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EXECUTIVE SUMMARY

BUFFALO CREEK WATERSHED STUDY LEVEL I

Prepared For:

**Wyoming Water Development Commission
6920 Yellowtail Road
Cheyenne, WY 82002**



Prepared By:

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Fort Collins, CO 80525**



ANDERSON CONSULTING ENGINEERS, INC.

Civil • Water Resources • Environmental

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(ACE Project No. WYWDC31)

March 9, 2012

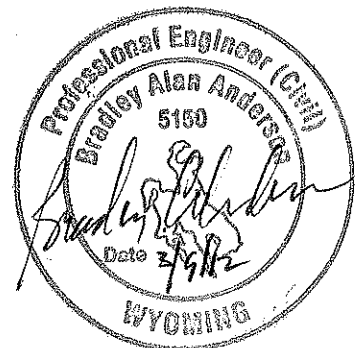


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I. INTRODUCTION

On June 30, 2010 Anderson Consulting Engineers, Inc. (ACE) entered into a contract with the Wyoming Water Development Commission (WWDC) to provide professional services for the Buffalo Creek Watershed Level I Study. ACE was retained to evaluate and describe the study area and specifically develop a watershed management plan. Opportunities and issues within the watershed were identified and practical economic solutions proposed. This report summarizes the results of all tasks associated with this effort.

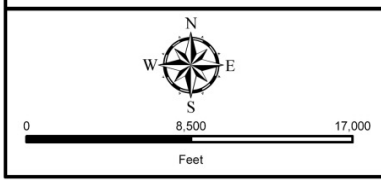
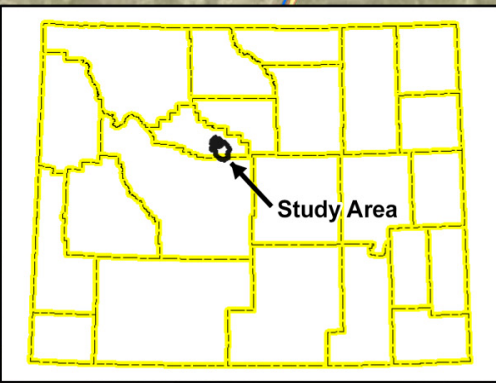
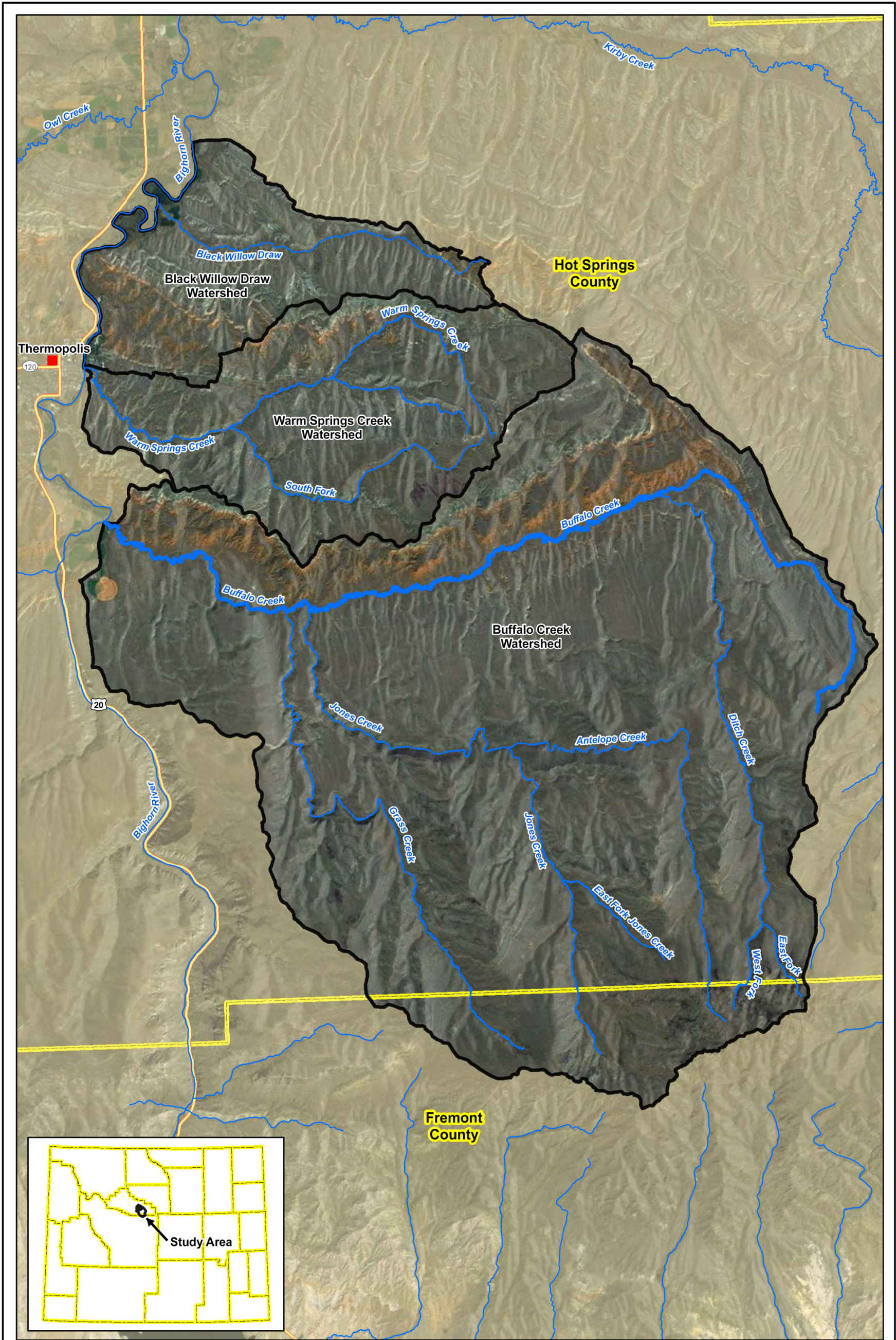
II. BACKGROUND

The Buffalo Creek watershed is located in the Big Horn River basin near the town of Thermopolis in Hot Springs County, Wyoming (Figure 1). The project study area includes the Buffalo Creek watershed plus the adjacent Warm Springs Creek and Black Willow Draw watersheds. For simplicity, the study area was referred to as the “Buffalo Creek watershed” throughout the report. The total area encompassed by these watersheds is approximately 175 square miles. With the exception of a small region at the mouth of Warm Springs Creek, there are no incorporated areas within the watershed and it is only sparsely populated. Elevations range from less than 4,350 feet above mean sea level at its mouth to over 8,300 feet on Copper Mountain, resulting in overall relief of over 3,950 feet. Annual precipitation typically averages 13 to 15 inches throughout most of the watershed with much of the precipitation derived from summer thunderstorms.

The majority of the basin (approximately 62.4 percent) is privately owned. The remainder of the study area is either federally owned lands managed by the Bureau of Land Management (25.1 percent), State of Wyoming (10.1 percent) or the Wind River Tribes (2.4 percent). The privately owned portion of the study area, including Buffalo Creek, Warm Springs Creek, and Black Willow Draw watersheds, consists of approximately 45 individual land owners.

Land owners and stakeholders within the study area face several key issues related to water within the basin and utilization of resources:

Bedrock geology plays a key and unique role in determining availability of streamflow within the Buffalo Creek watershed. Limestone bedrock underlies the majority of the upper reaches of Buffalo Creek watershed. Streams classified as perennial upstream of the limestone outcrops are depleted entirely as they flow across reaches underlain by limestone. Water is lost to sinks and infiltration. Consequently, the downstream reaches are classified as ephemeral and flow only when surface runoff exceeds the rate of loss. Local ranchers have resorted to construction of pipeline systems which divert flows in the upper reaches and pipe it downslope to the lower reaches of the watershed where it is used for irrigation and livestock watering purposes.



Legend

■ Cities	 Buffalo Creek Study Area
— Streams	 County Boundary

Figure 1. Buffalo Creek Watershed: Location Map

Grazing of livestock is one of the primary land uses within the study area; the livestock industry has played an important role in the economy and character of the area. In general, water available for livestock and wildlife consumption within the watershed is limited to riparian corridors in the upper portions of the watershed. In the lower portions of the watershed, water opportunities are limited to scattered stock reservoirs and pipeline/stock tank projects.

Juniper encroachment has resulted in a loss of habitat and rangeland. Historically juniper expansion was kept in check by naturally occurring range fires. However, fire suppression and grazing practices have contributed to juniper expansion into areas where it was not previously a factor. Juniper has expanded its area into more productive range sites and has greatly increased its density in its normal habitat. This has resulted in decreased forage production for livestock and wildlife. Decreased water infiltration has also had negative effects on watershed values.

III. LEVEL I PROJECT PURPOSE AND SCOPE

The primary purposes of the Buffalo Creek Watershed, Level I Study are to:

- Inventory all conditions in the watershed relevant to identification and characterization of issues and opportunities related to management of land and water resources.
- Develop a watershed management and rehabilitation plan describing potential alternative projects and management strategies to address water resource related issues and potential water development opportunities identified in the watershed inventory.
- Assess the potential environmental issues or constraints that may affect the projects/strategies identified in the watershed management and rehabilitation plan, and identify and characterize the permits/clearances and any associated environmental studies and/or mitigation that may be required.
- Develop conceptual-level estimates of the costs of the potential projects identified in the watershed management and rehabilitation plan.
- Perform preliminary economic analyses of major project alternatives (i.e., dams and reservoirs), including assessment of project benefits and sponsor ability to pay, and identify and describe potential funding sources for all potential project types identified in the watershed management and rehabilitation plan.
- Compile and collate all of the spatial data available into a comprehensive Geographic Information System (GIS) to facilitate the completion of this project and also to be available as a resource for future studies.

IV. PROJECT MEETINGS

An integral part of the Buffalo Creek Watershed Study was the public outreach and involvement effort. This effort was initiated by the Wyoming Water Development Office (WDO) prior to ACE being awarded the contract in June 2010.

Meetings were orchestrated by ACE and typically included informal presentations conducted by ACE staff and the WWDO. The objectives of the meetings were to:

- Obtain direction from landowners pertaining to the project;
- Obtain information and opinions of the public regarding their perspective on the watershed planning process;
- Provide guidance to landowners with respect to setting of goals; and
- Keep landowners informed of initial results and project progress.

Seven project meetings were held and included the following:

- | | |
|---------------------------------|-----------|
| • Steering Committee Meeting | 30-Jun-10 |
| • Project Update Meeting | 15-Sep-10 |
| • Project Update Meeting | 4-Nov-10 |
| • Project Update Meeting | 12-Dec-10 |
| • Project Open House / Workshop | 4-Apr-11 |
| • Project Open House / Workshop | 16-May-11 |
| • Project Open House / Workshop | 15-Nov-11 |

V. WATERSHED INVENTORY

The watershed inventory phase of the project involved the collection of information pertaining to a wide range of watershed characteristics, including the following:

<u>Land Uses and Activities</u>	<u>Natural Environment</u>
Land Ownership	Climate
Transportation, Energy Infrastructure	Vegetation and Land Cover
Irrigation	Geology
Range Conditions/Grazing Practices	Soils
Oil and Gas Production and Resources	Groundwater
Mining and Mineral Resources	Surface Water
Wildlife	Stream Geomorphology
Cultural Resources	Water Quality

The results of the data collection efforts were incorporated into a comprehensive Geographic Information System (GIS). Spatial data pertaining to the Buffalo Creek study area was collected from a wide range of sources. Agencies providing information included the State of Wyoming, USDI Bureau of Land Management, Wyoming Game and Fish Department, Hot Springs County, the USDA Natural Resources Conservation Service, and others. A significant amount of the information was also specifically developed during the course of this investigation.

One of the components of the watershed inventory phase of the project was the evaluation of groundwater resources. Specifically, the relationship between groundwater recharge where the principal tributaries (Jones Creek, Ditch Creek, Grass Creek, and Antelope Creek) cross the various limestone bearing formations. Streamflow measurements confirmed that a significant amount of surface flow is lost to groundwater in these areas. Area landowners expressed concern that development of projects utilizing waters upstream of the sinks could jeopardize springs located downslope.

Results of the groundwater investigation indicated that the groundwater produced from these springs and shallow wells is not derived from the deep, productive aquifers that are recharged by abundant infiltration across the upland areas to the south. Rather these springs and wells appear to reflect local, shallower groundwater systems, largely disconnected from the regional groundwater flow of the deeper aquifers.

VI. WATERSHED MANAGEMENT PLAN

A watershed management plan was developed which incorporates recommended projects in each of the various disciplines investigated:

- Project Components "I": Irrigation system rehabilitation components
- Project Components "L/W": Livestock / wildlife upland watering opportunities
- Project Components "G": Grazing management opportunities
- Project Components "C": Stream channel stability components
- Project Components "O": Other management opportunities

These improvements focus on potential mitigation of several key issues that presently exist within the watershed. The plan is summarized in Table 1. Included in the table are the various project components, estimated project costs, and other pertinent information.

VII. PERMITS

Many of the potential projects described in this plan will be subject to the National Environmental Policy Act (NEPA) and other federal environmental regulations administered by federal agencies such as the EPA, Bureau of Land Management (BLM), Army Corps of Engineers (COE), and/or the U.S. Fish and Wildlife Service (FWS). The Wyoming agencies which may have environmental, land use, and other regulatory approval requirements include, but are not necessarily limited to the Department of Environmental Quality (WDEQ), State Engineer's Office (WSEO), State Historic Preservation Officer (SHPO), Board of Land Commissioners through the State Lands and Investments Board (SLIB), and Game and Fish Department (WGFD).

Table 1 Buffalo Creek Watershed Management Plan.

Watershed Plan Component: Irrigation System Components (I)											
Plan Component I	No Specific Irrigation Components were identified for inclusion in the Buffalo Creek Watershed Management Plan. Restoration of channel gradient at headgates rendered inoperable by channel incision could be accomplished with recommendations under Stream Channel Restoration Components (Plan Components C) below										
Watershed Plan Component: Livestock / Wildlife Water Supply Projects (L/W)											
Plan Component	Project Name	Local Reference	Solar Pump	Spring Development	Stream Diversion	Pipeline	Stock Tank	Storage Tank	Stock Reservoir Rehabilitation	Stock Reservoir Construction	Total Project Cost
Plan Component LW- 01	Pipeline Extension Project	Axtell-1	1	0	0	6,000	1	0	0	1	\$39,310
Plan Component LW- 02	Pipeline Extension Project	Axtell-2	0	0	0	6,000	1	0	0	1	\$28,381
Plan Component LW- 03	Antelope Creek Stock Reservoir Enhancement	Axtell-3	0	0	1	21,000	2	0	0	0	\$56,307
Plan Component LW- 04	Unnamed Spring Development / Reservoir Enhancement	Axtell-4	0	1	0	1,800	1	0	1	0	\$26,821
Plan Component LW- 05	Stock Reservoir Rehabilitation	Axtell-5	0	0	0	0	0	0	0	0	\$7,400
Plan Component LW 06	Spring Development and Pipeline System	Axtell-6	0	1	0	3,475	2	0	0	0	\$25,233
Plan Component LW 07	Existing Pipeline Enhancement	Axtell-7	1	0	0	1,100	0	0	3	1	\$25,914
Plan Component LW-08	Stock Pond Rehabilitation Projects	Axtell-8	0	0	0	0	0	0	1	0	\$18,463
Plan Component LW-09	Stock Pond Rehabilitation Project	Axtell-9	0	0	0	0	0	0	0	0	\$9,630
Plan Component LW-10	Spring Development Project	Axtell-10	0	1	0	4,250	2	0	2	0	\$28,047
Plan Component LW-11	Stock Pond Rehabilitation Project	Axtell-11	0	0	0	0	0	0	2	0	\$22,229
Plan Component LW 12	Stock Pond Rehabilitation Project	Axtell-12	0	0	0	0	0	0	0	0	\$16,730
Plan Component LW 13	Pipeline Extension Project	Axtell-13	1	0	0	2,500	0	0	0	0	\$12,195
Plan Component LW-14	Upper Grass Creek Pipeline Project	Axtell-14	0	1	0	11,400	3	0	0	0	\$42,962
Plan Component LW-15	Grass Creek Spring Development and Pipeline Project	Axtell-15	0	1	0	11,500	3	0	0	0	\$43,131
Plan Component LW-16	Wild Horse Butte Spring Development	Jones-1	0	1	0	500	1	0	0	0	\$16,395
Plan Component LW-17	Blue Springs Draw Pipeline Project	Jones-2	1	0	0	16,100	2	2	0	0	\$107,620
Plan Component LW-18	Copper Mountain Pipeline Project	Thoren-1	0	1	0	6,600	3	0	0	0	\$26,735
Plan Component LW-19	Copper Mountain Pipeline Extension Project	Thoren-2	0	1	0	1,100	2	0	0	0	\$16,147
Plan Component LW-20	Spring Development Project	Thoren-3	0	1	0	1,100	1	0	0	0	\$10,197
Plan Component LW-21	Spring Enhancement Project	Thoren-4	1	1	0	15,000	2	1	0	0	\$49,155
Plan Component LW-22	Black Willow Draw Well Enhancement Project No. 1	Belden-1	1	0	0	200	1	0	0	0	\$20,359
Plan Component LW-23	Black Willow Draw Well Enhancement Project No. 2	Belden-2	1	0	0	1,400	3	0	0	0	\$29,483
Plan Component LW-24	Black Willow Draw Spring Enhancement Project	Belden-3	0	1	0	400	2	0	0	0	\$20,021
Plan Component LW-25	Grass Creek Pipeline	Baird-1	0	0	1	56,000	7	0	0	0	\$161,113
Plan Component LW-26	Johnson Spring Rehabilitation	Henthorne-1	0	1	0	0	0	0	0	0	\$11,753
Plan Component LW-27	Buchanon Pipeline Project- Phase I	Jennigis - 1	1	0	0	11,000	1	2	0	0	\$98,121
Plan Component LW-28	Buchanon Pipeline Project- Phase II	Jennigis - 2	0	0	0	16,500	4	1	0	0	\$67,419
Plan Component LW-29-A	Ditch Creek Parallel Pipeline : 2-Inch Option	Baird, John-1	0	0	1	16,500	4	0	0	0	\$73,441
Plan Component LW-29-B	Ditch Creek Parallel Pipeline : 4-Inch Option	Baird, John-1	0	0	1	16,500	4	0	0	0	\$101,050
Plan Component LW-29-C	Ditch Creek Parallel Pipeline : 6-Inch Option	Baird, John-1	0	0	1	16,500	4	0	0	0	\$129,468
Plan Component LW-30	Jones Creek Pipeline System	ACE-01	1	0	1	17,000	5	1	0	0	\$89,316
Plan Component LW-31-A	Antelope Creek Pipeline System 4-Inch Option	ACE-02	0	0	1	79,600	10	0	0	0	\$348,641
Plan Component LW-31-B	Antelope Creek Pipeline System 6-Inch Option	ACE-02	0	0	1	79,600	10	0	0	0	\$498,751
Plan Component LW-32	Guzzler Installation	ACE-03	0	0	0	0	0	0	0	0	\$13,300
Watershed Plan Component: Stream Channel Restoration Projects (C)											
Plan Component C-1	Installation of stream channel degradation/incision mitigation measures.										
Plan Component C-2	Installation of stream bank erosion mitigation measures										
Watershed Plan Component: Grazing Management Opportunities (G)											
Plan Component G-1	Expansion of grazing distribution / limited reliance on riparian areas.										
Plan Component G-2	Fencing to create pastures of similar ecological condition to enable a rest-rotation grazing system.										
Plan Component G-3	Strategic salting and herding are other tools that can be used to enhance grazing distribution.										
Plan Component G-4	Consideration of wildlife needs in upland water source development (escape ramps, wildlife watering facilities, etc).										
Plan Component G-5	Utilization of Ecological Site Description State and Transition Modeling to optimize range conditions.										
Plan Component G-6	Use of prescribed fire to assist in the restoration of range health areas benefitting by this treatment according to the state and transition models.										
Plan Component G-6	Application of chemicals may be utilized as a tool to assist in the restoration of range health areas benefitting by this treatment according to the state and transition models.										
Watershed Plan Component: Other Management Opportunities (O)											
Plan Component O-1	Continuation of eradication efforts targeting noxious weeds and undesirable vegetation										
Plan Component O-2	Prescribed burns planned and executed in an effort to control juniper encroachment.										
Plan Component O-3	Mechanical treatment of juniper infestation should be completed in areas where prescribed burns are not feasible or practical.										

The majority of the land within the watershed consists of deeded properties. However, the approximately 25.1 percent (43.9 square miles) are federally owned and are managed by the BLM. Despite the relatively low percentage of total areas, the distribution of federally owned parcels could potentially require coordination with the BLM in order to complete their construction. For example, pipeline projects may need to cross federal lands; routing around them could be cost-prohibitive if excess length is added.

VIII. FUNDING

Project funding/financing is a critical aspect associated with the implementation of watershed improvement projects. Given the scope of the investigation and the perceived projects which may be pursued (irrigation infrastructure improvements, wildlife/stock watering, stream/riparian corridor rehabilitation, and “other” water-resource related project types), there may be a large variety of funding sources which may be available to provide funding for future watershed improvements.

The Hot Springs Conservation District would serve as sponsor for those funding mechanisms requiring a sponsoring entity. For example, the WWDC’s Small Water Project Program (SWPP) funds sponsored projects defined as providing multiple benefits where the total estimated project costs (including construction, permitting, construction engineering, and land procurement) are less than \$100,000 or where WWDC’s maximum financial contribution is 50 percent of project costs or twenty-five thousand dollars (\$25,000), whichever is less. SWPP funding is a “one-time” grant so that ongoing operation and maintenance costs are not included. Loans are not available under SWPP.

By combining funding from additional sources (i.e., NRCS EQIP funding), total costs can be reduced or potentially eliminated for the landowner.

IX. CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

Upon completion of the watershed inventory phase of the project, the project team developed the watershed management plan. The plan was developed based upon findings of the inventory phase, a series of public meetings, questionnaires, and interaction with the project steering committee. In previous chapters, the key issues and problems were identified and ultimately, project goals and objectives were formulated to address them. Specifically, plans were developed to address issues associated with the following broad categories:

- Irrigation System Conservation and Rehabilitation,
- Livestock/Wildlife Upland Watering Opportunities,
- Stream Channel Condition and Stability,
- Grazing Management Opportunities, and
- Other Upland Management Opportunities.

In summary, the following conclusions are provided.

9.1.1 Irrigation System Components

1. No specific irrigation system components were identified for incorporation into the Buffalo Creek Watershed Management Plan.
2. Irrigation activities within the study area are limited, however, infrastructure does exist. Although no landowners requested evaluation of irrigation structures, headgates were observed on Buffalo Creek which are no longer operable due to channel degradation. Use of these facilities could be restored with completion of gradient restoration facilities recommended in the Stream Channel Restoration components of the watershed management plan.
3. Completion of the channel restoration projects in conjunction with an irrigation headgate would likely not require a 404 permit through the USCOE due to the irrigation infrastructure exclusion. Coordination with the COE Omaha District's Wyoming Regulatory Office in Cheyenne would be necessary to verify permit requirements.
4. Funding assistance for irrigation system rehabilitation projects within the study area is available from a number of sources, especially the WWDC Small Water Project Program and various programs administered by the NRCS.

9.1.2 Livestock/Wildlife Upland Watering Opportunities

1. There appears to be numerous opportunities to improve range and riparian conditions by means of increasing the availability of upland water sources for wildlife and livestock use.
2. Pipeline/tank systems appear to offer the most efficient and cost-effective means to provide adequate watering to large areas of rangeland. Water sources for these systems will depend on the location of the rangeland to be served and the available alternative sources. The most likely sources are wells or spring developments.
3. A total of 32 potential wildlife/livestock water supply projects were identified based upon evaluation of available water sources and input from local land owners and allotment permittees. Conceptual plans and conceptual level cost estimates were prepared for each project. Projects ranged from installation of a guzzler to a regional upland water supply project servicing 10 individual wildlife / livestock water tanks and approximately 15 miles of pipeline.
4. Any such improvements and practices must be fully implemented and maintained by the landowner. Without ongoing maintenance, watershed benefits are negated.

5. Streams measurements indicated that stream losses occur throughout lengthy reaches as opposed being isolated to discernable areas (i.e., 'sinks'). Consequently, water development alternatives considering bypassing the infiltration areas would not be practical.

9.1.3 Stream Channel Condition and Stability

1. Based on the geomorphic assessment, several impaired channel reaches were identified within the watershed. The categories of impairments identified include, but are not limited to degradation of riparian vegetation and degradation of riparian condition in the form of stream bank erosion and channel degradation.
2. Site-specific solutions should be developed to mitigate the channel impairment and ultimately included in the watershed management rehabilitation plan.
3. Locally-sponsored stream channel and habitat improvement projects could provide numerous benefits to the watershed. Potential projects would include efforts such as bank stabilization efforts using techniques such as willow plantings. In addition to providing direct benefits to the specific stream, ancillary benefits include education and community involvement.

9.1.4 Grazing Management Opportunities

1. Strategies, recommended in the state and transition models associated with NRCS descriptions of the ecological sites found within the watershed, should be adopted and employed to optimize range conditions through prescribed grazing management and best management practices.
2. Prescribed fire should be utilized as a tool to assist in the restoration of range health areas benefitting by this treatment according to the state and transition models. Delineation of specific areas potentially benefitting from this practice was beyond the scope of this Level I project. However, based upon input from landowners and land managers and observations made during the completion of this investigation, it is evident that there are areas which would likely benefit from prescribed fires.

9.1.5 Other Upland Management Opportunities

1. Eradication efforts targeting tamarisk and Russian Olive have been largely successful and continuation of these efforts is encouraged.
2. Noxious weed management programs currently being conducted by the respective weed and pest control districts of Washakie and Big Horn Counties should continue. Education opportunities for land owners and managers should continue to be made available.

3. Juniper encroachment has been identified as a management issue within the study area. Juniper treatment and control can include a number of different methods and strategies, including but not necessarily limited to:

- Prescribed burning
- Manual/mechanical removal: bulldozing, hand pulling (seedling stage), mowing, chain sawing (followed by spot chemical treatment if needed)
- Chemical treatment: Chemicals as recommended by Wyoming Weed and Pest Control Council

The appropriate treatment strategy and method(s) depends on a large number of factors including especially: maturity stage of the infestation; density of the stand(s), access and costs.

9.2 Recommendations

Based upon the information presented throughout this report and the conclusions presented above, the recommendations listed below are presented for consideration:

Many of the livestock / wildlife upland watering alternatives fall within the constraints for funding eligibility of the WWDC's Small Water Project Program (SWPP). These projects should be reviewed and selected alternatives should be implemented as soon as is practical. Completion of one or more of these projects in the near future would serve to benefit those directly involved in the project and increase interest and awareness of the benefits associated with the watershed planning process.

Funding through the SWPP does not require formation of a district. Consequently, individuals can seek funding through this program. As discussed in Section 8.0, projects providing multiple benefits and for which total project cost are less than \$100,000 are eligible for funding under this program. Grants are available for up to 50 percent of the total project cost or \$25,000, whichever is less.

Creative strategies for funding/financing of projects should be more fully investigated following identification of projects worthy of additional evaluation and potential implementation. *By combining funding sources, the owner could conceivably obtain grants for most, if not all, of the project costs.*