379	1,321,195	2734.35	2674.94	-59.41
02S 04E 24DBB1	1,083	570	1,083	9/1/1977	3,130	2,343,983	1,338,743	2765.00	2680.22	-84.79
03S 06E 35BCC1	902	6	902	3/14/1962	3,145	2,360,475	1,325,805	2747.01	2687.27	-59.74
02S 04E 27DDD1	1,190	149	1,190	4/23/1976	3,080	2,340,979	1,336,797	2827.96	2694.85	-133.11
03S 05E 07BDD1	497	240	497	1/17/1975	3,074	2,344,852	1,332,661	2826.37	2732.65	-93.72
04S 07E 17CAB1	500	20	500	4/27/1972	3,088	2,365,533	1,320,691	2779.63	2742.00	-37.64
02S 05E 26BDB1	429	--	--	<Null>	3,205	2,351,317	1,337,489	2897.63	2889.13	-8.50
02S 05E 36BBB1	357	50	357	1/1/1946	3,190	2,352,472	1,336,134	2907.06	2900.22	-6.83
01N 04E 28CAC1	763	500	752	9/4/1979	3,353	2,338,931	1,356,319	2963.40	2959.87	-3.53
01S 04E 10DAD1	525	496	525	9/30/1959	3,308	2,341,477	1,351,598	2966.06	2970.64	4.58
03S 06E 15BCD1	402	175	402	12/12/1975	3,195	2,359,130	1,330,623	3023.47	3010.96	-12.51
02S 05E 03BAB1	--	--	--	--	3,300	2,348,481	1,344,462	3026.07	3026.65	0.57
03S 06E 10ABA1	622	42	622	12/6/1977	3,235	2,359,898	1,332,829	3148.00	3150.26	2.26
03S 06E 10DBA1	394	50	394	10/7/1968	3,225	2,359,951	1,332,118	3182.34	3184.45	2.11
04S 10E 30BBA1	2,268	1,400	2,270	1/1/1959	3,455	2,392,495	1,317,795	3191.93	3186.99	-4.94
03S 07E 18CAB1	250	20	250	7/9/1974	3,255	2,364,074	1,330,429	3208.47	3186.54	-21.93
03S 06E 13BBA1	150	--	--	5/24/1957	3,240	2,362,870	1,331,256	3205.79	3215.67	9.89
03S 07E 08DBB1	225	--	--	6/1/1973	3,313	2,365,841	1,331,845	3245.89	3238.29	-7.60
02S 06E 11DAC1	1,620	1,040	1,550	1/1/1967	3,400	2,361,736	1,341,031	3292.48	3300.37	7.89

Appendix C:
Supporting Information for Infrastructure Alternatives

ALTERNATIVE B1
ANDERSON RANCH RESERVOIR TO LITTLE CAMAS RESERVOIR

PROJECT : ELMORE COUNTY WATER SUPPLY
CAPACITY: 10,000 AFA, 90 DAYS, 25,000 GPM, 56 CFS
JOB # : 1188.0020
LOCATION : Elmore County, ID

ESTIMATE CLASS : 5
DATE : 12/12/2016
BY : EL
REVIEWED :

NO.	DESCRIPTION	QTY	UNIT	UNIT PRICE	COST
1.1	INTAKE PUMP STATION	6,500	HP	$366	$2,379,000
1.2	48-IN DIA CARBON STEEL PIPELINE	1,500	LF	$386	$578,700
1.3	48-IN DIA C905 PVC PIPELINE	10,650	LF	$185	$1,975,000
1.4	CONTINGENCY		20%		$987,000
1.5	ENGINEERING, ADMINISTRATIVE, LEGAL		10%		$592,000
	TOTAL ESTIMATED PROJECT COST				**$6,510,000**
2.0	ANNUAL OPERATIONS AND MAINTENANCE COST				
2.1	POWER	10,340	MWH	$55.30	$571,800
2.2	OPERATIONS AND MAINTENANCE	2%	CAPITAL COST		$130,200
	TOTAL ESTIMATED ANNUAL O&M COST				**$702,000**
3.0	TOTAL ANNUAL COST				
3.1	CAPITAL PAYBACK	4%	40 YRS		$328,900
3.2	OPERATIONS AND MAINTENANCE (INCLUDING POWER)				$702,000
	TOTAL ESTIMATED ANNUAL COST				**$1,031,000**
	ANNUAL VOLUME (AF)				**10,000**
	UNIT COST OF WATER ($/AF)				**$103**

Notes:
Costs do not include potential permitting, land acquisition, easements, environmental studies, and legal costs.
Costs do not include potential electrical supply facility upgrades.
Power costs from Idaho Power Co. Schedule 19 for Large Power Service, Secondary Service. Costs reflect annual average power cost. Costs are higher during summer (June-August), and lower during non-summer. Cost are higher during peak and mid-peak times and lower off-peak. Power costs may vary somewhat depending on time of use.

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SPF WATER ENGINEERING

ALTERNATIVE B2
SOUTH FORK BOISE RIVER TO MHID CANAL

PROJECT : ELMORE COUNTY WATER SUPPLY
CAPACITY: 10,000 AFA, 90 DAYS, 25,000 GPM, 56 CFS
JOB # : 1188.0020
LOCATION : Elmore County, ID

ESTIMATE CLASS : 5
DATE : 12/12/2016
BY : EL
REVIEWED :

NO.	DESCRIPTION	QTY	UNIT	UNIT PRICE	COST
1.1	INTAKE PUMP STATION	8,200	HP	$366	$3,001,200
1.2	48-IN DIA CARBON STEEL PIPELINE	3,440	LF	$386	$1,327,100
1.3	CONTINGENCY		20%		$866,000
1.4	ENGINEERING, ADMINISTRATIVE, LEGAL		10%		$519,000
	TOTAL ESTIMATED PROJECT COST				**$5,710,000**
2.0	ANNUAL OPERATIONS AND MAINTENANCE COST				
2.1	POWER	10,340	MWH	$55.30	$571,800
2.2	OPERATIONS AND MAINTENANCE	2%	CAPITAL COST		$114,200
	TOTAL ESTIMATED ANNUAL O&M COST				**$686,000**
3.0	TOTAL ANNUAL COST				
3.1	CAPITAL PAYBACK	4%	40 YRS		$288,500
3.2	OPERATIONS AND MAINTENANCE (INCLUDING POWER)				$686,000
	TOTAL ESTIMATED ANNUAL COST				**$975,000**
	VOLUME DELIVERED (AF)				**10,000**
	UNIT COST OF WATER ($/AF)				**$98**

Notes:
Costs do not include potential permitting, land acquisition, easements, environmental studies, and legal costs.
Costs do not include potential electrical supply facility upgrades.
Power costs from Idaho Power Co. Schedule 19 for Large Power Service, Secondary Service. Costs reflect annual average power cost. Costs are higher during summer (June-August), and lower during non-summer. Cost are higher during peak and mid-peak times and lower off-peak. Power costs may vary somewhat depending on time of use.

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ALTERNATIVE B3
PARTICIPATE IN PUMPED STORAGE PROJECT

PROJECT : ELMORE COUNTY WATER SUPPLY — **ESTIMATE CLASS :** 5
CAPACITY: 10,000 AFA, 90 DAYS, 25,000 GPM, 56 CFS — **DATE :** 12/12/2016
JOB # : 1188.0020 — **BY :** EL
LOCATION : Elmore County, ID — **REVIEWED :**

NO.	DESCRIPTION	QTY	UNIT	UNIT PRICE	COST
1.0	ESTIMATED PORTION OF PUMPED STORAGE INFRASTRUCTURE				
1.1	INTAKE PUMP STATION	7,300	HP	$366	$2,671,800
1.2	48-IN DIA CARBON STEEL PIPELINE	4,800	LF	$386	$1,851,730
2.0	CONVEYANCE FROM CAT CREEK RESERVOIR TO LITTLE CAMAS RESERVOIR				
2.1	LOW-LIFT PUMP STATION	25,000	GPM	$28	$700,000
2.2	48-IN DIA C905 PVC PIPELINE	8,450	LF	$185	$1,567,027
3.1	CONTINGENCY		20%		$1,358,000
3.2	ENGINEERING, ADMINISTRATIVE, LEGAL		10%		$815,000
	TOTAL ESTIMATED PROJECT COST				**$8,960,000**
4.0	ANNUAL OPERATIONS AND MAINTENANCE COST				
4.1	POWER	11,710	MWH	$55.30	$647,600
4.2	OPERATIONS AND MAINTENANCE	2%	CAPITAL COST		$179,200
	TOTAL ESTIMATED ANNUAL O&M COST				**$827,000**
5.0	TOTAL ANNUAL COST				
5.1	CAPITAL PAYBACK	4%	40 YRS		$452,700
5.2	OPERATIONS AND MAINTENANCE (INCLUDING POWER)				$827,000
	TOTAL ESTIMATED ANNUAL COST				**$1,280,000**
	VOLUME DELIVERED (AF)				**10,000**
	UNIT COST OF WATER ($/AF)				**$128**

Notes:
Costs do not include potential permitting, land acquisition, easements, environmental studies, and legal costs.
Costs do not include potential electrical supply facility upgrades.
Power costs from Idaho Power Co. Schedule 19 for Large Power Service, Secondary Service. Costs reflect annual average power cost. Costs are higher during summer (June-August), and lower during non-summer. Cost are higher during peak and mid-peak times and lower off-peak. Power costs may vary somewhat depending on time of use.

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SPF WATER ENGINEERING

ALTERNATIVE B4
SOUTH FORK BOISE RIVER VIA LONG TOM TUNNEL

PROJECT :	ELMORE COUNTY WATER SUPPLY	**ESTIMATE CLASS :**	5
CAPACITY:	10,000 AFA, 90 DAYS, 25,000 GPM, 56 CFS	**DATE :**	12/12/2016
JOB # :	1188.0020	**BY :**	EL
LOCATION :	Elmore County, ID	**REVIEWED :**	

NO.	DESCRIPTION	QTY	UNIT	UNIT PRICE	COST
1.1	INTAKE PUMP STATION	8,400	HP	$366	$3,074,400
1.2	48-IN DIA CARBON STEEL PIPELINE	4,400	LF	$386	$1,697,400
1.3	72-IN TUNNEL - SHIELDED TBM - PCS LINING	2,000	LF	$2,250	$4,500,000
1.4	48-IN DIA C905 PVC PIPELINE	4,230	LF	$185	$784,400
1.5	CONTINGENCY		20%		$2,011,000
1.6	ENGINEERING, ADMINISTRATIVE, LEGAL		10%		$1,207,000
	TOTAL ESTIMATED PROJECT COST				**$13,270,000**
2.0	ANNUAL OPERATIONS AND MAINTENANCE COST				
2.1	POWER	13,540	MWH	$55.30	$748,800
2.2	OPERATIONS AND MAINTENANCE	2%	CAPITAL COST		$265,400
	TOTAL ESTIMATED ANNUAL O&M COST				**$1,014,000**
3.0	TOTAL ANNUAL COST				
3.1	CAPITAL PAYBACK	4%	40 YRS		$670,400
3.2	OPERATIONS AND MAINTENANCE (INCLUDING POWER)				$1,014,000
	TOTAL ESTIMATED ANNUAL COST				**$1,684,000**
	VOLUME DELIVERED (AF)				**10,000**
	UNIT COST OF WATER ($/AF)				**$168**

Notes:
Costs do not include potential permitting, land acquisition, easements, environmental studies, and legal costs.
Costs do not include potential electrical supply facility upgrades.
Power costs from Idaho Power Co. Schedule 19 for Large Power Service, Secondary Service. Costs reflect annual average power cost. Costs are higher during summer (June-August), and lower during non-summer. Cost are higher during peak and mid-peak times and lower off-peak. Power costs may vary somewhat depending on time of use.

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SPF WATER ENGINEERING

ALTERNATIVE B5
LUCKY PEAK RESERVOIR TO CINDER CONE AREA

PROJECT : ELMORE COUNTY WATER SUPPLY
CAPACITY: 25,000 AFA,180 DAYS, 31,400 GPM, 70 CFS
JOB # : 1188.0020
LOCATION : Elmore County, ID

ESTIMATE CLASS : 5
DATE : 12/12/2016
BY : EL
REVIEWED :

NO.	DESCRIPTION	QTY	UNIT	UNIT PRICE	COST
1.1	INTAKE PUMP STATION	5,800	HP	$366	$2,122,800
1.2	48-IN DIA CARBON STEEL PIPELINE	70,300	LF	$386	$27,120,100
1.3	48-IN DIA C905 PVC PIPELINE	75,000	LF	$185	$13,908,500
1.4	CONTINGENCY		20%		$8,630,000
1.5	ENGINEERING, ADMINISTRATIVE, LEGAL		10%		$5,178,000
	TOTAL ESTIMATED PROJECT COST				**$56,960,000**
2.0	ANNUAL OPERATIONS AND MAINTENANCE COST				
2.1	POWER	18,690	MWH	$55.30	$1,033,600
2.2	OPERATIONS AND MAINTENANCE	2%	CAPITAL COST		$1,139,200
	TOTAL ESTIMATED ANNUAL O&M COST				**$2,173,000**
3.0	TOTAL ANNUAL COST				
3.1	CAPITAL PAYBACK	4%	40 YRS		$2,877,800
3.2	OPERATIONS AND MAINTENANCE (INCLUDING POWER)				$2,173,000
	TOTAL ESTIMATED ANNUAL COST				**$5,051,000**
	ANNUAL VOLUME (AF)				**25,000**
	UNIT COST OF WATER ($/AF)				**$202**

Notes:
Costs do not include potential permitting, land acquisition, easements, environmental studies, and legal costs.
Costs do not include potential electrical supply facility upgrades.
Power costs from Idaho Power Co. Schedule 19 for Large Power Service, Secondary Service. Costs reflect annual average power cost. Costs are higher during summer (June-August), and lower during non-summer. Cost are higher during peak and mid-peak times and lower off-peak. Power costs may vary somewhat depending on time of use.

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ALTERNATIVE B1
MOUNTAIN HOME AFB TO CITY OF MOUNTAIN HOME

PROJECT : ELMORE COUNTY WATER SUPPLY
CAPACITY: 10,000 AFA, 365 DAYS, 6,200 GPM, 13.8 CFS
JOB # : 1188.0020
LOCATION : Elmore County, ID

ESTIMATE CLASS : 5
DATE : 12/12/2016
BY : EL
REVIEWED :

NO.	DESCRIPTION	QTY	UNIT	UNIT PRICE	COST
1.1	RIVER INTAKE PUMP ST (60% SHARE OF CAPACITY)	6,200	GPM	520	$3,220,000
1.2	30-IN DIA PIPELINE (60% SHARE OF CAPACITY)	40,120	LF	$95	$3,830,000
1.3	BOOSTER PUMP STATION	6,200	GPM	$218	$1,352,000
1.4	24-IN DIA C905 PVC PIPELINE	47,520	LF	$76	$3,611,400
1.5	CONTINGENCY		20%		$993,000
1.6	ENGINEERING, ADMINISTRATIVE, LEGAL		10%		$596,000
	TOTAL ESTIMATED PROJECT COST				**$13,600,000**
2.0	ANNUAL OPERATIONS AND MAINTENANCE COST				
2.1	POWER	13,660	MWH	$55.30	$755,400
2.2	OPERATIONS AND MAINTENANCE	2%	CAPITAL COST		$272,000
	TOTAL ESTIMATED ANNUAL O&M COST				**$1,027,000**
3.0	TOTAL ANNUAL COST				
3.1	CAPITAL PAYBACK	4%	40 YRS		$687,100
3.2	OPERATIONS AND MAINTENANCE (INCLUDING POWER)				$1,027,000
	TOTAL ESTIMATED ANNUAL COST				**$1,714,000**
	VOLUME DELIVERED (AF)				**10,000**
	UNIT COST OF WATER ($/AF)				**$171**

Notes:
Costs do not include potential permitting, land acquisition, easements, environmental studies, and legal costs.
Costs do not include potential electrical supply facility upgrades.
Power costs from Idaho Power Co. Schedule 19 for Large Power Service, Secondary Service. Costs reflect annual average power cost. Costs are higher during summer (June-August), and lower during non-summer. Cost are higher during peak and mid-peak times and lower off-peak. Power costs may vary somewhat depending on time of use.

This cost estimate reflects our professional opinion of accurate costs at this time based on current conditions at the project location. This estimate is subject to change through the project planning and design process. Actual construction cost will depend on the cost of labor, materials, equipment, and services provided by others, contractor’s methods of determining prices, competitive bidding and market conditions.

ALTERNATIVE S2
SOUTH ELMORE TO CITY OF MOUNTAIN HOME

PROJECT : ELMORE COUNTY WATER SUPPLY
CAPACITY: 10,000 AFA, 180 DAYS, 12,600 GPM, 28 CFS
JOB # : 1188.0020
LOCATION : Elmore County, ID

ESTIMATE CLASS : 5
DATE : 12/12/2016
BY : EL
REVIEWED :

NO.	DESCRIPTION	QTY	UNIT	UNIT PRICE	COST
1.1	INTAKE PUMP STATION	3,800	HP	$329	$1,251,720
1.2	36-IN DIA CARBON STEEL PIPELINE	38,500	LF	$299	$11,511,500
1.3	36-IN DIA C905 PVC PIPELINE	49,700	LF	$117	$5,805,300
1.4	CONTINGENCY		20%		$3,714,000
1.5	ENGINEERING, ADMINISTRATIVE, LEGAL		10%		$2,228,000
		TOTAL ESTIMATED PROJECT COST			**$24,510,000**
2.0	ANNUAL OPERATIONS AND MAINTENANCE COST				
2.1	POWER	12,250	MWH	$55.30	$677,400
2.2	OPERATIONS AND MAINTENANCE	2%	CAPITAL COST		$490,200
2.3	PURCHASE WATER AT RESERVOIR	10,000	AF	$49.62	$496,200
		TOTAL ESTIMATED ANNUAL O&M COST			**$1,664,000**
3.0	TOTAL ANNUAL COST				
3.1	CAPITAL PAYBACK	4%	40 YRS		$1,238,300
3.2	OPERATIONS AND MAINTENANCE (INCLUDING POWER)				$1,664,000
		TOTAL ESTIMATED ANNUAL COST			**$2,902,000**
		ANNUAL VOLUME (AF)			**10,000**
		UNIT COST OF WATER ($/AF)			**$290**

Notes:
Costs do not include potential permitting, land acquisition, easements, environmental studies, and legal costs.
Costs do not include potential electrical supply facility upgrades.
Power costs from Idaho Power Co. Schedule 19 for Large Power Service, Secondary Service. Costs reflect annual average power cost. Costs are higher during summer (June-August), and lower during non-summer. Cost are higher during peak and mid-peak times and lower off-peak. Power costs may vary somewhat depending on time of use.

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ALTERNATIVE S3
BENNETT CREEK RESERVOIR TO MOUNTAIN HOME RESERVOIR

PROJECT : ELMORE COUNTY WATER SUPPLY
CAPACITY: 10,000 AFA, 90 DAYS, 25,000 GPM, 56 CFS
JOB # : 1188.0020
LOCATION : Elmore County, ID

ESTIMATE CLASS : 5
DATE : 12/12/2016
BY : EL
REVIEWED :

NO.	DESCRIPTION	QTY	UNIT	UNIT PRICE	COST
1.1	INTAKE PUMP STATION	2,000	HP	$329	$658,800
1.2	48-IN DIA C905 PVC PIPELINE	70,200	LF	$185	$13,018,400
1.3	CONTINGENCY		20%		$2,735,000
1.4	ENGINEERING, ADMINISTRATIVE, LEGAL		10%		$1,641,000
	TOTAL ESTIMATED PROJECT COST				**$18,050,000**
2.0	ANNUAL OPERATIONS AND MAINTENANCE COST				
2.1	POWER TO PUMP FROM BENNETT TO MH RES.	3,220	MWH	$55.30	$178,100
2.2	OPERATIONS AND MAINTENANCE	2%	CAPITAL COST		$361,000
2.3	PURCHASE WATER AT RESERVOIR	10,000	AF	$104	$1,035,200
	TOTAL ESTIMATED ANNUAL O&M COST				**$1,574,000**
3.0	TOTAL ANNUAL COST				
3.1	CAPITAL PAYBACK	4%	40 YRS		$911,900
3.2	OPERATIONS AND MAINTENANCE (INCLUDING POWER)				$1,574,000
	TOTAL ESTIMATED ANNUAL COST				**$2,486,000**
	ANNUAL VOLUME (AF)				**10,000**
	UNIT COST OF WATER ($/AF)				**$249**

Notes:
Costs do not include potential permitting, land acquisition, easements, environmental studies, and legal costs.
Costs do not include potential electrical supply facility upgrades.
Power costs from Idaho Power Co. Schedule 19 for Large Power Service, Secondary Service. Costs reflect annual average power cost. Costs are higher during summer (June-August), and lower during non-summer. Cost are higher during peak and mid-peak times and lower off-peak. Power costs may vary somewhat depending on time of use.

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SPF WATER ENGINEERING

ALTERNATIVE S4
SNAKE RIVER (RM517) TO MOUNTAIN HOME RESERVOIR

PROJECT : ELMORE COUNTY WATER SUPPLY
CAPACITY: 10,000 AFA, 180 DAYS, 12,600 GPM, 28 CFS
JOB # : 1188.0020
LOCATION : Elmore County, ID

ESTIMATE CLASS : 5
DATE : 12/12/2016
BY : EL
REVIEWED :

NO.	DESCRIPTION	QTY	UNIT	UNIT PRICE	COST
1.1	INTAKE PUMP STATION	3,800	HP	$329	$1,251,720
1.2	36-IN DIA CARBON STEEL PIPELINE	58,100	LF	$299	$17,371,900
1.3	36-IN DIA C905 PVC PIPELINE	24,800	LF	$117	$2,896,800
1.4	CONTINGENCY		20%		$4,304,000
1.5	ENGINEERING, ADMINISTRATIVE, LEGAL		10%		$2,582,000
	TOTAL ESTIMATED PROJECT COST				**$28,410,000**
2.0	ANNUAL OPERATIONS AND MAINTENANCE COST				
2.1	POWER	12,050	MWH	$55.30	$666,400
2.2	OPERATIONS AND MAINTENANCE	2%	CAPITAL COST		$568,200
	TOTAL ESTIMATED ANNUAL O&M COST				**$1,235,000**
3.0	TOTAL ANNUAL COST				
3.1	CAPITAL PAYBACK	4%	40 YRS		$1,435,400
3.2	OPERATIONS AND MAINTENANCE (INCLUDING POWER)				$1,235,000
	TOTAL ESTIMATED ANNUAL COST				**$2,670,000**
	ANNUAL VOLUME (AF)				**10,000**
	UNIT COST OF WATER ($/AF)				**$267**

Notes:
Costs do not include potential permitting, land acquisition, easements, environmental studies, and legal costs.
Costs do not include potential electrical supply facility upgrades.
Power costs from Idaho Power Co. Schedule 19 for Large Power Service, Secondary Service. Costs reflect annual average power cost. Costs are higher during summer (June-August), and lower during non-summer. Cost are higher during peak and mid-peak times and lower off-peak. Power costs may vary somewhat depending on time of use.

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ALTERNATIVE S4b
SNAKE RIVER (RM517) TO MOUNTAIN HOME RESERVOIR

PROJECT : ELMORE COUNTY WATER SUPPLY
CAPACITY: 20,000 AFA, 365 DAYS, 12,400 GPM, 28 CFS
JOB # : 1188.0020
LOCATION : Elmore County, ID

ESTIMATE CLASS : 5
DATE : 12/12/2016
BY : EL
REVIEWED :

NO.	DESCRIPTION	QTY	UNIT	UNIT PRICE	COST
1.1	INTAKE PUMP STATION	3,000	HP	$329	$988,200
1.2	36-IN DIA CARBON STEEL PIPELINE	11,090	LF	$299	$3,315,900
1.3	36-IN DIA C905 PVC PIPELINE	73,390	LF	$117	$8,572,500
1.4	BOOSTER PUMP STATION	900	HP	$366	$329,400
1.5	36-IN DIA C905 PVC PIPELINE	18,480	LF	$117	$2,158,600
1.6	CONTINGENCY		20%		$2,575,000
1.7	ENGINEERING, ADMINISTRATIVE, LEGAL		10%		$1,794,000
	TOTAL ESTIMATED PROJECT COST				**$19,730,000**
2.0	ANNUAL OPERATIONS AND MAINTENANCE COST				
2.1	POWER	22,220	MWH	$55.30	$1,228,800
2.2	OPERATIONS AND MAINTENANCE	2%	CAPITAL COST		$394,600
	TOTAL ESTIMATED ANNUAL O&M COST				**$1,623,000**
3.0	TOTAL ANNUAL COST				
3.1	CAPITAL PAYBACK	4%	40 YRS		$996,800
3.2	OPERATIONS AND MAINTENANCE (INCLUDING POWER)				$1,623,000
	TOTAL ESTIMATED ANNUAL COST				**$2,620,000**
	ANNUAL VOLUME (AF)				**20,000**
	UNIT COST OF WATER ($/AF)				**$131**

Notes:
Costs do not include potential permitting, land acquisition, easements, environmental studies, and legal costs.
Costs do not include potential electrical supply facility upgrades.
Power costs from Idaho Power Co. Schedule 19 for Large Power Service, Secondary Service. Costs reflect annual average power cost. Costs are higher during summer (June-August), and lower during non-summer. Cost are higher during peak and mid-peak times and lower off-peak. Power costs may vary somewhat depending on time of use.

This cost estimate reflects our professional opinion of accurate costs at this time based on current conditions at the project location. This estimate is subject to change through the project planning and design process. Actual construction cost will depend on the cost of labor, materials, equipment, and services provided by others, contractor's methods of determining prices, competitive bidding and market conditions.

SPF WATER ENGINEERING

ALTERNATIVE S5
SNAKE RIVER (RM501) TO CINDER CONE AREA

PROJECT : ELMORE COUNTY WATER SUPPLY
CAPACITY: 25,000 AFA, 180 DAYS, 31,400 GPM, 70 CFS
JOB # : 1188.0020
LOCATION : Elmore County, ID

ESTIMATE CLASS : 5
DATE : 12/12/2016
BY : EL
REVIEWED :

NO.	DESCRIPTION	QTY	UNIT	UNIT PRICE	COST
1.1	INTAKE PUMP STATION	8,200	HP	$329	$2,701,080
1.2	48-IN DIA CARBON STEEL PIPELINE	10,600	LF	$386	$4,089,200
1.3	48-IN DIA C905 PVC PIPELINE	68,600	LF	$185	$12,721,700
1.4	CONTINGENCY		20%		$3,902,000
1.5	ENGINEERING, ADMINISTRATIVE, LEGAL		10%		$2,341,000
	TOTAL ESTIMATED PROJECT COST				**$25,750,000**
2.0	ANNUAL OPERATIONS AND MAINTENANCE COST				
2.1	POWER	26,360	MWH	$55.30	$1,457,700
2.2	OPERATIONS AND MAINTENANCE	2%	CAPITAL COST		$515,000
	TOTAL ESTIMATED ANNUAL O&M COST				**$1,973,000**
3.0	TOTAL ANNUAL COST				
3.1	CAPITAL PAYBACK	4%	40 YRS		$1,301,000
3.2	OPERATIONS AND MAINTENANCE (INCLUDING POWER)				$1,973,000
	TOTAL ESTIMATED ANNUAL COST				**$3,274,000**
	ANNUAL VOLUME (AF)				**25,000**
	UNIT COST OF WATER ($/AF)				**$131**

Notes:
Costs do not include potential permitting, land acquisition, easements, environmental studies, and legal costs.
Costs do not include potential electrical supply facility upgrades.
Power costs from Idaho Power Co. Schedule 19 for Large Power Service, Secondary Service. Costs reflect annual average power cost. Costs are higher during summer (June-August), and lower during non-summer. Cost are higher during peak and mid-peak times and lower off-peak. Power costs may vary somewhat depending on time of use.

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ALTERNATIVE S6
SNAKE RIVER (RM510) TO SOUTH ELMORE COUNTY

PROJECT : ELMORE COUNTY WATER SUPPLY
CAPACITY: 10,000 AFA, 180 DAYS, 12,600 GPM, 28 CFS
JOB # : 1188.0020
LOCATION : Elmore County, ID

ESTIMATE CLASS : 5
DATE : 12/12/2016
BY : EL
REVIEWED :

NO.	DESCRIPTION	QTY	UNIT	UNIT PRICE	COST
1.1	INTAKE PUMP STATION	2,500	HP	$329	$823,500
1.2	36-IN DIA CARBON STEEL PIPELINE	5,280	LF	$299	$1,578,700
1.3	36-IN DIA C905 PVC PIPELINE	21,120	LF	$117	$2,467,000
1.4	CONTINGENCY		20%		$974,000
1.5	ENGINEERING, ADMINISTRATIVE, LEGAL		10%		$584,000
	TOTAL ESTIMATED PROJECT COST				**$6,430,000**
2.0	ANNUAL OPERATIONS AND MAINTENANCE COST				
2.1	POWER	8,020	MWH	$55.30	$443,500
2.2	OPERATIONS AND MAINTENANCE	2%	CAPITAL COST		$128,600
	TOTAL ESTIMATED ANNUAL O&M COST				**$572,000**
3.0	TOTAL ANNUAL COST				
3.1	CAPITAL PAYBACK	4%	40 YRS		$324,900
3.2	OPERATIONS AND MAINTENANCE (INCLUDING POWER)				$572,000
	TOTAL ESTIMATED ANNUAL COST				**$897,000**
	ANNUAL VOLUME (AF)				**10,000**
	UNIT COST OF WATER ($/AF)				**$90**

Notes:
Costs do not include potential permitting, land acquisition, easements, environmental studies, and legal costs.
Costs do not include potential electrical supply facility upgrades.
Power costs from Idaho Power Co. Schedule 19 for Large Power Service, Secondary Service. Costs reflect annual average power cost. Costs are higher during summer (June-August), and lower during non-summer. Cost are higher during peak and mid-peak times and lower off-peak. Power costs may vary somewhat depending on time of use.

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ALTERNATIVE S7
INITIAL POINT TO CINDER CONE

PROJECT : ELMORE COUNTY WATER SUPPLY
CAPACITY: 25,000 AFA, 180 DAYS, 31,400 GPM, 70 CFS
JOB # : 1188.0020
LOCATION : Elmore County, ID

ESTIMATE CLASS : 5
DATE : 3/1/2017
BY : EL
REVIEWED :

NO.	DESCRIPTION	QTY	UNIT	UNIT PRICE	COST
1.1	INTAKE PUMP STATION	12,000	HP	$329	$3,952,800
1.2	48-IN DIA CARBON STEEL PIPELINE	35,376	LF	$386	$13,647,200
1.3	48-IN DIA C905 PVC PIPELINE	97,680	LF	$185	$18,114,500
1.4	CONTINGENCY		20%		$7,143,000
1.5	ENGINEERING, ADMINISTRATIVE, LEGAL		10%		$4,286,000
	TOTAL ESTIMATED PROJECT COST				**$47,140,000**
2.0	ANNUAL OPERATIONS AND MAINTENANCE COST				
2.1	POWER	37,870	MWH	$55.30	$2,094,200
2.2	OPERATIONS AND MAINTENANCE	2%	CAPITAL COST		$942,800
	TOTAL ESTIMATED ANNUAL O&M COST				**$3,037,000**
3.0	TOTAL ANNUAL COST				
3.1	CAPITAL PAYBACK	4%	40 YRS		$2,381,700
3.2	OPERATIONS AND MAINTENANCE (INCLUDING POWER)				$3,037,000
	TOTAL ESTIMATED ANNUAL COST				**$5,419,000**
	ANNUAL VOLUME (AF)				**25,000**
	UNIT COST OF WATER ($/AF)				**$217**

Notes:
Costs do not include potential permitting, land acquisition, easements, environmental studies, and legal costs.
Costs do not include potential electrical supply facility upgrades.
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