DRAFT
Environmental Impact Statement for the Westside Land Conveyance Project

January 2008

MISSION STATEMENT

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BLM/WY/PL-08/003+5440

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United States Department of the Interior

BUREAU OF LAND MANAGEMENT
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Cheyenne, Wyoming 82003-1828

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In Reply Refer To:
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DEC 13 2007

Dear Reader:

This Draft Environmental Impact Statement (DEIS) for the Westside Land Conveyance Project is submitted for your review and comment. This DEIS has been prepared to analyze the potential impacts of a Congressionally-mandated transfer of approximately 16,000 acres of public land to the Westside Irrigation District. The project area is located in Big Horn and Washakie Counties, Wyoming.

The DEIS will be available for review at the Bureau of Land Management (BLM) offices listed below. All of these documents may be viewed or downloaded from the BLM website at http://www.blm.gov/wy/st/en/info/NEPA/wfodocs/westside.html.

Bureau of Land Management
Wyoming State Office
5353 Yellowstone Road
Cheyenne, WY 82009

Bureau of Land Management
Worland Field Office
101 South 23rd Street
P.O. Box 119
Worland, WY 82401

Public Law 106-485 (Nov. 9, 2000; 114 Stat. 2199) directs the Secretary of the Interior, acting through the Bureau of Land Management, to convey a parcel of public land in Big Horn County and Washakie County, Wyoming to the Westside Irrigation District (Irrigation District). Public Law 106-485 also directs the BLM to complete an environmental analysis under the National Environmental Policy Act (NEPA).

The DEIS considers the environmental consequences of three alternatives: the legislated proposed action transferring 16,500 acres; an alternative under which only those lands actually suitable for irrigation and those needed for project infrastructure, approximately 11,500 acres, would be transferred; and the no action alternative. The irrigable-lands-only alternative is BLM's Preferred Alternative. After the sale and conveyance of the land, it is anticipated that the Irrigation District would offer the land for sale in parcels of no less than 160 acres per individual, to be used for agricultural purposes. The Irrigation District would select qualified individuals through a lottery. Successful individuals would then be required to be members of and their lands included in the Irrigation District. However, this is merely an anticipated scenario based on the current plans of the Irrigation District. It is possible these plans could change. P.L. 106-485 places no restrictions on the eventual disposal or uses of the land transferred and the BLM would exercise no regulatory control post-transfer.

This DEIS was prepared pursuant to the National Environmental Policy Act and other regulations and statutes to address the environmental and socio-economic impacts which could result from the project. This DEIS is not a decision document. Its purpose is to inform the public and interested Agencies of impacts associated with the transfer of public land to the Irrigation District, to evaluate alternatives to the proposal, and to solicit comments.

If you wish to submit comments on the DEIS, we request that you make them as specific as possible. Comments are more helpful if they include suggested changes, sources, or methodologies. Comments that contain only opinions or preferences will not receive a formal response from the BLM. However, they will be considered and included as part of the BLM decision-making process. The BLM can best use your comments if they are submitted within 60 days after the Environmental Protection Agency (EPA) publishes its Notice of Availability in the Federal Register.

Comments, including names and street addresses of respondents, will be available for public review at the Worland Field Office (address listed above), during regular business hours (8:00 a.m. to 4:30 p.m.), Monday through Friday, except holidays, and will be published as part of the final EIS. Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment – including your personal identifying information – may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Please send written comments to the Bureau of Land Management, Worland Field Office, Attn: Don Ogaard, Project Manager, P.O. Box 119, Worland, WY 82401. Written comments may also be e-mailed to the attention of Don Ogaard at "*wymail_westside@blm.gov*". E-mail comments must include the name and mailing address of the commentor to receive consideration. Written comments may also be faxed to (307) 347-5228.

A copy of the DEIS has been sent to affected Federal, State, and local government agencies, and to those persons who have indicated they wished to receive a copy of the DEIS. If you have questions or need additional information, please contact Don Ogaard, Project Manager, at the Worland Field Office, address shown above, or by phone (307) 347-5160.

Sincerely,

Robert A. Bennett
State Director

1 Attachment
1 – Draft EIS

DRAFT ENVIRONMENTAL IMPACT STATEMENT
WESTSIDE LAND CONVEYANCE PROJECT
BIG HORN AND WASHAKIE COUNTIES, WYOMING
ABSTRACT

Lead Agencies

USDI Bureau of Land Management
Worland Field Office
Worland, Wyoming

Wyoming Water Development Office
Cheyenne, Wyoming

Cooperating Agencies:

Big Horn County Commission
Basin, Wyoming

Washakie County Commission
Worland, Wyoming

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Abstract:

This Draft Environment Impact Statement (EIS) assesses the environmental and socioeconomic consequences of a Congressionally-mandated transfer of 16,500 acres of public land to the Westside Irrigation District and the actions which could be expected to follow the transfer. If the land is transferred, it is anticipated that it would be re-sold to individuals in 160-acre tracts and placed in agricultural use.

This Draft EIS describes the physical, biological, cultural, historic, and socioeconomic resources in and around the lands proposed for transfer. The alternatives in the Draft EIS consider the impacts of transferring the entire 16,500 acres, transferring only those lands actually suitable for irrigation or needed for infrastructure (approximately 10,000 acres), and No Action, under which the lands would not be transferred. The No Action alternative would not be in compliance with P. L. 106-485, which mandates the transfer, but is included for baselining purposes. The focus for the impact analysis was based upon resource issues and concerns identified during internal scoping and public scoping conducted for the transfer. Potential concerns related to the transfer and subsequent development include impacts to wildlife, water quality and flows in the Bighorn River, and cultural and paleontological resources.

Executive Summary

On November 9, 2000, Public Law 106-485 was signed directing the Secretary of the Interior (Secretary), acting through the Bureau of Land Management (BLM), to convey all right, title, and interest (excluding mineral interest) in an approximately 16,500 acre parcel of public land in Big Horn and Washakie Counties, Wyoming, to the Westside Irrigation District (WID). On agreement of the Secretary and WID, acreage may be added to or subtracted from the land to be conveyed as necessary to satisfy any mitigation requirements under National Environmental Policy Act of 1969 (NEPA). The land would be conveyed to the WID following the completion of an environmental analysis in compliance with NEPA.

Under NEPA and Council on Environmental Quality (CEQ) guidance, implementation of Public Law 106-485 and the connected actions of the WID purchasing and developing the land for crop production, fall within the definition of a major federal action and requires the preparation of an Environmental Impact Statement (EIS).

The State of Wyoming Water Development Office (WWDO) is joint lead agency with the BLM for the NEPA process and the development of the EIS. Cooperating agencies are the Boards of Commissioners for Big Horn and Washakie counties.

Proposed Action

Under the Proposed Action Alternative, the BLM would sell to the WID all rights, title and interest in the selected lands, except for mineral rights, amounting to approximately 16,500 acres. The BLM would appraise lands following Uniform Appraisal Standards for Federal Land Acquisition (UASFLA) and the WID would be charged the appraised value. The proceeds from the sale would be utilized for the acquisition of land and interests in land in the Worland District of the BLM in the State of Wyoming that will benefit public recreation, public access, fish and wildlife habitat, or cultural resources.

It is anticipated that once the land is owned by the WID it would then be re-sold to private individuals or institutions for crop production in parcels of 160 acres, up to a maximum of 960 acres per individual, unless a larger parcel is approved by the WID Board. It is important to note that this should be considered a “reasonably foreseeable development” scenario based on best available information. Public Law 106-485 places no restriction on the eventual disposition or use of the land following transfer to the WID.

Scoping

The BLM conducted a public scoping process from July 19, 2004 to August 19, 2004 with meetings held on August 3 and 4, 2004 in Basin and Worland, Wyoming. A Notice of Intent to prepare an EIS was published in the Federal Register on February 22, 2005 which reopened the scoping period extending the comment period to March 25, 2005. No additional scoping

meetings were conducted and comments and information submitted during the original 2004 scoping process were considered and did not have to be resubmitted. A total of ten comment letters were received during the two comment periods.

Alternatives

No Action Alternative

The No Action Alternative represents the baseline or existing conditions from which to compare the impacts from the alternatives. Under this alternative, the proposed land transfer and subsequent connected actions would not take place. The BLM would not convey all right, title and interest on the parcel of land under consideration to the WID and there would be no connected actions of converting the land to crop production or developing infrastructure to the site for irrigation. The No Action Alternative would not be in compliance with Public Law 106-485.

Alternative 1 – Proposed Action

Under the Proposed Action Alternative, the BLM would sell to the WID all rights, title and interest in the selected lands, except for mineral rights, amounting to approximately 16,500 acres.

Alternative 2 – BLM's Preferred Irrigable Land Alternative

Within the boundaries of the mapped land used in the legislation authorizing the land transfer, areas exist that are unsuitable for irrigated agriculture. Unsuitable lands include those that occur on steep slopes, have shallow rocky soils unsuitable for tillage, or are highly alkaline (saline) soils and may be only marginally suitable for growing crops. Based on these factors, approximately 80% of the land (approximately 9,300 acres) within the Irrigable Land Alternative boundary is considered suitable for irrigation.

Under the Irrigable Land Alternative, the BLM would sell to the WID all rights, title and interest in the selected lands, except for mineral rights, amounting to approximately 11,576 acres. Some lands not suitable for irrigation are included for support of infrastructure, to avoid creating small isolated tracts.

The lands to be transferred are delineated into three parcels, determined by topography and the configuration of a hypothetical irrigation system. Under this alternative, the three parcels could be transferred at once, or they could be transferred and developed in separate phases. A phased transfer may be determined by such factors as the level of interest in acquiring and developing lands as expressed by potential irrigators, and by the amount of funding available to the WID at the time of the transfer.

Environmental Impacts

Geology and soils

Previous studies utilized crop rotations of malt barley, sugar beets, alfalfa, and pasture to calculate an estimated average soil loss of 4.1 tons per acre per year. Based on these calculations it is estimated that 38,130 tons per year of soil would be lost if all 9,300 acres were irrigated. However, this number may be reduced due to the predicted grading of sloping fans, swales, and drainages into the surrounding terraces that would be required to render the area irrigable.

Water resources

Impacts to surface hydrology were modeled based on a hypothetical irrigation system using the Bighorn River as a source of water. The total water demand for crop production during an irrigation season is estimated to be 18,600 acre-feet per year. The results determined there is ample water in the Bighorn River to meet the future requirements associated with the WID Project.

Degradation of water quality in the Bighorn River in the form of increased sediment load, total dissolved solids, and pesticide residues caused by the additional return flows are estimated to be proportional to the percentage of land added to agricultural production. This would translate to an approximate 10 percent increase of water degradation above the current conditions resulting from flood irrigation practices in the entire watershed. Implementation of sprinkler irrigation would reduce the percent increase of water degradation to only two percent as there is less return flow associated with sprinkler irrigation as compared to flood irrigation.

Minimal impacts are anticipated to groundwater. Potential impacts were evaluated by extrapolating analysis conducted previously by the Department of Interior. The analysis included a mass balance assessment of ground water quality considering the effect of trace constituents/metallic elements, pesticides, and nitrate. Iron was the only element to exceed Environmental Protection Agency (EPA) standards. It is suggested that a baseline for groundwater quality be established, due to the presence of shallow (less than 50 feet in depth) domestic wells in the area. Additionally, it is suggested that a suite of up-gradient monitoring wells be installed as the precise recharge characteristics and overall ground water flow regime is unknown.

Air quality

Increased emissions would primarily be generated from the use of farming equipment. Due to topography of the area and the prevailing atmospheric conditions the potential increase in emissions would readily dissipate to a level that is insignificant. The potential increase in fugitive dust and vehicle emissions are anticipated to occur at levels that are insignificant and would not result in an adverse effect to the region.

Vegetation

The conversion to cropland associated with Alternative 1 and 2 would result in a permanent loss of approximately 9,300 acres of Wyoming big sagebrush. This equals approximately 0.62 percent of the Wyoming big sagebrush plant community that occurs within the Bighorn Basin. This loss would not likely result in a significant impact to the Wyoming big sagebrush plant community.

Wildlife

Conversion to cropland would result in a loss of crucial winter/yearlong habitat for pronghorn antelope and mule deer, as well as parturition range for pronghorn antelope. The pronghorn antelope herd unit that occupies the project area would lose an estimated 3.5% of the total crucial winter/yearlong habitat available to the herd as a result of the conversion. Additionally, the pronghorn antelope would lose approximately 0.3% of the total winter/yearlong range available in the unit and approximately 14.6% of the available parturition range. At the present time, parturition range is not considered a limiting resource such that it controls the capacity of the area to support pronghorn antelope. It is unknown if the loss of 14.6% of the identified parturition range would result in a change in this condition. Mule deer would lose approximately 1.6% of the total crucial winter/yearlong habitat available in the region. Mule deer and white-tailed deer would both lose yearlong habitat equaling 1.5% and 0.09%, respectively, of the total available yearlong habitat. It is difficult to predict the impact to a herd due to a partial loss of crucial winter habitat. However, it is anticipated that over the long term, there would be a reduction in population based on the reduction in carrying capacity during a severe winter when available crucial winter range limits the number of surviving individuals. The loss of crucial winter range reduces the capacity of the herd unit to support animals and therefore, over the long term, the population size of the herd would be expected to decline.

Alternative 1 and 2 will result in a loss of public ownership and multiple use management of these seasonal ranges. Due to the greater number of acres conveyed in Alternative 1, there will be a greater loss associated with Alternative 1. Alternative 2 contains no additional acres of seasonal ranges other than those considered for conversion to cropland, therefore the percentages for Alternative 2 did not change. The noticeable differences between Alternative 1 and Alternative 2 regarding loss of seasonal range management occurs in the pronghorn antelope crucial winter/yearlong range (4.7% versus 3.5% loss, respectively), pronghorn antelope parturition (28.7% versus 14.6%), and mule deer crucial winter/yearlong (2.4% versus 1.6%). The other seasonal ranges showed 0.5% or less difference between the two alternatives.

Water to be used for irrigation of the conveyed land would be from currently unappropriated water from the Bighorn River estimated at 18,600 acre-feet per year, with a maximum monthly depletion of approximately 5,000 acre-feet per month (83 cubic feet per second (cfs)) during July. These depletions are not measurable losses as they will occur during the growing season when there are large fluctuations already occurring within the river. The fish populations that occur in the Bighorn River exist within the already fluctuating water levels. The additional depletions to the WID lands will not result in a measurable change in water volume in the river

over existing conditions. It is not expected that fish in the Bighorn River would be impacted by a reduction in water volumes greater than the existing conditions.

There is potential for individual fish, primarily young-of-the-year and downstream migrants, to be pulled into the water intake valves of the pumps that would be located in the Bighorn River. However, it is standard practice to equip intake valves associated with irrigation systems with screens to minimize the amount of debris and aquatic life that enters the system.

Wetlands that have been identified within the project area were all within the boundaries of Alternative 1. No wetlands occurred within the Alternative 2 boundaries. Direct impacts to these wetlands would not occur as the wetlands are outside of the identified irrigable land. Indirect impacts to these wetlands would potentially result from changes in runoff patterns, contaminants in the runoff, and migration of chemicals utilized in crop production. However, chemicals and pesticides utilized in crop production are not expected to result in a significant impact to the return flow therefore, it is not anticipated that these chemicals will impact the wetlands. Activities associated with the reclamation of high saline soils could potentially result in selenium accumulation in wetlands.

No impacts are anticipated to threatened, endangered, or special status species.

Land Use

There are six grazing allotments equaling 200 animal units per month that would be affected by the conversion of land ownership. The conversion of native land to cropland would considerably reduce the viability of these areas as grazing allotments. There are 29 rights-of-way (use authorizations) which may be impacted by this land conveyance. Prior to the time of any land transfer, existing holders of the rights-of-way would be offered a series of options including maintaining the current terms and conditions of the existing rights-of-ways negotiating an easement with patentee, submitting an application to the BLM to amend the rights-of-ways to a term of perpetuity or to a perpetual easement.

Socioeceonomics

The project would have a modest positive impact on area employment and population. Construction of a water delivery system for the irrigable lands would create some new jobs, as approximately 35 construction workers would be employed for a period of six months, and 15 of the 35 jobs would last another six months. These employment opportunities are, however, unlikely to have any significant impacts upon area population.

Irrigation of project lands would increase employment opportunities in several sectors of the local economy. The project would support up to 118 additional local jobs. Approximately $3.23 million in earnings would be generated by the project annually, spread across 118 new jobs with an average wage of $27,400 annually (2004 dollars).

The $19 million in materials and equipment for the project would generate about $950,000 in additional sales and use tax revenue during project construction. The project will have a long-term positive impact on sales and use taxes in the area due to increased purchases of equipment, materials, and supplies for farming an additional 9,300 acres of land. Purchased materials alone, such as fertilizer, pesticides, and seed, can range from $25 per acre for alfalfa to over $200 per acre for sugar beets. Assuming an average expenditure of $75 per acre on taxable items means that sales tax revenues would increase by about $35,000 annually. The assessed valuation of irrigated land in the area would increase from about $13.5 million to $14.3.

Assuming that water delivery system costs would be financed by the Wyoming Water Development Commission (WWDC) over 20 years at four percent interest, and land and irrigation system costs would be financed at market rates, the resulting annual costs range from $255 to $261 per acre, which exceeds the estimated annual return of $194 per acre. These results indicate that the financial viability of the project is dependent upon either obtaining more favorable funding terms than are currently available from the WWDC or private sources, or possibly diversifying into higher valued specialty crops that could support the capital and operating costs of the project.

Cultural and Paleontological Resources

Under both alternatives the transfer of ownership from public to private represents an irretrievable resource commitment. Once the land is transferred, the significant cultural resources will not be afforded any protection by the federal government. In order to mitigate this adverse effect, a data recovery plan will be designed and implemented to mitigate the impact caused by the land transfer.

Alternative 1 would result in a total of 22 cultural sites potentially being affected by the land conveyance. Alternative 2 would potentially adversely affect a total of eight cultural sites as a result of the connected actions associated with the land conveyance.

Alternative 1 proposes to transfer 9,735 acres of surface exposed Willwood Formation, which is noted for being rich in paleontological resources. The land that is converted to cropland would directly impact this resource through farming practices. Alternative 2 proposes to transfer 6,105 acres of Willwood Formation surface exposure.

Recreational Resources

Two critical recreation resource values associated with this area; remoteness and scenery, would be altered due to either Alternative 1 or 2. The number of human encounters will likely increase due to the increase of farming activity in the area. However, oil field development and nearby agriculture have already altered this area from a natural state. The conversion to more agricultural fields associated with Alternative 1 or 2 in the area will reduce the feeling of solitude and influence the viewing of scenery.

Access to the Bighorn River will not be altered by this project. The only activity associated with the project that will occur adjacent to the Bighorn River is the creation of two diversion points. It is estimated that the area required for constructing the pumps and necessary facilities will be five acres for both diversion location. Therefore, the project will only affect an estimated ten acres along the Bighorn River in relation to public access for fishing and hunting.

The hunting area for pronghorn antelope and mule deer that includes the project area consists of 720,000 and 620,000 acres respectively and provides seasonal range for pronghorn antelope, mule deer and white tailed deer according to information from the Wyoming Game and Fish Department (WGFD). The amount of animals that are actually harvested off the project area is unknown, but is considered very small. Therefore, based on the size of the hunt area and the number of animals that utilize that area, it is anticipated that the land transfer and conversion to cropland would not have a significant impact on big game hunting activities around the project area.

The land transfer and connected actions will likely result in an increase in upland game bird-hunting opportunities as species such as ring-necked pheasant and Hungarian partridge invade the new croplands. The availability of this hunting opportunity to the general public will be based largely on the willingness of the WID and the new landowners to accommodate hunting on private lands.

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List of Acronyms

ACHP	Advisory Council on Historic Preservation
ACOE	Army Corps of Engineers
AUM	Animal Unit Month
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
CEQ	Council on Environmental Quality
C-C-W	Clyde-Criddle-Woodward, Inc.
cfs	cubic feet per second
cm	centimeter
cm/sec	centimeter per second
CRAI	Cultural Resource Analysts, Inc.
CWA	Clean Water Act
dB	decibel
DEIS	Draft Environmental Impact Statement
DEQ	Department of Environmental Quality
EC	specific conductance
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERS	U.S. Department of Agriculture's Economic Research Service
ESA	Endangered Species Act
FLPMA	Federal Land Policy and Management Act
ft	Feet
ft/sec	feet per second
FWCA	Fish and Wildlife Coordination Act
GCRMP	Grass Creek Resource Management Plan
GCRPA	Grass Creek Resource Planning Area
GPM	gallons per minute
in	Inch
km	Kilometer
m	Meter
MBTA	Migratory Bird Treaty Act
MLA	Mineral Leasing Act
mm	millimeter
MOU	Memorandum of Understanding
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
OSHA	Occupational Safety and Health Act
OWSA	Office of the Wyoming State Archaeologist
ROW	Right-of-Ways

PA	Programmatic Agreement
PLIT	payments in lieu of taxes
ppb	parts per billion
ppm	parts per million
Secretary	Secretary of the Interior
SHPO	State Historic Preservation Officer
SLAMS	State and Local Air Monitoring Station
SPCC	Spill Prevention Control and Countermeasures
TDS	total dissolved solids
TPY	tons per year
TSP	total suspended particulates
UASFLA	Uniform Appraisal Standards for Federal Land Acquisition
USBR	United States Bureau of Reclamation
USFWS	United States Fish and Wildlife Service
VRM	Visual Resource Management
WGFD	Wyoming Game and Fish Department
WID	Westside Irrigation District
WOS	Wyoming Observation System Records
WWDC	Wyoming Water Development Commission
WWDO	State of Wyoming Water Development Office
WYNDD	Wyoming Natural Diversity Database

Chapter 1.0 - Purpose and Need

1.1 INTRODUCTION

On November 9, 2000, Public Law 106-485 (Appendix A) was signed directing the Secretary of the Interior (Secretary), acting through the Bureau of Land Management (BLM) to convey all right, title, and interest (excluding mineral interest) in an approximately 16,500 acre parcel of public land in Big Horn and Washakie Counties, Wyoming, to the Westside Irrigation District (WID). On agreement of the Secretary and the WID, acreage may be added to or subtracted from the land to be conveyed as necessary to satisfy any mitigation requirements under the National Environmental Policy Act of 1969 (NEPA). The land would be conveyed to the WID following the completion of an environmental analysis under the NEPA.

Under the guidance of the NEPA and Council on Environmental Quality (CEQ), implementation of Public Law 106-485 and the connected actions of the WID purchasing and developing the land for crop production fall within the definition of a major federal action and requires the preparation of an Environmental Impact Statement (EIS).

1.2 HISTORY OF THE WESTSIDE PROJECT

1942 – U.S. Bureau of Reclamation (USBR) identified three potential irrigation units with a total of 3,740 acres along the west side of the Big Horn Canal.

1962 – USBR published the “Report on Big Horn Basin Division” showing 2,556 irrigable acres in the three original areas, based on detailed land classification.

May 1974 – The Big Horn Canal Association filed an application with the Wyoming Office of the State Engineer for an enlargement of the Big Horn Canal. The application was amended in May of 1976 to modify the acres served by the original application. The application requested a change of capacity from 579 cubic feet per second (cfs) to 1,693.4 cfs. The enlarged canal, as amended in May of 1976 was to provide irrigation water to 39,530.79 acres of private, state and federal lands.

June 1975 – Clyde-Criddle-Woodward, Inc. (C-C-W) published the “Feasibility Study of Big Horn Westside Irrigation Project” for the Big Horn Basin Irrigation Development Association, a local group of farmers and businessmen interested in developing the Westside area identified by the USBR in 1942. Approximately 28,000 acres were outlined for study, with about 21,000 acres identified as actual farmable area. The BLM prepared an environmental analysis. The Wyoming Department of Environmental Quality (DEQ) commented on the Bighorn Basin water supply and on turbidity in the Bighorn River due to temporary diversion dams. The Big Horn Basin Irrigation Development Association applied to the Wyoming Interdepartmental Water Conference for assistance to develop the Westside Irrigation Project.

May 1976 - The Big Horn Canal Association filed five separate applications (Westside Irrigation Project Diversion Numbers 1 - 5) to the Wyoming Office of the State Engineer for five separate points of diversion totaling 590 cfs of water from the Bighorn River. The purpose of the water was for irrigation of a total of 39,561.89 acres of private, state and federal lands.

March 1978 – Engineering Associates prepared the "Westside Irrigation Project Study" for the Governor's Interdepartmental Water Conference. This soil and drainage study eliminated 8,000 acres outlined by C-C-W. A pre-feasibility study on the lands considered suitable for farming concluded that the original area was not cost effective, so four increasingly smaller project area alternatives were considered. They concluded that a project of about 7,500 acres or less was most likely to be economically viable.

September 1983 – USBR prepared the "Westside Irrigation Project (Wyoming) Special Report" concluding that a 9,026-acre irrigation project was economically justifiable and further investigation of this project was warranted. This project would require diversion of 20,363 acre-feet per year from the Big Horn Canal, and fifteen pumping stations to raise the irrigation water the necessary 200 feet.

February 1984 – A petition for the organization of the WID was filed with the Fifth Judicial District Court of Wyoming in Washakie County. A formal hearing was held in March 1984 and the WID was officially formed.

June 1985 – Nelson Engineering, Inc. produced the "Westside Project Plan Formulation Working Document" to document consensus among government and public entities for the preferred project alternative. The report stated a need for the irrigation project to stabilize area farm income. "Alternative 3" from that report was the preferred plan to pursue, and it included 12,135 total acres, including 9,400 irrigable acres.

September 1988 – USBR produced the "Westside Irrigation Project Planning Report/Draft Environmental Statement" analyzing the USBR preferred plan to irrigate 4,068 acres and a no-action alternative. The preferred plan would divert 15,400 acre-feet per year from the Bighorn River, with supplemental water released from Boysen Reservoir during low flows. Water would be conveyed through the Big Horn Canal, which would require three pumping plants. The State of Wyoming would finance construction with 75% anticipated as a grant, and 25% as a loan.

November 2000 – Public Law 106-485 (Nov. 9, 2000; 114 Stat.2199) directed the Secretary of the Interior, acting through the BLM, to convey all right, title, and interest (excluding mineral interest) in a parcel of public land in Big Horn County and Washakie County, Wyoming, comprising approximately 16,500 acres. The land would be conveyed to the WID at appraised value and following the completion of an environmental analysis under NEPA. On agreement between the BLM and WID, acreage could be added or subtracted to the conveyed land to satisfy mitigation requirements under the NEPA.

1.3 PURPOSE OF AND NEED FOR ACTION

This chapter describes the purpose and need for the project and the connected Applicant's (the WID) need for the project. Because the proposed action is specified in Public Law 106-485, the federal purpose and need is brief and very specific. The Applicant's purpose and need statement is broader and reflects the WID's specific land acquisition, development and water supply management needs. This analysis is based largely on the connected actions proposed by the Applicant.

The basic project purpose is to comply with Public Law 106-485, which is to provide for the conveyance of all rights, title and interest (excluding mineral interest) of approximately 16,500 acres of public land currently administered under the BLM in Big Horn and Washakie counties, Wyoming, to the WID. The law provides that this acreage may be adjusted as necessary by agreement between BLM and WID.

1.3.1 Objectives

1.3.1.1 BLM Objectives

The primary objective of the BLM is to comply with Public Law 106-485. As part of this federal action (project), the BLM has determined that the proposed land transfer, and the resale of the land for agricultural development that is expected to occur as a reasonably foreseeable consequence of the transfer, would be a major federal action as defined by NEPA. To meet this objective the BLM must comply with NEPA and thus, the BLM has prepared this EIS. The objectives of the EIS are to (1) assess the environmental, social, and economic impacts associated with the land transfer and subsequent connected actions, and (2) evaluate a range of reasonable alternatives to the proposed action (in this case the connected actions to be taken by the WID) and to identify potential measures that could be incorporated to mitigate identified potential impacts.

If the land is transferred into private ownership, BLM would exercise no regulatory control, nor make any further decisions regarding the development related to surface rights that would ensue. (Mineral rights would remain under federal ownership, and the BLM would exercise regulatory control over mineral development.) However, the BLM has an obligation under the NEPA to analyze and disclose reasonably foreseeable "connected actions" that might result from its decision to transfer the land and to insure that the transfer is accomplished in compliance with all other state and federal laws and regulations.

1.3.1.2 WID Objectives

The primary objective of the WID is to exercise their right under Public Law 106-485. Subsequent to acquiring the land from the BLM, the WID proposes to resell the lands to private individuals or organizations, minus those lands needed for infrastructure development or for mitigation purposes. The final project configuration and land transfers from the WID is unknown but will be determined based on a number of factors including results of this environmental

analysis and mitigation requirements, the WID's infrastructure design, existing rights of way, and the participation of private individuals/entities in the project.

1.3.2 Need for Project

The WID, as described in the original Civil Action filing in District Court, includes a 2,254.75 acre private land area on the west side of the Big Horn Canal in Washakie and Big Horn Counties. In general, the district is bordered on the west by BLM land and on the east by the Big Horn Canal. Members of the WID own the majority (2,226.5 acres) of the land within the district. A petition to form the WID was filed in District Court in February 1984 and the petition was granted in March 1984 officially forming the WID.

The project would provide additional agricultural development opportunities for potential members of the WID and to contribute to and expand agricultural production in Washakie and Big Horn Counties.

To meet these objectives the WID must develop the necessary irrigation infrastructure capable of delivering water to individual parcels of land transferred to participating landowners and to divert irrigation water necessary for developed agriculture. Current development plans envision: (1) up to two pumping stations along the Bighorn River for diversion of up to 83 cubic feet per second (cfs) during the irrigation season; (2) pipeline infrastructure that will deliver the water to each property; and, (3) on-site infrastructure such as roads, pipelines, and powerlines. However, the current plans could change depending on the final project configuration. Certain development activities may require additional permits, such as a Section 404 permit from the Corps. The WID will provide continued support for agriculture and irrigation development to its members for the life of the development. It is anticipated that following the initial land conveyance, development grant applications will be submitted to the State of Wyoming Water Development Office (WWDO) for continued project development (irrigation development) within the project boundaries.

1.4 RELATIONSHIP TO POLICIES, PLANS, AND PROGRAMS

1.4.1 Conformance with the Grass Creek Resource Management Plan

The applicable land-use plan for the area is the Grass Creek Resource Management Plan (GCRMP) (1998). With respect to landownership adjustments, the plan provides that “Before any public lands are exchanged or sold … the BLM will consult with county commissioners and other representatives of local government in the affected areas. Other affected and interested citizens will be given opportunities to comment as well.” Appendix 4 of the GCRMP provides guidance regarding transfer of public lands. It states that “No landownership adjustments would be implemented without a feasibility study, site-specific environmental analyses, and a determination that the sale, exchange, or transfer is in the public interest.” It also describes certain categories of land that will not be transferred, including lands within Wilderness Study Areas, withdrawn lands, and lands with important resource values, such as habitat for threatened or endangered species.

1.4.2 Relationship to Other Statutes and Authorities

The sale of land to the WID is to take place upon completion of an environmental analysis under the NEPA by the Worland Field Office of the BLM. The NEPA requires that federal agencies not only evaluate the impacts of the proposed action, but also identify and comply with all other federal laws that may pertain or have jurisdictional authority. CEQ Regulations (Sec 1502.25) direct agencies to conduct the EIS process concurrently with environmental impact analyses and related studies required by other federal laws.

The following federal laws or executive orders may have some jurisdiction over the proposed action and project and will be considered during the NEPA process.

Aquatic Resources
Clean Water Act (CWA)
Section 401. State certification requires that discharge of dredge or fill material will not harm jurisdictional water or wetlands such that an exceedance of state water quality standards will occur.
Section 402. A General Stormwater Permit under the National Pollutant Discharge Elimination System (NPDES) is required for all soil-disturbing activities where one or more acres will be disturbed and where the acreage will have a discharge of storm water to a receiving water.
Section 404. A permit from the Army Corps of Engineers (ACOE) is required for the discharge of dredge or fill material into jurisdictional waters, including wetlands of the U.S.

Wildlife and Vegetation
Endangered Species Act (ESA) – The U.S. Fish and Wildlife Service (USFWS) is responsible for implementation and enforcement of the primary law that protects species threatened with or in danger of extinction. Under Section 7 of the ESA, federal agencies are directed to consult with the USFWS if listed species are present in the vicinity of the agency proposed action. The agency must prepare a Biological Assessment describing potential effects to listed species that may be affected by the action.

Fish and Wildlife Coordination Act (FWCA) – Federal and state agencies are required to consult with the USFWS, National Marine Fisheries Service (NMFS), and the appropriate state agencies regarding activities that impact, impound, or modify public waterways. This Act may address plant and wildlife concerns that may not be addressed by the ESA.

Migratory Bird Treaty Act (MBTA) – The MBTA generally protects all birds classified by the act as migratory in the U.S. and is enforced by the USFWS. The MBTA prohibits take, import, export, possession, purchase, sale, or barter of any migratory bird, feathers, or other parts, eggs, nests, and products made from migratory birds. *Take* is defined as pursuing, hunting, shooting, poisoning, wounding, killing, capturing, trapping, or collecting.

Bald and Golden Eagle Protection Act (BGEPA) - The BGEPA prohibits import, export, take, sale, purchase, or barter of any bald or golden eagle, their parts, products, nests, or eggs. Take includes pursuing, shooting, poisoning, wounding, killing, capturing, trapping, collecting, molesting, or disturbing eagles.

Cultural Resources

National Historic Preservation Act (NHPA)

Section 106, Historic sites, building, objects, and antiquities – All federal agencies are required to consider the effect of their actions on historic properties. The Advisory Council on Historic Preservation (ACHP) and the Wyoming State Historic Preservation Officer (SHPO) must be given an opportunity to comment on the undertaking/action in compliance with section 106 of the National Historic Preservation Act, and pursuant to the BLM's 1997 National Programmatic Agreement with the Council and the Conference of National Historic Preservation Officers and the Wyoming Protocol. Major cultural resource categories include historic places, Native American cultural resources, and archaeological sites. The BLM has requested the comments of the Advisory Council on Historic Preservation (Council).

"An Act for the Preservation of American Antiquities," also known as the Antiquities Act of 1906 (P.L. 59-209; 34 Stat. 225; 16 U.S.C. 432, 433)

Historic Sites Act of 1935 (P.L. 74-292; 49 Stat. 666; 16 U.S.C. 461)

Reservoir Salvage Act of 1960, as amended by Archeological and Historic Preservation Act of 1974 (P.L. 86-523; 74 Stat. 220, 221; 16 U.S.C. 469; P.L. 93-291; 88 Stat. 174; 16 U.S.C. 469)

National Historic Preservation Act of 1966 (P.L. 89-665; 80 Stat. 915; 16 U.S.C. 470)

Executive Order 11593 ("Protection and Enhancement of the Cultural Environment," 36 F.R. 8921, May 13, 1971)

American Indian Religious Freedom Act of 1978 (P.L. 95-431; 92 Stat. 469; 42 U.S.C. 1996)

Archaeological Resources Protection Act of 1979 (P.L. 96-95; 93 Stat. 721; 16 U.S.C. 470aa et seq.) as amended (P.L. 100-555; P.L. 100-588)

Native American Graves Protection and Repatriation Act of 1990 (P.L. 101-601; 104 Stat. 3048; 25 U.S.C. 3001)

Executive Order 13007 ("Indian Sacred Sites," 61 F.R. 104, May 24, 1996)

Executive Order 13287 ("Preserve America" 68 F.R. 43, March 5, 2003)

Socioeconomics

Executive Order 12898 Federal Actions to Address Environmental Justice in Minority and Low Income Populations – Federal agencies are directed to incorporate environmental justice as part of their mission to the greatest extent practicable and permitted by law. Federal agencies are specifically directed to identify and address, as appropriate, disproportionately high and adverse human health effects of their programs, policies, and activities on minority and low-income populations.

Air Quality

National Ambient Air Quality Standards (NAAQS) are established by the Environmental Protection Agency (EPA) for certain air pollutants at concentration levels against which all areas of the country are evaluated. If an area meets the standards, it is in "Attainment," and if it does not, it is considered a "Nonattainment" area. New stationary sources of air emissions in nonattainment areas must undergo more rigorous permitting than equivalently-sized sources in attainment areas. Mobile sources (construction equipment, maintenance vehicles) are regulated separately under the federal Clean Air Act through vehicle inspection and maintenance programs, and are not included when determining if a source requires permitting.

Public Health and Safety

Occupational Safety and Health Act (OSHA) – OSHA provides for standards for health and safety in Federal regulations.

National Electrical Manufacturers Association, Institute of Electrical and Electronics Engineers –This law sets standards for the design of electrical equipment and controls.

Spill Prevention Control and Countermeasures (SPCC) – The SPCC regulates the handling of hazardous materials, including batteries, mineral oil coolants, fuel for vehicles, leaning solvents, and lubrication fluids.

1.5 AGENCY ROLES AND RELATIONSHIPS

1.5.1 Joint Lead Agencies

Under CEQ regulations implementing the NEPA (40 CFR Sec. 1501.5), more than one agency may act as joint lead agencies, if at least one is a federal agency. For the current project the BLM and the WWDO are acting as joint lead agencies for the NEPA process and the development of the EIS. The lead agency or joint lead agencies take responsibility for preparing the EIS, developing the interdisciplinary study team, and requesting participation of cooperating agencies.

1.5.1.1 BLM

The BLM Worland Field Office is acting as the federal lead agency for the NEPA process. The federal lead agency is typically the federal agency with the greatest magnitude of involvement in the project and with project approval authority. In this case Public Law 106-485 authorizes the sale of BLM-managed public land to the WID.

1.5.1.2 WWDO

The WWDO is acting as the state lead agency for the proposed project and the joint lead agency with the BLM. Under the state water development program, the WWDO is authorized to provide financial support and facilitate project development and implementation for water projects in Wyoming. The primary objective of the WWDO in this project is to provide financial support for the NEPA process.

The Wyoming Water Development Commission (WWDC) was established in 1975 to implement the State water development program and to conduct water and related resource planning and

management including the facilitation and promotion of the development of the state's human, industrial, mineral, agricultural, water, and recreational resources. The program provides procedures and policies for planning, selection, financing, construction, acquisition and operation of projects and facilities for the conservation, storage, distribution and use of water in Wyoming. Projects must be in the public interest to develop and preserve Wyoming's water and related land resources. The program is intended to encourage development of water facilities for irrigation, flood control, and pollution control; preservation and development of fish and wildlife resources; and, for protection and improvement of public lands. The program is also intended to help make available the waters of the state for beneficial uses, including but not limited to municipal, domestic, agricultural, industrial, instream flows, hydroelectric, recreational, conservation of land resources, and protection of public health and safety.

The WWDC, supported by the WWDO, is charged with implementation of the Water Development Program. The Wyoming Water Development Program receives funding from two sources: (1) the Water Development Account I which receives twelve and forty-five hundredths percent of the revenues from the state's severance tax distribution account; and (2) the Water Development Account II which receives revenue from two and one tenth percent of the revenues from the state's severance tax distribution account and accrued interest on the accounts unspent balance. Account I is utilized for new development projects, and Account II is used to fund water projects that have been in existence for 15 years or longer.

The Water Development Account I funds are directed at the development of presently unused and/or unappropriated waters of Wyoming (i.e., the New Development Program). The WID applied to the WWDO as a Project Sponsor for assistance from the New Development Program in conducting project planning activities for the proposed land conveyance project. This NEPA analysis for the BLM is included under the project planning stages and is being funded by the WWDO.

1.5.2 Cooperating Agencies

1.5.2.1 Big Horn and Washakie County Commissions

The project area falls within portions of Washakie and Big Horn Counties. The counties have authority over zoning of private lands in the county for development purposes and have direct interest in the conveyance of public lands to private ownership. The economies of both counties rely heavily on agriculture. As cooperating agencies, the primary objectives of the counties are to support the joint lead agencies in the description of the local regulatory authority and in the assessment of the economic impacts of the Applicant (WID) in its effort to acquire lands and develop the Westside project. Continued agriculture development falls under the overall county plans and economic development objectives for both counties. Memorandums of Understanding (MOU) that establish the relationship of the counties to this project are being developed; generally the counties will provide special expertise in the areas of land use, socioeconomics, and custom and culture.

1.6 PUBLIC PARTICIPATION

The BLM conducted the public scoping process from July 19, 2004 to August 19, 2004 with meetings held on August 3 and 4, 2004 in Basin and Worland, Wyoming. The purpose of the scoping process was to receive public and agency comment on the types of potential effects from the proposed project that should be addressed in the EIS, the environmental and social resources that might be affected, and the alternatives that should be considered. Specifics regarding the scoping process for this analysis are discussed in Chapter 6 of the EIS.

1.7 ISSUES AND CONCERNS

The following is a summary of the key issues and concerns identified during the scoping process.

Table 1-1. Key Issues and Concerns Identified During the Scoping Period

Issue	Description of Issue	Where is Issue Addressed?
1. Impacts to surface water hydrology	Withdrawal of water from the Bighorn River for agricultural purposes could: • Adversely impact fish species in the river, particularly sauger, burbot, shovelnose sturgeon, sturgeon chub, plains minnow, and western silvery minnow. • Affect the rights of existing downstream users Returns flows of irrigation water could cause an increase in sediment, agricultural chemicals, and selenium in the river.	3.6.3.1 4.6.3.1 4.3.4 4.2.2
2. Changes in land use	Only those lands actually suitable for irrigation should be transferred. Existing public access routes should be maintained.	2.4.3 4.10.1, 4.10.2, 5.2.4
3. Impacts to wildlife species	Conversion to agricultural use could adversely impact important habitat for several species, including pronghorn antelope, mule deer, migratory birds, and raptors. Fences constructed after the transfer could restrict wildlife movement.	4.6.2 4.6.2.1 4.6.2.2 4.6.5.2 4.6.2.1
4. Socioeconomic impacts	Additional agricultural development would benefit the local economy. The transfer may affect the development of other minerals, including oil and gas.	4.8.3 4.8.5 4.2.3

Issue	Description of Issue	Where is Issue Addressed?
5. Cultural resources	Transfer to private ownership could cause adverse impacts to cultural, paleontological, and historic resources.	4.9.1 4.9.2

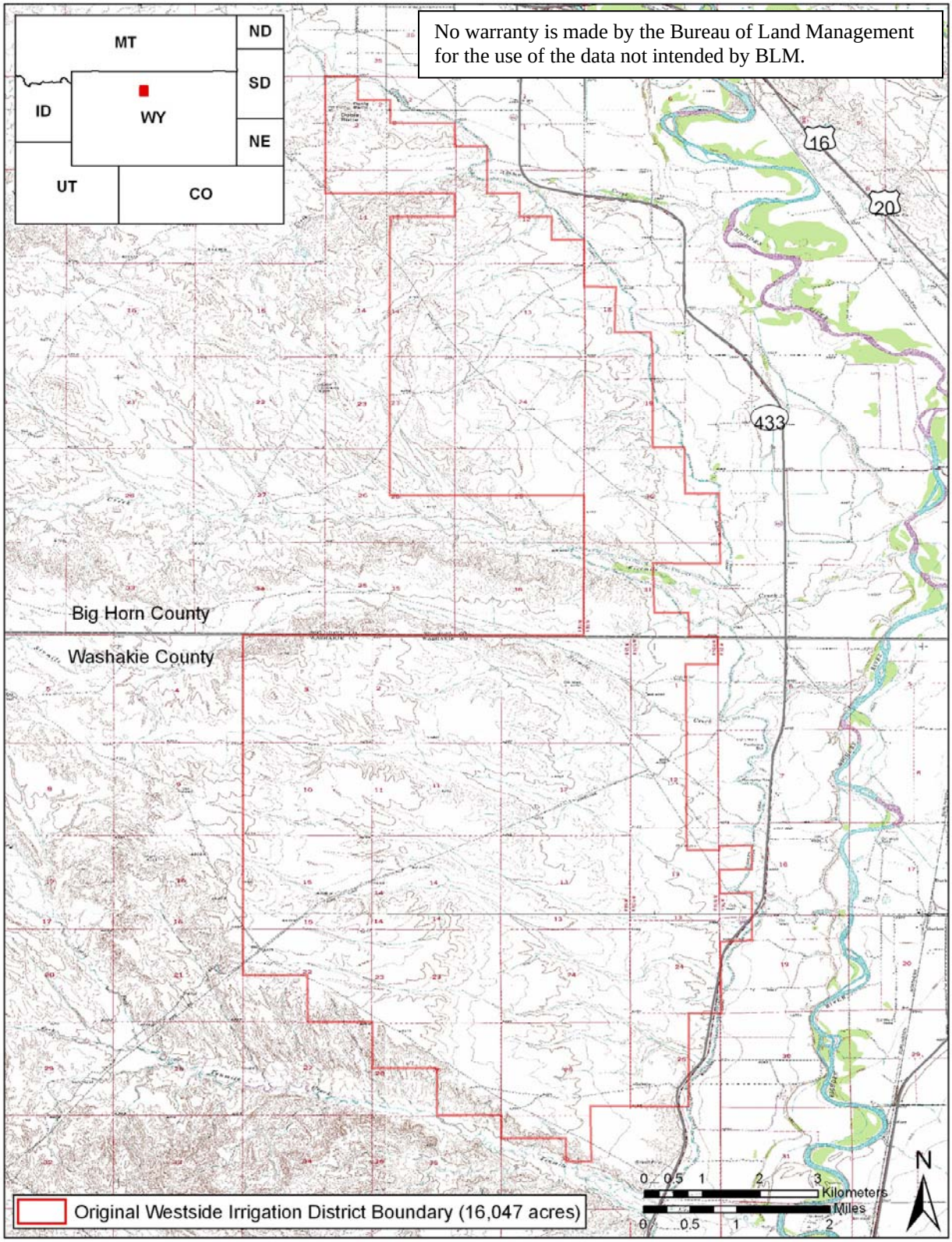
Chapter 2.0 - Alternatives

2.1 INTRODUCTION

The purpose of this chapter is to describe the Proposed Action and alternatives. Alternatives that were considered but eliminated from the analysis are listed with the reasons they were eliminated. The selected alternatives that are carried forward with the analysis are described in more detail.

2.2 ALTERNATIVE DEVELOPMENT AND EVALUATION

With the passing of Public Law 106-485 (Appendix A), Congress directed the Secretary of the Interior to convey certain land under the jurisdiction of the BLM in Washakie County and Big Horn County, Wyoming, to the WID. The land identified with the legislation was mapped and identified a project boundary containing approximately 16,050 acres. The actual map associated with the law is not available; however, based on the legal descriptions that were included in previous versions of the law and modified (elimination of redundancy and faulty legal descriptions) by the BLM, the project boundary depicted on Map 2-1 has been identified and agreed to by all parties. Further, the law stipulated that, “On agreement of the Secretary of the Interior and Westside acreage may be added to or subtracted from the land to be conveyed as necessary to satisfy any mitigation requirements under the National Environmental Policy Act of 1969”. Under this direction, the BLM implemented a process for alternatives development and evaluation that considered the purpose for the land transfer and potentially sensitive resources of the site. It was determined through this evaluation process that a reasonable alternative would be that the WID may chose to purchase only irrigable lands and lands necessary to support irrigation infrastructure, and subtract those lands not irrigable or containing sensitive cultural and/or other environmental resources.



Map 2-1. Map of lands identified for conveyance to the Westside Irrigation District.

Natural Resource Conservation Service (NRCS) soils maps and maps produced from an aerial survey resulting in data on two-foot contour, provided the basis for quantifying irrigable lands within the project area. Shallow, rocky soils were considered as un-irrigable. The remainder of the lands predominantly fell under non-irrigated classification 6 soils, with varying limitations for irrigation suitability. These lands were assessed according to the following information and criteria:

1. Two-foot contour maps were used to determine areas of acceptable slope for irrigation. It was assumed that small areas of excessive slope could be leveled. Slopes in excess of 10% were assumed to be excessive and non-irrigable.
2. Soil maps were assessed on a quarter-section basis to determine the predominant soil type within the quarter section and assess suitability for irrigable agriculture (see Appendix B). Where there were relatively small areas of unsuitable soils within a quarter section, it was assumed that upgrading those portions was possible; and it was assumed that the numerous drainages could be contoured and vegetated to control erosion.

For quarter sections that were marginally suitable for irrigation, either based on the presence of inclusions of poor soils, steep slopes, or because they were discontinuous with other more irrigable areas, a judgment call was made as to whether that parcel (quarter section or portion of quarter section) should be maintained within the project area. The resultant depiction of irrigable lands provides a generalized picture of opportunity and the basis for developing an Irrigable Land Alternative (Map 2-2). Further detail about soil types and mapping is provided in Chapter 3 and provides a more detailed summary of the irrigable acreage by quarter section as derived from this analysis.

2.3 CONNECTED ACTIONS

While the proposed action is the sale of public land to the WID, NEPA requires that “connected actions” and “cumulative actions” be considered in the same environmental analysis. The CEQ regulations implementing the NEPA indicates that actions are connected if they:

1. automatically trigger other actions which may require environmental impact statements;
2. cannot or would not proceed unless other actions are taken previously or simultaneously;
3. are interdependent parts of a larger action and depend on the larger action for their justification.

Cumulative actions are other actions that when considered with the proposed action have cumulatively significant impacts and should therefore be addressed in the same environmental analysis.

To insure that the environmental analysis is complete, it includes potential connected and cumulative actions that would result from the transfer of lands as directed in the Federal Action of the NEPA. Specifically, these include the reasonably foreseeable intended actions of the WID

after the land is acquired. It is anticipated that once the land is owned by the WID it would then be re-sold to private individuals or institutions for crop production in parcels of 160 acres, up to a maximum of 960 acres per individual, unless a larger parcel is approved by the WID Board. For either of the land sale alternatives discussed in Sections 2.3 and 2.4 below, the connected WID actions would be similar.

This description in Section 2.5 of the development that would take place post-transfer is based on the scenario supplied by the WID and the best available information. It is, however, a prediction used for purposes of analysis and not a stipulation or requirement which would encumber the land transfer. Many of the specific project design features, including selection of a source for the irrigation water, cannot be determined until it is known how much of the transferred land is sold to irrigators, who would then determine the types of crops that would be planted. Public Law 106-485 places no restrictions on eventual land use.

For purposes of analysis, it is assumed that water for irrigation would come from the Bighorn River. This is based on application filings by the WID in 1974 and 1976 with the Wyoming State Engineer's Office, and a preliminary review of possible alternate sources (Section 2.7). These applications are still valid but have not been advanced to permit status. Depending on final project design, use of water from the Bighorn River may require additional permits, such as a Section 404 permit under the Clean Water Act (CWA), which could trigger additional NEPA analysis by the appropriate agency.

The BLM would be required to take certain actions connected to any land transfer. The lands involved were withdrawn under a reclamation withdrawal which was subsequently terminated. However, the lands were never re-opened to mineral entry. This would need to be addressed in conjunction with any sale. By regulation, grazing permittees losing privileges must be provided notice, and receive compensation for any improvements on the allotments. The sale must also include a provision to protect existing third-party right-of-way holders.

2.4 ALTERNATIVES DESCRIPTION

2.4.1 No Action Alternative

The No Action Alternative represents the baseline or existing conditions from which to compare the impacts from the alternatives. Under this alternative the proposed land transfer and subsequent connected actions would not take place. The BLM would not convey all right, title and interest on the parcel of land under consideration to the WID and there would be no connected actions of converting the land to crop production or developing infrastructure to the site for irrigation. The No Action Alternative would not meet the purpose and need as stated for the project.

2.4.2 Proposed Action Alternative (Alternative 1)

Public Law 106-485 (November 9, 2000; 114 Stat. 2199) directs the Secretary of the Interior, acting through the BLM, to convey all right, title and interest (excluding mineral interest) in a parcel of public land in Big Horn County and Washakie County, Wyoming, to the WID. The

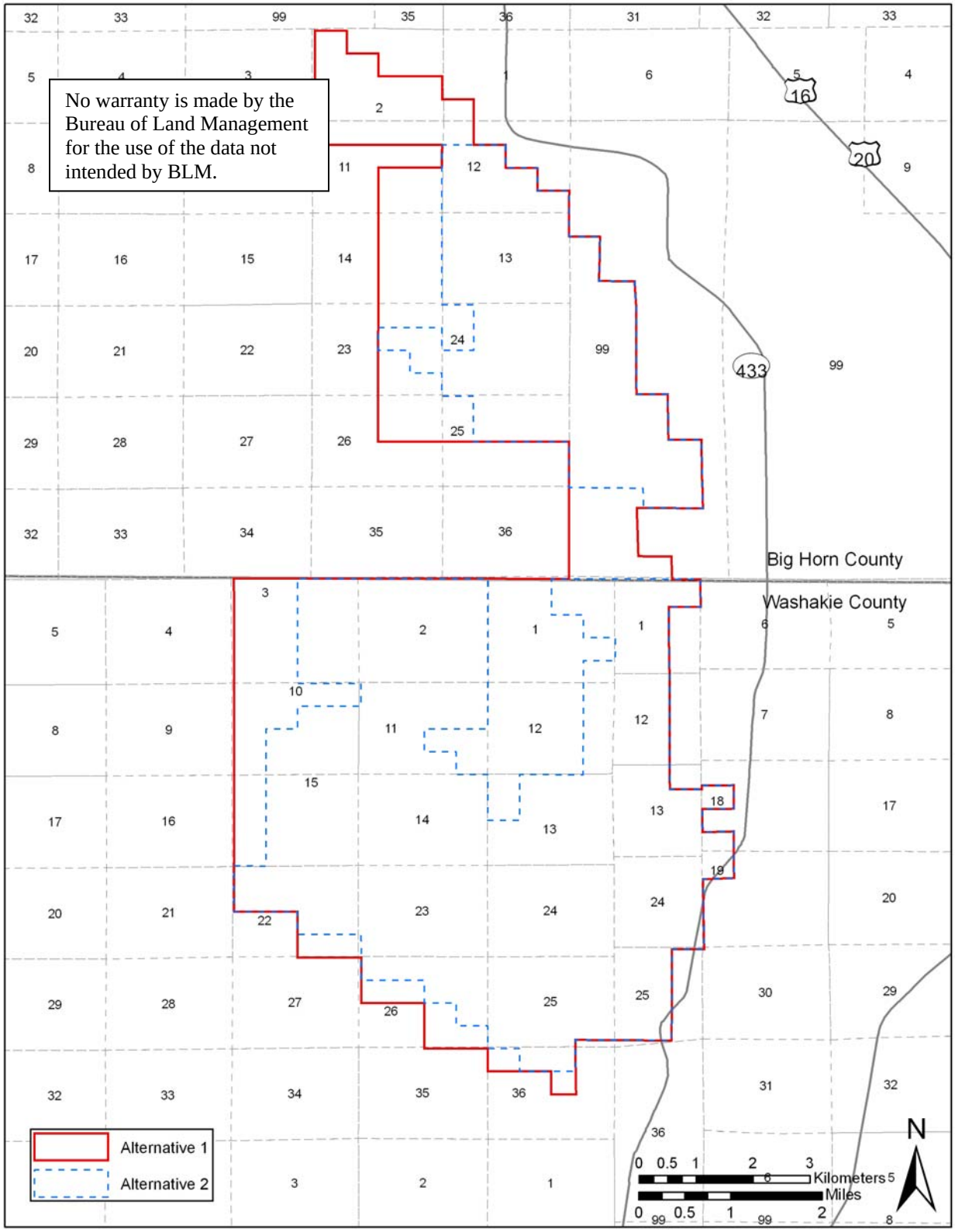
mapped land used in the legislation authorizing the transfer of land identified a primary project boundary containing approximately 16,050 acres (Map 2-1). Conveyance is to be made to the WID, at appraised value in one transaction. These lands (within the boundary of the 16,050 acre parcel) would include irrigable land or areas suitable for crop agriculture, non-irrigable land, and land unsuitable for crop production.

The sale to the WID is to take place after "completion of an environmental analysis under the National Environmental Policy Act" by the Worland Field Office of the BLM. The law authorizing transfer of the land specifies that acreage may be added to or subtracted from the original 16,050 acres to satisfy any mitigation requirements resulting from the NEPA analysis. The law also provides that proceeds from the sale are to be used "for the acquisition of land and interests in land in the Worland District of the BLM that would benefit public recreation, public access, fish and wildlife habitat, or cultural resources."

Under the Proposed Action Alternative, the BLM would sell to the WID all rights, title and interest in the selected lands, except for mineral rights, amounting to approximately 16,050 acres (Map 2-1). The BLM would appraise lands following UASFLA and the WID would be charged the appraised value. The proceeds from the sale would be then utilized to purchase other lands within the Worland District for the purpose of mitigating the effects of transfer, in accordance with Public Law 106-485.

2.4.3 Irrigable Land Alternative (Alternative 2)

Within the boundaries of the mapped land used in the legislation authorizing the land transfer, areas exist that are unsuitable for irrigated agriculture. Unsuitable lands include those that occur on steep slopes, have shallow rocky soils unsuitable for tillage, or are highly alkaline (saline) soils and may be marginally or unsuitable for growing crops. These areas were identified through two processes (see Section 2.2 above). Because the available mapping was at too gross of a scale (20-foot contours), a detailed land survey was conducted to better define slopes throughout the 16,050 acre parcel and soils mapping of the NRCS was used to determine soil classifications. In addition, the continuity of quarter-section parcels was considered for feasibility of developing water delivery infrastructure to cover the identified areas. The land evaluation process resulted in definition of lands within the approximately 16,050 acre parcel that were more suitable for irrigable agriculture and for which irrigation pipeline infrastructure would be feasible (Map 2-2). The boundary of the resulting parcel of land was based on quarter-quarter sections and contained approximately 11,576 acres (Map 2-2). This parcel continues to encompass areas considered unsuitable for irrigable agriculture; however, these have been minimized and provide location for infrastructure development and/or would have created unmanageable isolated tracts if retained by the BLM. Based on the analysis, approximately 80% of the land (approximately 9,300 acres) within the Irrigable Land Alternative boundary is considered suitable for irrigation.



Map 2-2. Map of Irrigable Lands Alternative for the Westside Irrigation District.

Under the Irrigable Land Alternative, the BLM would sell to the WID all rights, title and interest in the selected lands, except for mineral rights, amounting to approximately 11,576 acres (Map 2-2). The BLM would appraise lands following UASFLA and the WID would be charged the appraised value. The proceeds from the sale would be then utilized to purchase other lands within the Worland District for the purpose of mitigating the effects of the transfer, in accordance with Public Law 106-485.

The lands to be transferred are shown in Map 2-2 in two discrete parcels. This parceling results from the topography of the lands and from the preliminary design of the potential irrigation system infrastructure, which could be constructed in stages. Under this alternative, the three parcels could be transferred at once, or they could be transferred and developed in two or three separate phases. A phased transfer may be determined by such factors as the level of interest in acquiring and developing lands as expressed by potential irrigators, and by the amount of funding available to the WID at the time of the transfer. The appraised value of the lands determined by the BLM would be valid for one year. If phased parcels were to be transferred after one year, a new appraisal would be required. The procedures to be followed in the transfer would be specified in a Purchase Agreement to be negotiated between the WID and the BLM. The agreement would be valid for a term of five years. Beyond this time, renewal of the agreement would require supplemental NEPA analysis.

2.5 RESONABLY FORESEEABLE POST-TRANSFER DEVELOPMENT

Connected actions under either of the land sale alternatives include the reasonably foreseeable intended actions of the WID after the land is acquired. The following is a description of the approach to administration of these lands as provided by the WID.

It is anticipated that once the land is owned by the WID it would then be re-sold to private individuals or institutions and that the WID would select these individuals or institutions to receive the lands through a lottery. The WID would administer the lottery and determine qualified participants. Qualifying participants must demonstrate financial responsibility by showing proof that they have resources to develop the lands for agriculture and that they are citizens of the United States of America. All landowners participating in the land acquisition would be required to agree to management and access provisions as described below or agreed upon mitigation measures to minimize or offset potential impacts. This agreement would likely take the form of a covenant attached to the lands upon sale by the WID.

Financial responsibility criteria include the ability to purchase the land and the cost of bringing the lands under crop production within five years from purchase. The financial responsibility also includes the ability to maintain the land in crop production including startup costs and operating capitol. Lands may be resold to individuals meeting the same criteria as the original purchaser, although the grace period of five years to achieve crop production would only be available to the original owner and following the first re-sale.

Based on the WID proposal, the sale of the lands would be conducted in two phases. The first phase would be the sale of lands on the south end of the project area which is the largest contiguous block. The second phase would be the sale of the balance of the selected lands in the

northern portion. Under the current proposal, both phases would be completed within seven years of the original conveyance of lands to the WID. It is assumed that most of the area identified in the Irrigable Lands Alternative is suitable for crop production if overhead irrigation is used, although, portions may be less suitable due to saline soils or steep slopes. It is also assumed that the primary cropping patterns to be implemented, while ultimately up to the individual land owner, would be similar to existing crops in the Big Horn Basin and would include alfalfa, corn, dry beans, malting barley, sugar beets, and grass hay mixtures.

Lands would be selected for sale that are irrigable and that to the extent practicable, avoid or minimize impacts to wildlife, recreation, cultural resources, other sensitive environmental areas, and other land uses (e.g., pipeline or powerline right-of-way). Impacts that cannot be avoided would be mitigated. Lands to be sold would be determined by hypothetically fitting center pivots on the irrigable lands within the identified parcel, while avoiding any sensitive resources that might require high mitigation costs. Residual areas such as field corners that are not cultivated and lands within the project area that are not considered suitable for overhead sprinkler irrigation would be owned by the WID and used for irrigation infrastructure (e.g., pipelines, roads, power line right-of-ways) or mitigation purposes (e.g., managed as wildlife habitat).

The WID would provide water to each parcel of land sold. The WID has a state water right for 240 cfs pending with the State Engineer, which must be adjudicated to insure adequate water for the project. The current plan includes pumping water from the Bighorn River at two locations. Each site would likely contain one or more pumps collectively capable of pumping 80 cfs, a pump station, and a fore bay. The water would be delivered by pipeline to individual parcels. A direct route via a 48 inch pipeline would be selected from each pump station to a central location within the project lands. A manifold system of reducing pipeline capacity to distribute water to individuals would be installed within the project area. Each landowner would have their own flooded suction pump to deliver water to center pivots. The source of electricity for operating the pumps is assumed to be a local commercial source, although the actual source has not been determined.

Environmental impacts associated with the BLM action of transferring the land to the WID and the connected actions as described above are addressed in more detail in the following analysis. The mitigation opportunities identified as part of the WID plan as well as mitigation measures intended to avoid, minimize, or offset the foreseeable impacts from the project determined through the analysis are also described in more detail in the following analysis. Suggested mitigation opportunities that would be available to the WID are described in Chapter 5.

2.6 COMPARISON OF ALTERNATIVES

The two action alternatives evaluated in this EIS are compared in this section, first by the features they have in common and then by features unique to each one. Table 2-1 provides a brief comparison of potential impacts to project issues across alternatives. Greater detail is provided in the detailed impact assessments provided in Chapter 4.

2.6.1 Features Common to Both Action Alternatives

Both action alternatives involve the transfer of land from public ownership into private ownership. The connected action of converting a portion of the transferred land applies to both action alternatives. The water to irrigate the converted lands would be pumped from the Bighorn River and applied to the land by overhead irrigation sprinkler systems. Existing rights-of-ways (ROW) holders would be offered the following options described in Section 4.7, prior to the time of any land transfer.

2.6.2 Features Unique to Action Alternatives

Alternative 1 contains irrigable and non-irrigable lands. Conversely, Alternative 2 contains primarily those lands that have been identified as irrigable.

2.7 ALTERNATIVES CONSIDERED AND ELIMINATED FROM FURTHER ANALYSIS

Throughout the project scoping and alternatives development process, various alternatives for the connected action of developing the WID were brought forth that were eventually eliminated from further consideration because of infeasibility or environmental issues. It was also determined that it was impractical to attempt to specify a particular water source at this point, when the number of acres that would eventually be placed under irrigation, and the types of crops that would be grown, cannot be determined with certainty. These alternatives included taking water from the Big Horn Canal and ground water development. An alternative that considered a different overall location for the WID was not addressed because Public Law 106-485 was specific in terms of the location and land available for conveyance. Selecting a new area was considered non-compliant with the law.

2.7.1 Big Horn Canal Diversion

Currently, the proposed action of the WID (see Section 2.5 Connected Actions) is to divert water from the Bighorn River under available water rights to provide irrigation water to the new lands. The Big Horn Canal parallels the Bighorn River adjacent to the 16,050 acre parcel under consideration. Water diversion from the canal was considered as an option to diverting water from the river, but was dropped from further consideration when it was deemed infeasible. The cost of expanding approximately 10 miles of the canal, modifying the diversion to accommodate the increase in flow needs, and modifying the canal near the WID for pumping, was considered prohibitive. In addition, the Big Horn Canal Irrigation District expressed opposition to the proposal of supplying the WID water via the canal (Estes 2005) precluding further consideration of this alternative. Thus, to a large extent, water for the WID would be from available return flows to the Bighorn River downstream of the Big Horn Canal diversion point (see Section 3.3.1 Surface Hydrology below).

2.7.2 Groundwater Development

Groundwater development was considered as a potential alternative to diverting Bighorn River water, but was eliminated due to the insufficient amount of available ground water. A survey of existing groundwater wells in the 4-Township vicinity of the proposed WID indicates that there would not be sufficient ground water to irrigate approximately 9,300 acres (Table 2-2), which is the amount of land that would be available for crop production under the Irrigable Land Alternative (Section 2.4.3).

Based on the available information, and given an annual crop demand of 2.0 acre-feet of water, approximately 11,500 gallons per minute (GPM) would be required to irrigate approximately 9,300 acres. Groundwater as an alternative irrigation supply source is deemed untenable. The shallow wells in the vicinity tap the Willwood Formation with maximum production capabilities of approximately 25 GPM. Underlying and confined minor aquifers are generally tighter and less productive. Very deep exploration to the Paleozoic limestone aquifers is fiscally prohibitive, while supply dependability would be entirely uncertain and of considerable risk; moreover, any potential yield is likely of poor quality.

Table 2-2. Summary of wells located within a 4-Township area surrounding the WID.

	Wells in Adjoining 4-Township Area			West of Bighorn River Only		
Use	**# Wells**	**Total GPMa**	**Avg Depth**	**# Wells**	**Total GPM[a]**	**Avg Depth**
Not Specified	2	18	25			
Domestic	99	1052	120	39	455	137
Domestic, Stock	46	509	96	20	276	74
Stock	32	361	83	11	160	77
Industrial	8	40	3374			
TOTAL	187	1980	244	70	891	110

[a] gallons per minute

Table 2-1. Brief Comparison of Impacts to Key Issues across Alternatives

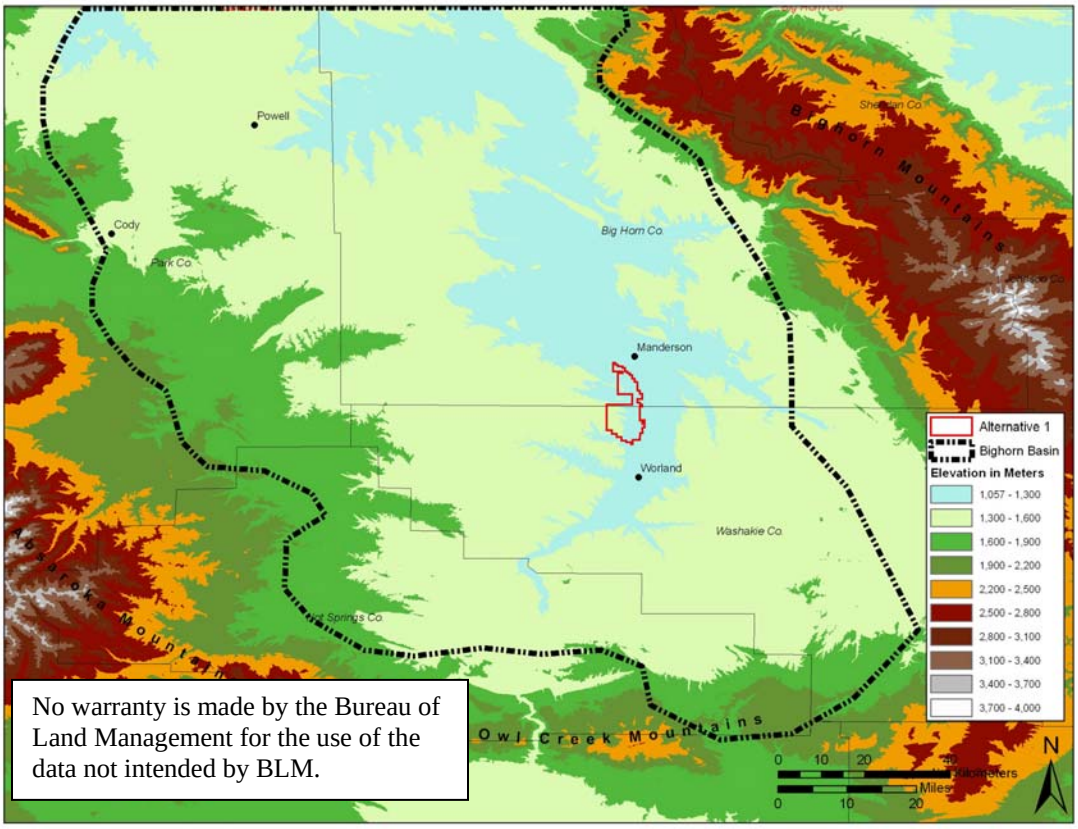
Impact by Key Issues	Alternatives		
	No Action	**Proposed Action Alternative (Alternative 1)**	**Irrigable Land Alternative (Alternative 2)**
Project Description			
Land conveyed to private ownership	0	16,050 acres	11,576 acres
Land converted to cropland	0	9,300 acres	9,300 acres
Geology and Soils			
Erosion	No change form existing rate of erosion	Estimated an additional loss of 38,130 tons per year of soil if all 9,300 acres were irrigated.	Estimated an additional loss of 38,130 tons per year of soil if all 9,300 acres were irrigated.
Saline soil reclamation	Not required	9,300 acres	9,300 acres
Water Resources			
Surface Hydrology Maximum monthly demand	0	5,000 acre-feet/month	5,000 acre-feet/month
Yearly demand	0	18,600 acre-feet/year	18,600 acre-feet/year
Biological Resources			
Vegetation Permanent loss of big sagebrush	0	0.62% of Bighorn Basin	0.62% of Bighorn Basin
Wildlife Converted to Cropland Pronghorn critical winter/yearlong	0	3.5% seasonal range lost	3.5% seasonal range lost
Pronghorn winter/yearlong	0	0.3% seasonal range lost	0.3% seasonal range lost
Pronghorn Parturition	0	14.6% seasonal range lost	14.6% seasonal range lost
Mule deer crucial winter/yearlong	0	1.6% seasonal range lost	1.6% seasonal range lost
Mule deer yearlong	0	1.5% seasonal range lost	1.5% seasonal range lost
White-tailed deer yearlong	0	0.09% seasonal range lost	0.09% seasonal range lost
Loss of public ownership and multiple use management Pronghorn critical winter/yearlong	0	4.7% seasonal range lost	3.5% seasonal range lost
Pronghorn winter/yearlong	0	0.5% seasonal range lost	0.3% seasonal range lost
Pronghorn Parturition	0	28.7% seasonal range lost	14.6% seasonal range lost
Mule deer crucial winter/yearlong	0	2.4% seasonal range lost	1.6% seasonal range lost
Mule deer yearlong	0	2.0% seasonal range lost	1.5% seasonal range lost

White-tailed deer yearlong	0	0.15% seasonal range lost	0.09% seasonal range lost
Wetlands Palustrine forested	0	85	0
Palustrine scrub-shrub	0	2.69	0
Palustrine emergent	0	3.81	0
Land Use			
Total Grazing allotments affected (acres)	0	15,817	11,435
Socioeconomic			
Annual cost per acre	0	Washakie County $286 Big Horn County $291	Washakie County $281 Big Horn County $286
Annual Return per acre	0	Washakie County $194 Big Horn County $194	Washakie County $194 Big Horn County $194
Net return to land and water	0	Washakie County ($92) Big Horn County ($97)	Washakie County ($87) Big Horn County ($92)
Annual cost per acre with Pick-Sloan Power	0	Washakie County $255 Big Horn County $261	Washakie County $250 Big Horn County $256
Annual Return per acre with Pick-Sloan Power	0	Washakie County $194 Big Horn County $194	Washakie County $194 Big Horn County $194
Net return to Land and Water with Pick-Sloan Power	0	Washakie County ($61) Big Horn County ($67)	Washakie County ($56) Big Horn County ($62)
Cultural and Paleontological Resources			
Potential Cultural sites affected	0	22	8
Percent of acres in high or very high sensitivity zone	0	26.5%	23.7%
Willwood formation surface exposure	0	9,735 acres	6,105 acres
Recreational Resources			
Non-consumptive	Access remains the same	Potential loss of access to 16,050 acres	Potential loss of access to 11,576 acres
Remote/Solitude value	Remoteness and solitude remain as currently exists	9,300 acres converted from natural state to agricultural fields	9,300 acres converted from natural state to agricultural fields

Chapter 3.0 - Affected Environment

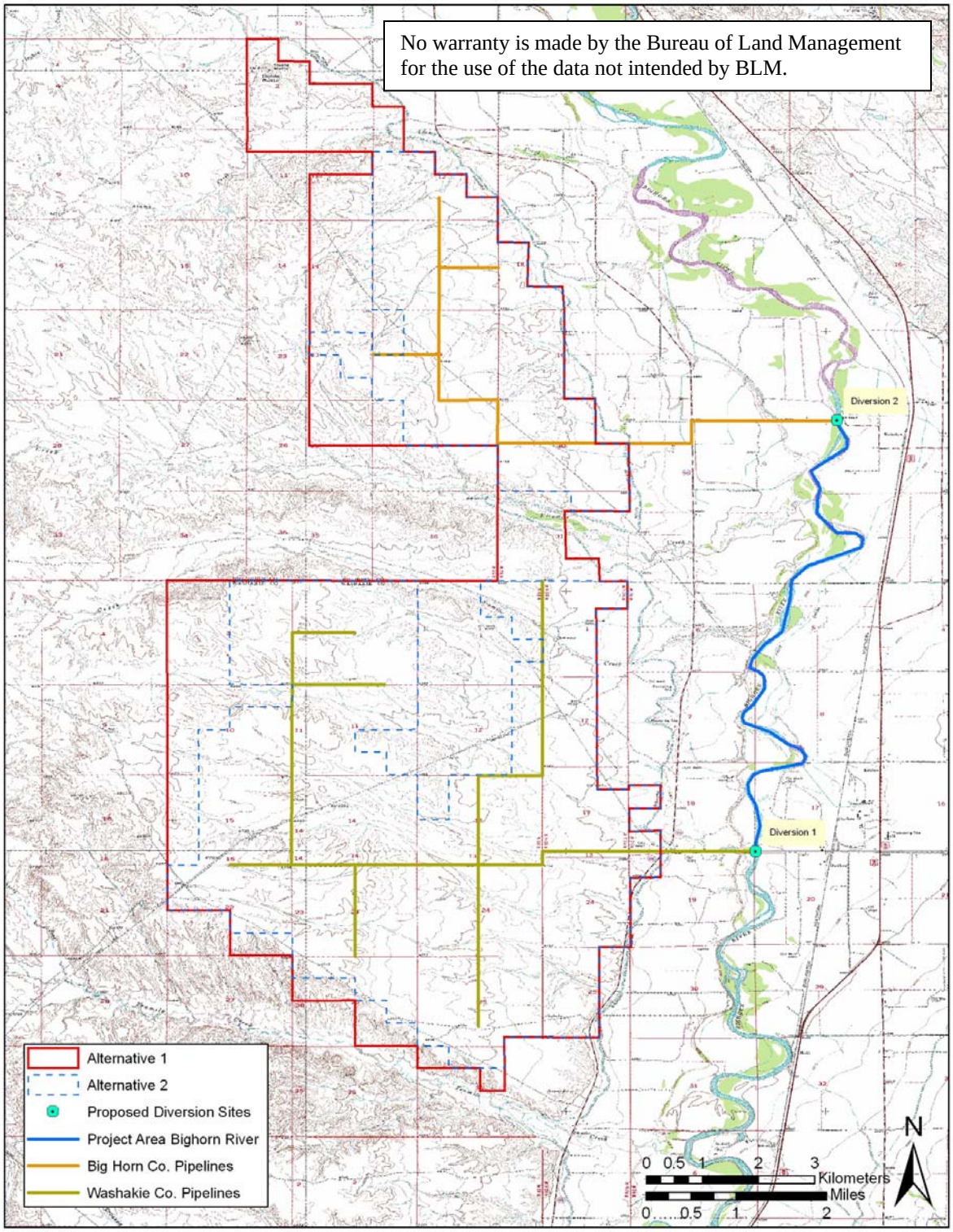
3.1 INTRODUCTION

This Chapter describes the physical, biological, social, and economic components of the environment that may be affected by implementing the proposed action or the alternatives. Descriptions of the physical and biological components apply generally to the Bighorn Basin between Manderson and Worland and more specifically to those areas that would be directly and indirectly affected by the land conveyance. Economic, social, agricultural, and cultural elements deal with both the larger context of state, Bighorn Basin, and Big Horn and Washakie Counties as well as within the project area. The Bighorn Basin for this project is defined by the Bighorn Mountains to the east, the Owl Creek Mountains to the south, the Absoraka Mountains to the west, and the state border with Montana to the north (Map 3-1).



Map 3-1. Bighorn Basin

The project area for each action alternative is defined as: the area that will be conveyed from BLM to WID ownership, water pipeline corridors, pumping station locations, and the Bighorn River corridor between water diversions and return flows (Map 3-2). The environment for each alternative is primarily the same, but differs in amount of land conveyed. If important environmental differences exist between the alternatives, they are discussed in the appropriate sections of this Chapter.



Map 3-2. Project area alternatives.

3.2 LAND FEATURES

3.2.1 General Setting

3.2.1.1 Location

The project area is located in the north-central portion of Wyoming in the Bighorn Basin, between Worland, approximately 4.4 miles (7 km) south, and Manderson, approximately 1.8 miles (3 km) north (Map 3-1). The acreage is positioned on the west side of the Big Horn Canal and located on the county line between the Big Horn County and Washakie County (Map 3-2). It is situated in T48N R92.5W, the eastern half of T48N R93W, western extreme of T49N R92W, and the eastern third of T49N R93W. Lands within the project area consist entirely of public lands managed by the BLM. Lands to the east are privately-owned; land to the west is a mixture of public land and State of Wyoming land.

3.2.1.2 Climate

The region is arid, with 1971-2000 mean annual precipitation of 6.77 inches in Basin, Wyoming and 8.03 inches in Worland, Wyoming. About 60 to 70 percent of the annual precipitation occurs during the irrigation season. The irrigation season has been characterized as an average frost-free period of 133 days (Wyoming Water Planning Program Report, 1972), or a normal period of at least 40 degree Fahrenheit mean daily temperatures which occurs during the months of April through October (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climate Data Center, 2002).

In this arid region there are also slight microclimate changes around the plants that occupy the landscape. A microclimate occurs in an area where there is a local modification of the general climate that is imposed by special configuration of a small area. It is influenced by topography, ground surface and plant cover, and man-made activities (e.g., irrigated agriculture). Plants can alter the form of the surface, increase the area for radiation and transpiration, shade the ground, change air movements, and trap air. All these factors cause a cooler, more humid, and stable microclimate.

The proposed Big Horn County lands are at elevations ranging from about 1,237.5 to 1,298.5 meters. Lands in Washakie County range up to 46 meters higher.

3.2.2 Geology and Soils

The proposed project area is dominated by Quaternary terrace deposits that slope gently eastward toward the Bighorn River. The terraces are approximately 30-feet in depth, and are bounded and intersected by outcrops of the underlying Tertiary Willwood Formation predominantly within the rolling landscape of gullies and tributary drainages. Moderate to heavy surface gravel and cobble are present on eroded terrace edges and drainage side slopes. The Willwood Formation is a variegated claystone, shale and sandstone.

Soils in the project area are formed on alluvial fans, shale uplands and terraces under arid conditions. The NRCS has rated the soils as Class III or poorer for irrigation capability; that is,

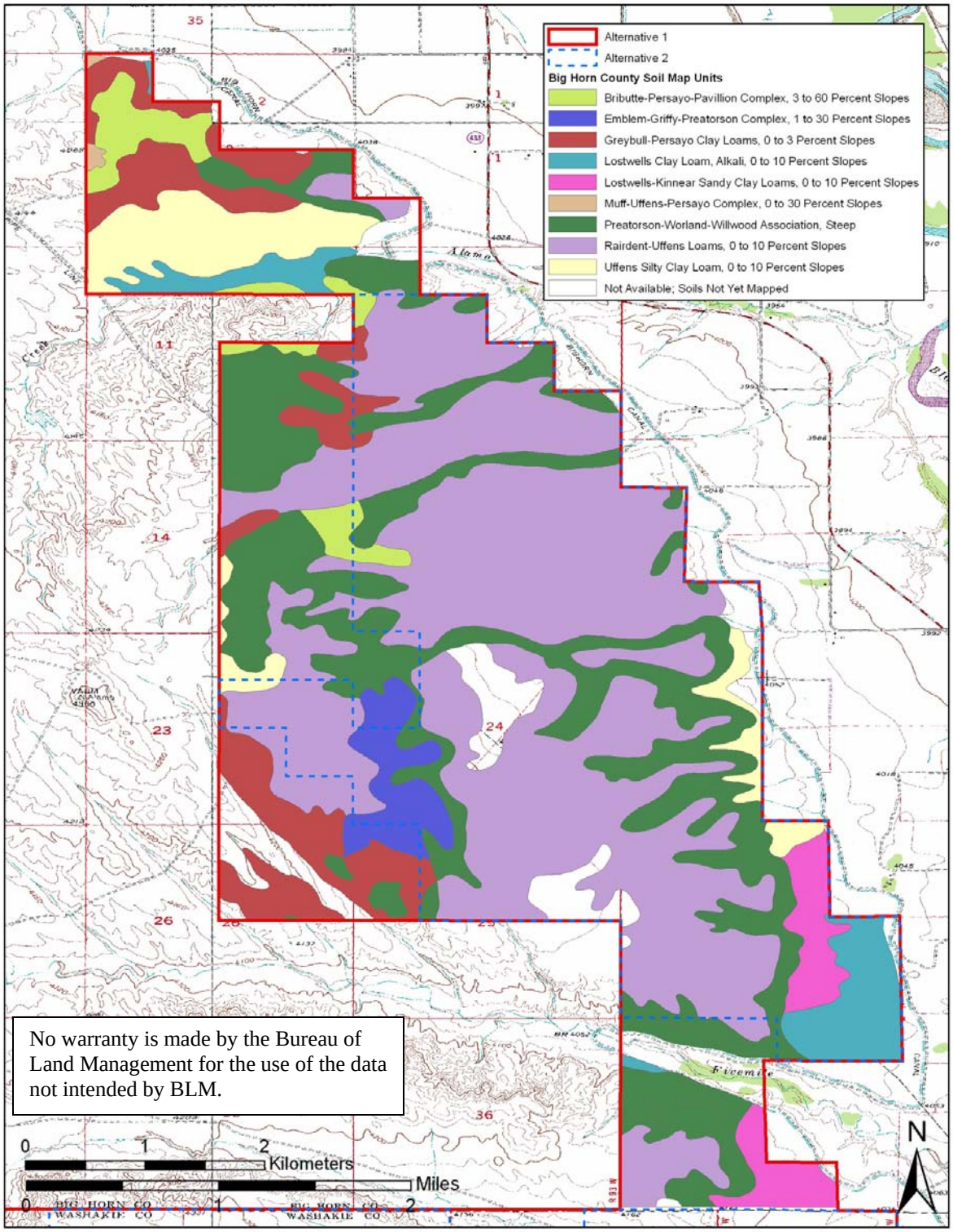
suitable for 2-3 years of row crop production in rotation with the equivalent period of hay and pasture use.

Within the project area, soils in the sloping fans, swales, and drainages are usually deep and well drained. These have formed from material washed from the terraces or sandstone escarpments immediately above them. Soils in the uplands are typically shallow and are formed by weathering of underlying saline shale bedrock. Much of these lands are deemed unirrigable for lack of subsurface drainage to leach the salts that would inevitably build with continued irrigation.

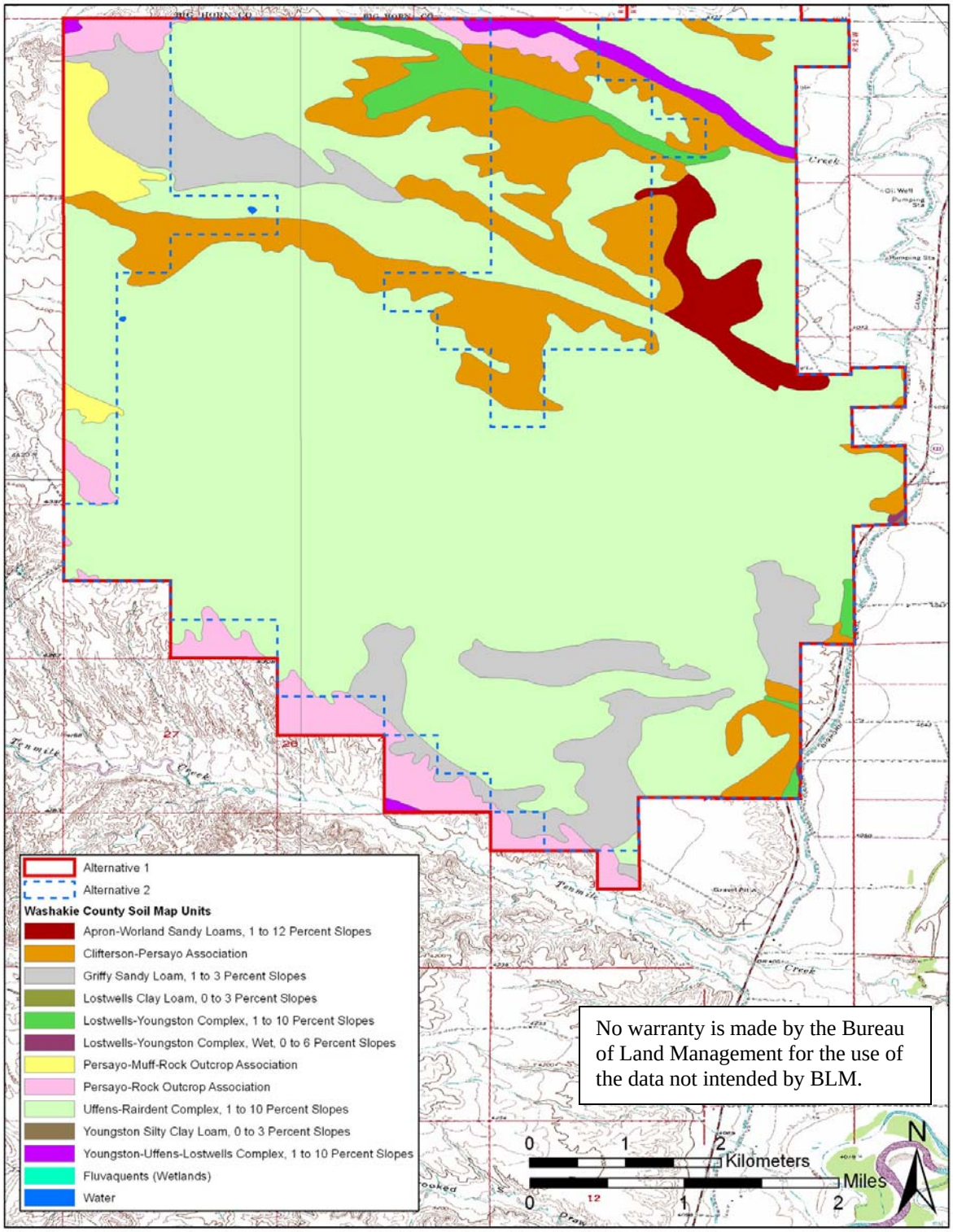
Soils on the uniform, nearly level to sloping terraces are usually deep and well drained. They have sand and/or gravel substrata underlain by shale bedrock. Lime, gypsum and salts have been leached and deposited in subsurface horizons. Limited precipitation has resulted in a relatively thin (8 to 17 inches) leaching zone. In some instances, clay layers, some high in sodium, can be within a few inches of the surface.

The most detailed soils study of the area to date was conducted by Engineering Associates (1978). Soil boring tests and soil samples were taken at 35 locations, but only 6 of these are within the presently proposed WID boundary. The samples verify adverse salinity and/or drainage capacity in soils of the Rairdent-Uffens Complex; however, actual on-site investigation is necessary to determine the exact locations and the extent of the Uffens or Rairdent Series. Although the percentages of soil series have been specified within mapped units, it must be emphasized that these are average percentages; the actual percentage of problematic soils within a smaller tract of land may be much larger.

Soil classification maps divided into Big Horn and Washakie County are based on NRCS information and provide a visualization of soil characteristics and distribution throughout the project area (Map 3-3 and 3-4). Categorized soil reports provide soil parameters such as irrigated and non-irrigated capability class, drainage capability, permeability, water capacity, salinity, soil depth, slope, and erodibility (Appendix C).



Map 3-3. Soils in the Big Horn County portion of the project area.



Map 3-4. Soils in the Washakie County portion of the project area.

3.2.3 Mineral Resources

Federally owned oil and gas leases exist in the project area. Five oil wells presently exist within or very near the proposed WID boundary. Coal resources likely also underlie the area, but no evident plans exist for their exploitation. Sand and gravel deposits exist in the project area and associated exploration and development are possible, although there is not a foreseeable demand.

The project area is covered by the GCRMP. Surface-disturbing and disruptive activities associated with all types of minerals exploration and development and with geophysical exploration are subject to appropriate mitigation developed through use of the mitigation guidelines described in Appendix 3 of the GCRMP.

3.3 WATER RESOURCES

3.3.1 Surface Hydrology

The Wind River flows more than 120 miles through central Wyoming from its headwaters near the Continental Divide to the Bureau of Reclamation's Boysen Reservoir south of Thermopolis. At the "Wedding of the Waters" below the Wind River Canyon, the river becomes the Bighorn River. Flows in the Bighorn River are controlled by Boysen Dam and Reservoir. The Bighorn River below Boysen Reservoir has an average discharge of 1,387 cfs, or 1,004,000 acre-feet per year. The Bighorn River between Thermopolis and Kane (near Bighorn Lake) has a historic mean annual discharge that exceeded 1,100 cfs 90 percent of the time.

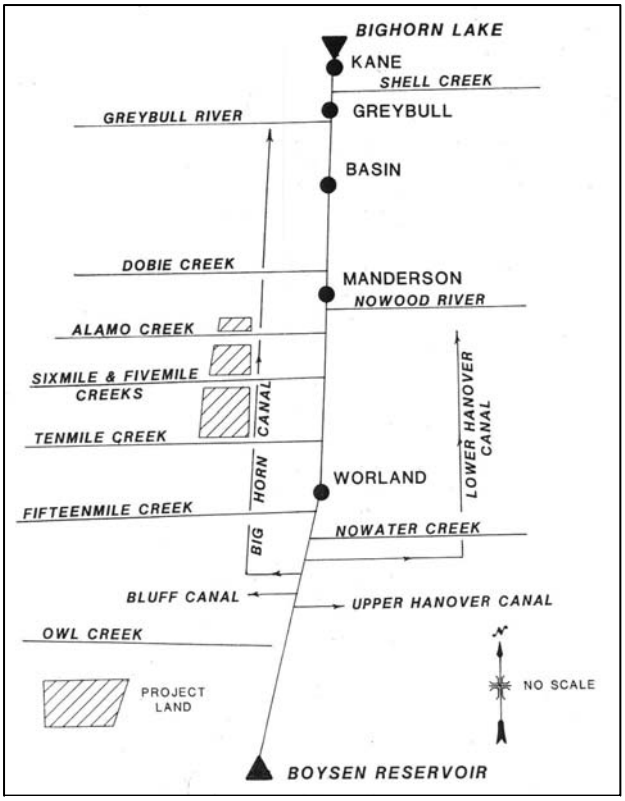


Figure 3- 1. WWDC Wind/Bighorn Basin Planning Flow Model.

The WWDC Wind/Bighorn Basin Planning Flow Model provides estimates of stream flow in the Bighorn River upstream of the project area at the confluence with Fifteenmile Creek (Figure 3-1). Referencing the "Existing Conditions—Dry Year" scenario, the model estimates the water availability during the irrigation season generally decrease through the growing (farming) season (Table 3-1). Within the Upper Bighorn River drainage below Boysen Reservoir, and above Basin, Wyoming (and exclusive of the Nowood Creek drainage above Manderson), there are 88,135 acres of presently irrigated lands. The flow volumes reported in the Basin Planning Flow Model and indicated in Table 3-1

Table 3-1. Water availability in Bighorn River between Boysen Reservoir and Bighorn Lake during a dry year measured at Fifteenmile Creek.

Month	Discharge (cfs)
May	970
June	990
July	950
August	800
September	530

include return flows from the irrigated lands.

The town of Basin, Wyoming diverts Bighorn River water for municipal use (State of Wyoming 1998). The WWDC Water System Survey Report for 1998 states Basin's average daily use at 300,000 gallons per day, or about 336 acre-feet per year. However, Basin must divert at least 454 acre-feet per year to compensate for leakage loss of about 35 percent.

3.3.2 Water Quality

Bighorn River water is a sodium sulfate or sodium calcium sulfate type. When the discharge of the river is large, most of the water is derived from snowmelt and rainfall and the water has a low specific conductance. When the discharge is small, a large part of the water is derived from return flow from irrigation, thermal springs, and oilfields and the specific conductance of the water is high (specific conductance (EC) is generally proportional to total dissolved solids (TDS)).

Several mineral hot springs flow into the Bighorn River around Thermopolis. These contribute approximately 20 percent of the average annual salt load between Boysen Reservoir and the Kane gauging station (above Bighorn Lake).

The effect of irrigation return flows on water quality is not readily available. Oilfields provide discharge waters to water-starved tributaries of the Bighorn River. Much of this discharged water is used to irrigate pastures within the drainage. The local landowners readily accept the net benefit of this water without regard for its substandard quality for irrigation purposes. This, combined with channel losses, results in fairly small quantities of oilfield discharges actually reaching the main stem of the Bighorn River during the irrigation season.

Water quality data from the Bighorn River at Boysen Reservoir (number 06259000) and at the Kane gauging station (number 06279500) indicates that arsenic and selenium concentrations increase markedly between the two sampling stations (Table 3-2). There is an anticipated rise in EC as a result of the influx of mineral spring waters at Thermopolis. EC ranges from 322 to 1460 µS/cm at Boysen and from 321 to 3030 µS/cm at Kane.

Table 3-2. Water quality of Bighorn River below Boysen Reservoir and Kane Gauge Station.

Constituents (µg/l):	Below Boysen Reservoir (averages)	Sampling Period Below Boysen Reservoir	Kane Gauging Station (averages)	Sampling Period at Kane Gauging Station	Standard (µg/l)
EC (µS/cm)	713	11/24/1953- 3/1/2002	938	3/16/1947-8/30/2005	(TDS=500mg/l)
Arsenic	2.1	12/13/1977 -8/31/1992	3.9	10/1/1970-10/26/1999	50
Cadmium	1.0	12/13/1977- 8/31/1992	1.0	10/1/1970-8/5/2002	10
Iron (unfiltered)	28	12/1/1953- 8/21/2001	28	3/26/1947-9/15/1971	300
Iron (filtered)	51	10/20/1071- 8/31/1992	47	8/29/1969-8/5/2002	300
Selenium	1.1	12/13/1977- 8/31/1992	2.5	11/4/1987-10/26/1999	10

The downstream Kane gauge was upgraded to collect baseline pesticide data in October 1987 to enable accurate assessment of the actual effects of the Westside Project (USDOI, 1988). The four pesticides assessed are commonly used in crop production including two insecticides, aldicarb and carbaryl, and two herbicides dicamba and picloram. A review of the data indicates that collection of dicamba data actually began in 1984, and carbaryl and aldicarb analysis did not begin until 1996 (Table 3-3). The availability of this data provides for the possibility of assessing actual pesticide loads to the Bighorn River from Westside agricultural practices, and may serve as a means of regulating or enforcement of protective measures if toxicity levels become acute. Current measurements indicate that pesticide concentrations are at or below trace amounts. The trace amounts that occur are results of the extensive crop production that occurs along the Bighorn River.

Table 3-3. Record of pesticide concentrations at Kane Gauge Station.

Pesticide	Number of samples	Average (mg/L)	First sample date	Last sample date
Aldicarb sulfone, water, filtered (0.7 micron glass fiber filter), recoverable, micrograms per liter	11	0.07	3/26/1996	7/1/1999
Aldicarb sulfoxide, water, filtered (0.7 micron glass fiber filter), recoverable, micrograms per liter	11	0.04	3/26/1996	7/1/1999
Aldicarb, water, filtered (0.7 micron glass fiber filter), recoverable, micrograms per liter	11	0.34	3/26/1996	7/1/1999
Carbaryl, water, filtered (0.7 micron glass fiber filter), recoverable, micrograms per liter	11	0.01	3/26/1996	7/1/1999
Carbaryl, water, filtered (0.7 micron glass fiber filter), recoverable, micrograms per liter	26	0.00	3/26/1996	8/5/2002
Dicamba, water, filtered (0.7 micron glass fiber filter), recoverable, micrograms per liter	11	0.04	3/26/1996	7/1/1999
Dicamba, water, unfiltered, recoverable, micrograms per liter	34	0.03	6/20/1984	8/31/1992
Picloram, water, unfiltered, recoverable, micrograms per liter	34	0.01	6/20/1984	8/31/1992

3.3.3 Groundwater Resources

As of 2006, the Wyoming State Engineer's Office has 187 existing groundwater well permits in the 4-Township vicinity of the project area (Table 3-4). Seventy domestic or livestock water wells were located west of the Bighorn River closer to the proposed district.

Table 3-4. State Engineer's Office Groundwater Records.

Uses	Wells in Adjoining 4-Township Area			West of Bighorn River		
	# Wells	Total GPM	Avg Depth	# Wells	Total GPM	Avg Depth
unspecified	2	18	25			
Domestic	99	1052	120	39	455	137
Domestic, Livestock	46	509	96	20	276	74
Livestock	32	361	83	11	160	77
Industrial	8	40	3374	0	0	0
TOTAL	**187**	**1980**	**244**	**70**	**891**	**110**

Existing domestic wells along the eastern boundary of the project area were sampled around 1988. Well depths range from 40-180 feet, with static water levels averaging 26 feet. Nitrate concentrations from these samples ranged from 50-141 parts per billion (ppb), selenium ranged from 4-27 ppb and iron from 241-508 ppb. Two arsenic samples were slightly above detection, at concentrations of 1 and 2 ppb. All cadmium values were below detection. Twenty-four other constituents included in the analysis were either insignificant or below detection. Historic samples were reported to have shown TDS as high as 1,590 parts per million (ppm).

3.3.4 Water Rights

Water rights in Wyoming are issued by the Wyoming State Engineer's Office through a permitting process. Priority of water rights is decided by date of application, "first in time, first in right". Water rights for surface irrigation in Wyoming are issued on the basis of 1 cfs of water per 70 acres of irrigated land. There are a total of approximately 500,000 acres of land covered by adjudicated water rights in the Bighorn River Basin in Wyoming.

The Big Horn Canal Association applied to the Wyoming State Engineer in May of 1974 for enlargement of the Big Horn Canal to divert an additional 1,114 cfs of water from the Bighorn River. In May, 1976 they then applied for the right to pump directly from the Bighorn River to the Big Horn Canal at five locations between Worland and Greybull. These five applications are for a total of 590 cfs. These applications are tabulated below:

Temporary Filing No. 21 4/329 – Priority May 3, 1974	1,114 cfs
Temporary Filing No. 22 6/173 – Priority May 12, 1976	143 cfs
Temporary Filing No. 22 1/174 – Priority May 12, 1976	160 cfs
Temporary Filing No. 22 1/174 – Priority May 12, 1976	63 cfs
Temporary Filing No. 22 3/174 – Priority May 12, 1976	138 cfs
Temporary Filing No. 22 4/174 – Priority May 12, 1976	86 cfs

These applications are still valid but have not been advanced to permit status. They are currently being held within the Wyoming State Engineers Office "Hold File" pending final determination of just what lands should be considered for irrigation. These applications would be available for the proposed WID development. It is anticipated that a small portion of these applications (83 cfs) would be advanced to permit status by the WID for use on the area identified in Alternative 1 or 2 (J. Wildman, WID President, pers. comm.).

3.4 AIR QUALITY

Total suspended particulates (TSP) are the primary air pollutant in Wyoming (USDOI 1996). Sources of TSP include wind blown dust and particulates from natural sources, such as exposed topsoil, surface mines, highway and other construction sites, unpaved roads, agriculture activity, fires, and other developments. Increases in TSP concentrations occur during dry windy periods. However, conditions such as atmospheric stability, vertical air movement, and prevailing winds may lower the TSP concentrations by dispersing pollutants.

The Bighorn Basin is lacking in monitoring stations and the nearest State and Local Air Monitoring Station (SLAMS) is in Cody, which would not provide representative data for the project area. Thus there is no baseline data collected by the State (G. Meeker, WDEQ, Air Quality Division, pers. comm.). However, the Wyoming Department of Environmental Quality does maintain a database for permits approved for specific emissions. In an attempt to understand the current air quality of the region, a permit inventory query of the database was conducted to identify potential sources of emissions in close proximity to the project area. Additionally, a review of the emissions in the area would indicate the quantity of emissions that are released by industrial operations. The query resulted in the identification of five facilities in the Big Horn County and four facilities in Washakie County (Table 3-5). The facilities in Big Horn County are all in the vicinity of Lovell, Wyoming except for one near Greybull. All of the facilities in Washakie County are located in close proximity to Worland, Wyoming. These data are for 2002, as that was the most current data available and are reported as tons per year (TPY).

Table 3-5. Emissions measured from permitted facilities in Big Horn and Washakie Counties for 2002.

Facility	Carbon Monoxide (TPY)	Volatile Organic Compounds (TPY)	Nitrogen Oxides (TPY)	Primary PM10 (TPY)	Ammonia (TPY)	Sulfur Dioxide (TPY)	Total Emissions (TPY)
Big Horn County							
Big Horn Gas Plant	0.960	0.850					1.810
Greybull Plant	71.100		12.620	62.050			145.760
Lovell Compressor Station	34.990	6.010	174.590				215.600
Lovell Gypsum Plant	21.850		26.270	19.390		0.170	67.690
Lovell Plant	31.210	0.130	254.490	215.530	11,133.000	47.230	11,681.590
						Big Horn County Total	**12,112.440**
Washakie County							
Hiland Gas Plant	31.390	59.870	52.350			263.930	407.540
Worland	104.300	10.130	26.780	51.640	24.600	3.250	220.710
Worland Can Manufacturing Plant	0.290	76.910	1.360				78.550
Worland Compressor	274.430	26.030	1,164.480				1,464.950
						Washakie County Total	**2,171.750**

The area surrounding the project area is composed primarily of agriculture land and saltbush fans/flats. Air quality in the project area is typical of rural areas. Primary sources of air pollutants in the area include smoke from fires (for example, burning of agriculture fields and irrigation ditches); sulfur compounds associated with oil and gas development; and exhaust from vehicular traffic and agriculture equipment.

3.5 NOISE

Noise in the project area is typical of rural areas. Ambient noise sources are primarily associated with agriculture and livestock operations (for example, farm equipment, herding cattle), intermittent vehicular traffic on roads, seasonal construction activity, and natural sources such as wildlife, wind, or river water). The project area and the surrounding areas are rural and sparsely populated and sources of loud noises few. Ambient noise levels are likely to be between 40-50

decibles (dBA) under calm wind conditions. These noise levels are similar to those experienced in libraries or residential living rooms and are characterized as being very quiet.

3.6 BIOLOGICAL RESOURCES

3.6.1 Vegetation

Vegetation was characterized using aerial photographs, topographic maps, ground surveys, and data from the Wyoming Natural Diversity Database's (WYNDD) Gap Analysis. Ground surveys provided the most accurate description of the plant communities present at the project area and was combined with the more general coverage to create a more accurate characterization of the existing vegetation.

The approximate locations of the proposed pumping sites are within the riparian corridor of the Bighorn River (Map 3-2) and the associated pipeline will extend from the diversion points to the area proposed for agriculture following existing roadways as much as possible, but will likely travel through some irrigated cropland. According to the Wyoming Game and Fish Department (WGFD) description of the current habitat conditions for the Lower Big Horn River Corridor (WGFD 2003, website), the riparian corridor vegetation has been affected by the change in the river dynamics due to the regulation of water for the purpose of crop production in the Bighorn Basin. Flow regulation has prevented natural flooding which is necessary to provide habitat conditions for rejuvenation of native stream bank vegetation, such as cottonwood and willow. Additionally, grazing along the corridor has also limited the health and survival of young plants (WGFD 2003). The WGFD determined that these factors have contributed to the current invasion of noxious weeds within the riparian corridor including tamarisk and Russian olive. Vegetation at Diversion 1 (Map 3-2) consists of a narrow (6-8 feet wide) band of emergent vegetation, forming a fringe wetland along the steep riverbank. The bank rises approximately 10 feet above the river channel and is dominated by reed canarygrass and common reed. Patches of curly dock, beaked sedge, and snowberry are also common. An agricultural field is immediately west of Diversion 1 and adjacent the fringe wetland. A general location was provided for Diversion 2, the lower terrace along the river, which is highly variable in species composition and structure. Portions of this area are dominated by Russian olive and it has a herbaceous understory that has been heavily grazed by livestock. The remaining understory is dominated by upland pasture grasses that have also been heavily grazed. A narrow fringe of emergent vegetation occurs along the river's edge. Relatively large tracts of dense sandbar willow and tall graminoids (e.g., reed canarygrass and common reed) also dominate the river terrace at various locations. Habitats further upstream and downstream of Diversion 2 include mature stands of plains cottonwood, intermixed with willows and herbaceous vegetation.

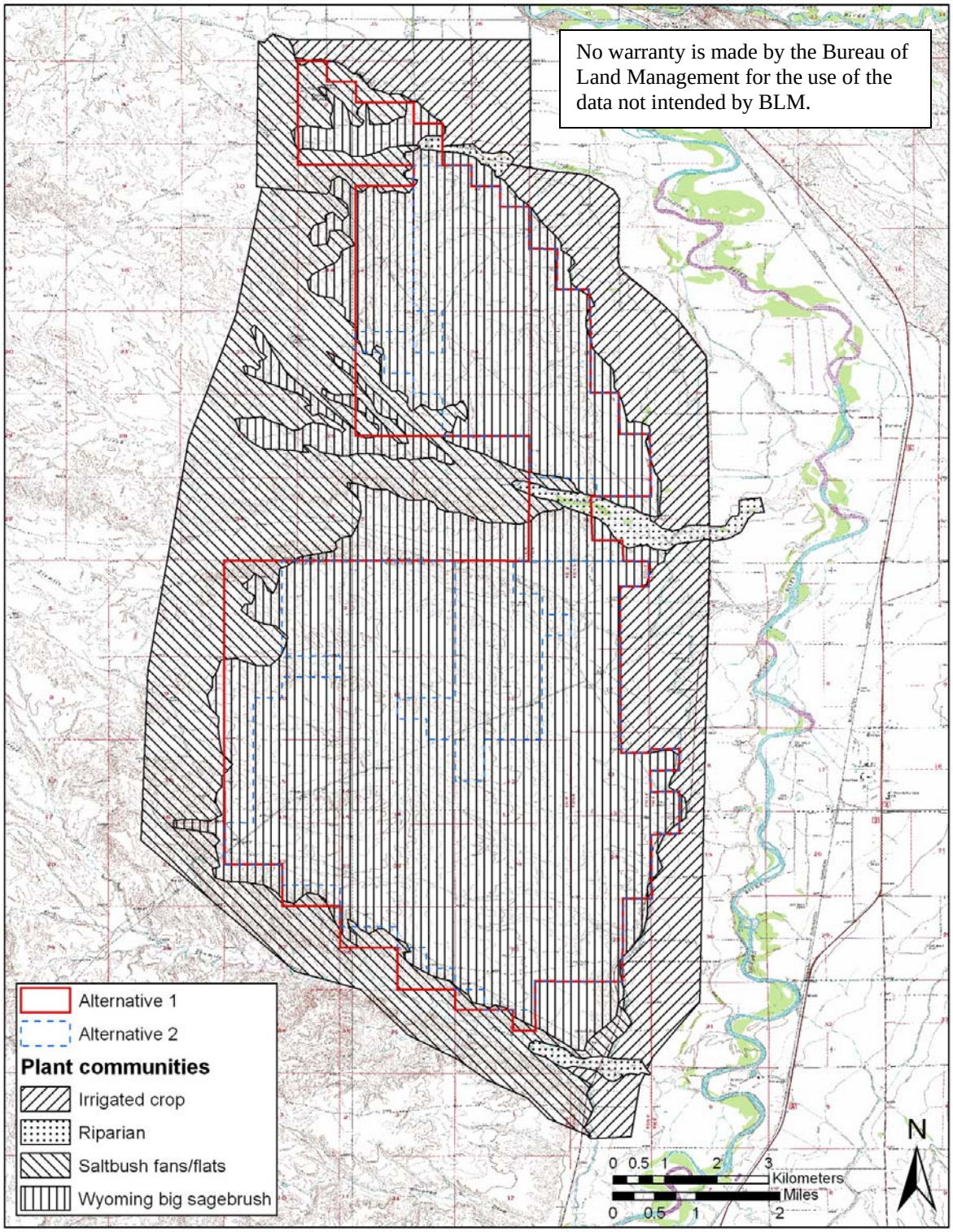
The vegetation for the 16,050 acre area is dominated by saltbush fans/flats with small inclusions of irrigated crops according to the Wyoming Gap Analysis. However, during botanical surveys it was determined that the dominant plant community within the project area is more accurately described by the Wyoming big sagebrush classification (Map 3-5). There are small areas along the western edges where the Saltbush fans/flats extend into the project area (Map 3-5). The plant communities identified in Map 3-5 are described in the following paragraphs.

Wyoming big sagebrush. This is a shrub steppe vegetation type with *Artemisia tridentata* spp. *wyomingensis* the dominant shrub. This type is variable in Wyoming and ranges from dense, homogeneous Wyoming big sagebrush stands to sparsely vegetated arid areas where Wyoming big sage is the dominant shrub where vegetation occurs. This land cover is found throughout most of the state at lower elevations with exception of the extreme southeast corner (Wyoming GAP Analysis 1996).

Saltbush fans/flats. The dominant plant species is *Atriplex gardneri*. These are relatively pure saltbush stands and are often sparsely vegetated with bare soil constituting most of the land surface. Grasses or other shrub species occur in this land cover but these comprise less than 25% of total vegetative cover. This land cover is typically found on saline flats or fans at the bottom of western and central basins but can also occur on rapidly eroding slopes of soft marine shales.

Irrigated crop. Any irrigated agricultural area is categorized as this land cover. This includes most row crops, irrigated pastureland and hayfields.

Riparian. This is a riparian zone in which tree species dominate the vegetation of the riparian corridor. Tree species occupy more than 25% of the vegetation cover and typically include cottonwood, aspen, box elder, or a variety of conifer species.



Map 3-5. Dominant plant communities in relation to Alternative 1 and 2.

3.6.2 Wildlife

Information on wildlife in the project area was obtained from multiple sources including files and information maintained by the WGFD and the BLM, the Wyoming Observation System Records (WOS) database maintained by WGFD, the Wyoming Natural Diversity Database (WYNDD), maintained at the University of Wyoming, scientific and other technical literature, and ground surveys. Field observations were made during project area visits on 23-24 February, 22 March, 26 April, 3-4 June, 15 June, 27-31 August, and 12-15 September 2005. Appendix D contains scientific names of species discussed in this text. For wildlife resources the project area was defined as the project area and the surrounding Bighorn Basin (Map 3-2). The issues identified during the scoping process were used to determine the primary focus of this section.

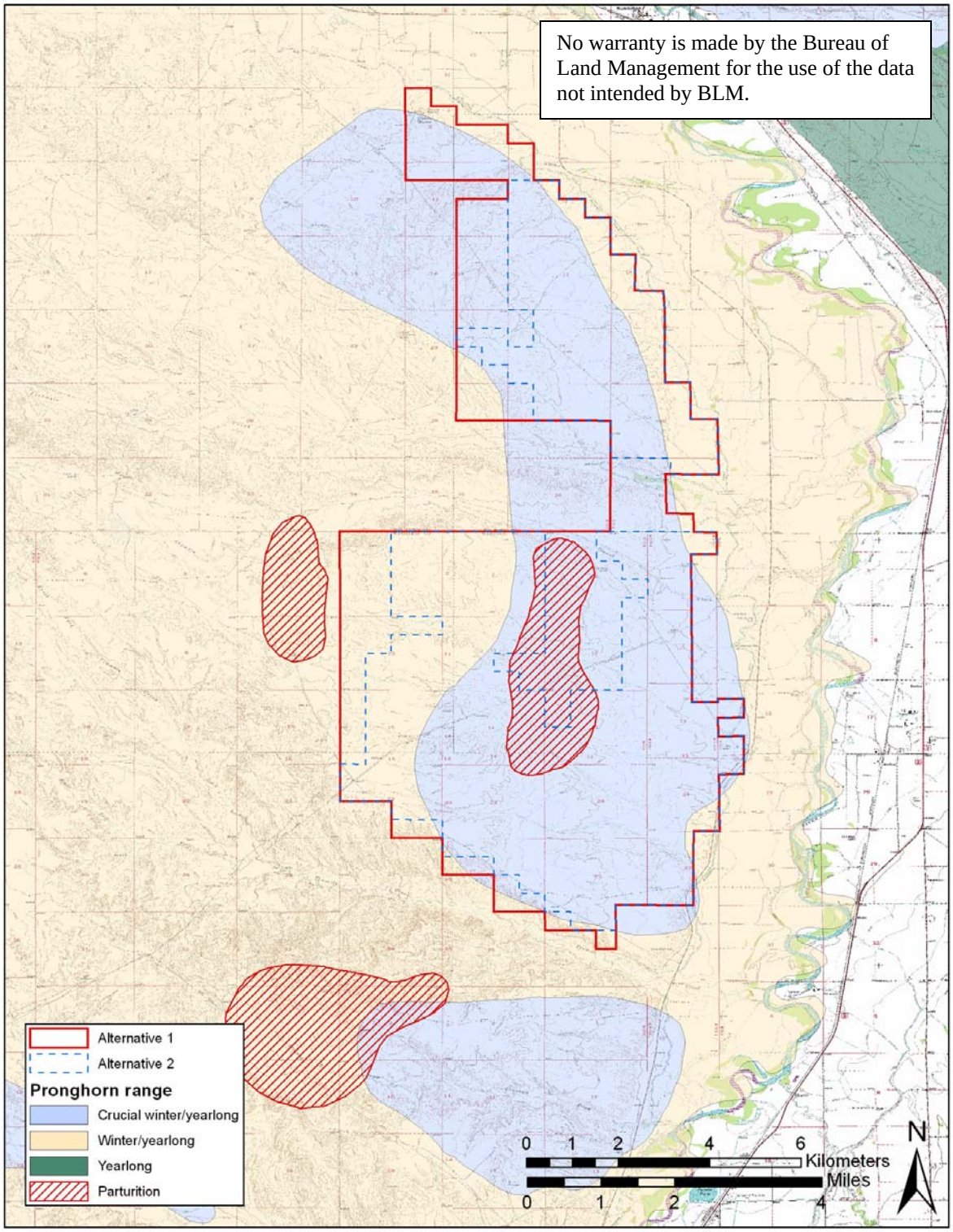
3.6.2.1 Big Game

The project area includes WGFD designated seasonal ranges for pronghorn antelope, white-tailed deer, and mule deer (Maps 3-6, 3-7, and 3-8) (WGFD 2005, 2006a, 2006b). The WGFD defines 6 types of seasonal ranges for big game (Table 3-6).

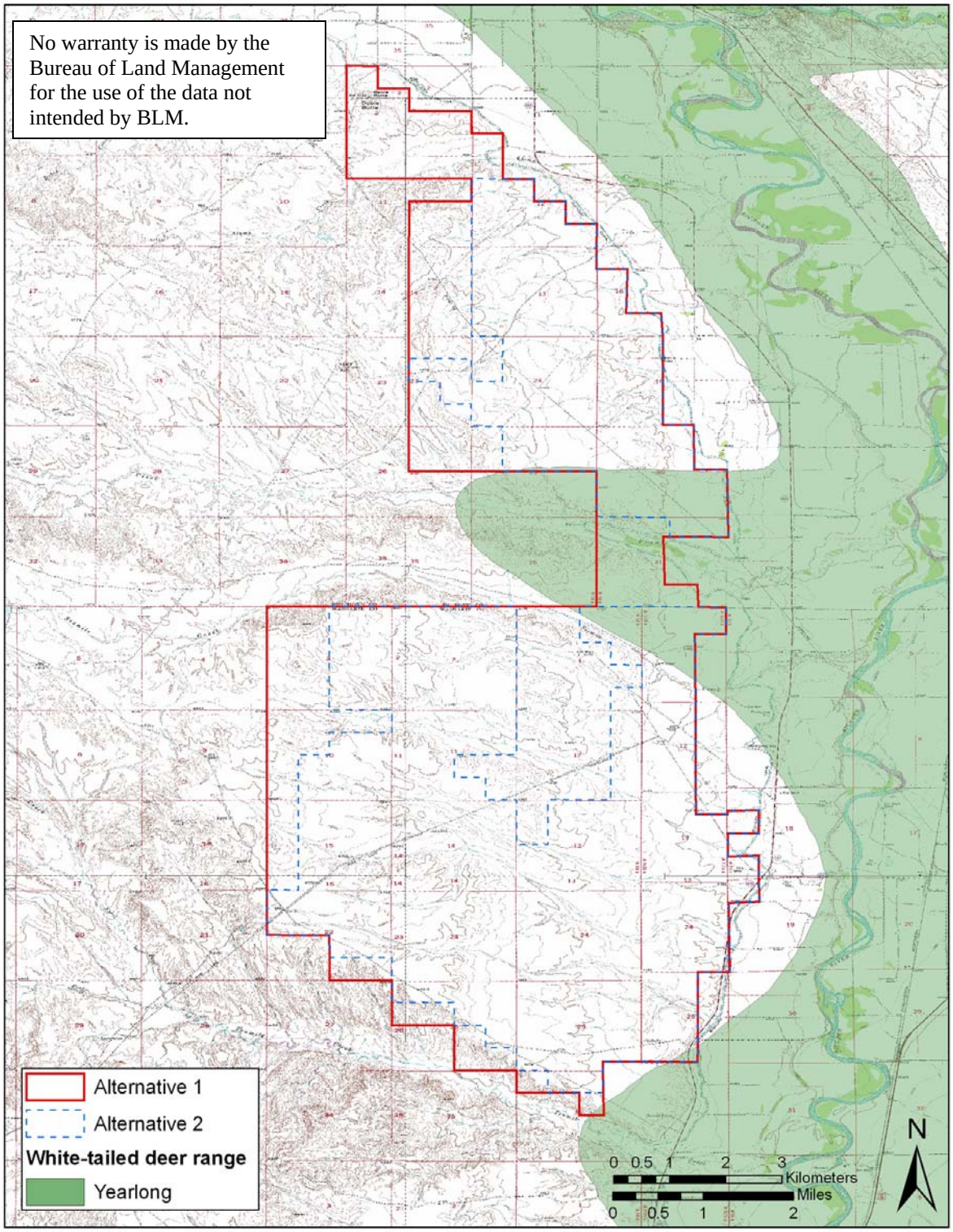
Table 3-6. Seasonal ranges for big game populations as defined by the Wyoming Game and Fish Department (WGFD 2005, 2006a, 2006b).

Range	Definition
Crucial	Crucial range is any particular range or habitat component which determines whether a population maintains and reproduces itself at or above the WGFD population objective over the long term.
Winter	A population or portion of a population uses this habitat annually in substantial numbers only during winter (12/1-4/30).
Winter/Yearlong	A portion of a population uses this habitat yearlong, but during winter there is a significant influx of animals into this area from other seasonal ranges.
Yearlong	A population or substantial portion of a population uses this habitat yearlong.
Spring/Summer/Fall	A population or portion of a population uses this habitat annually (5/1-11/30), excluding winter.
Parturition	Birthing areas commonly used by a substantial number of females from a population.

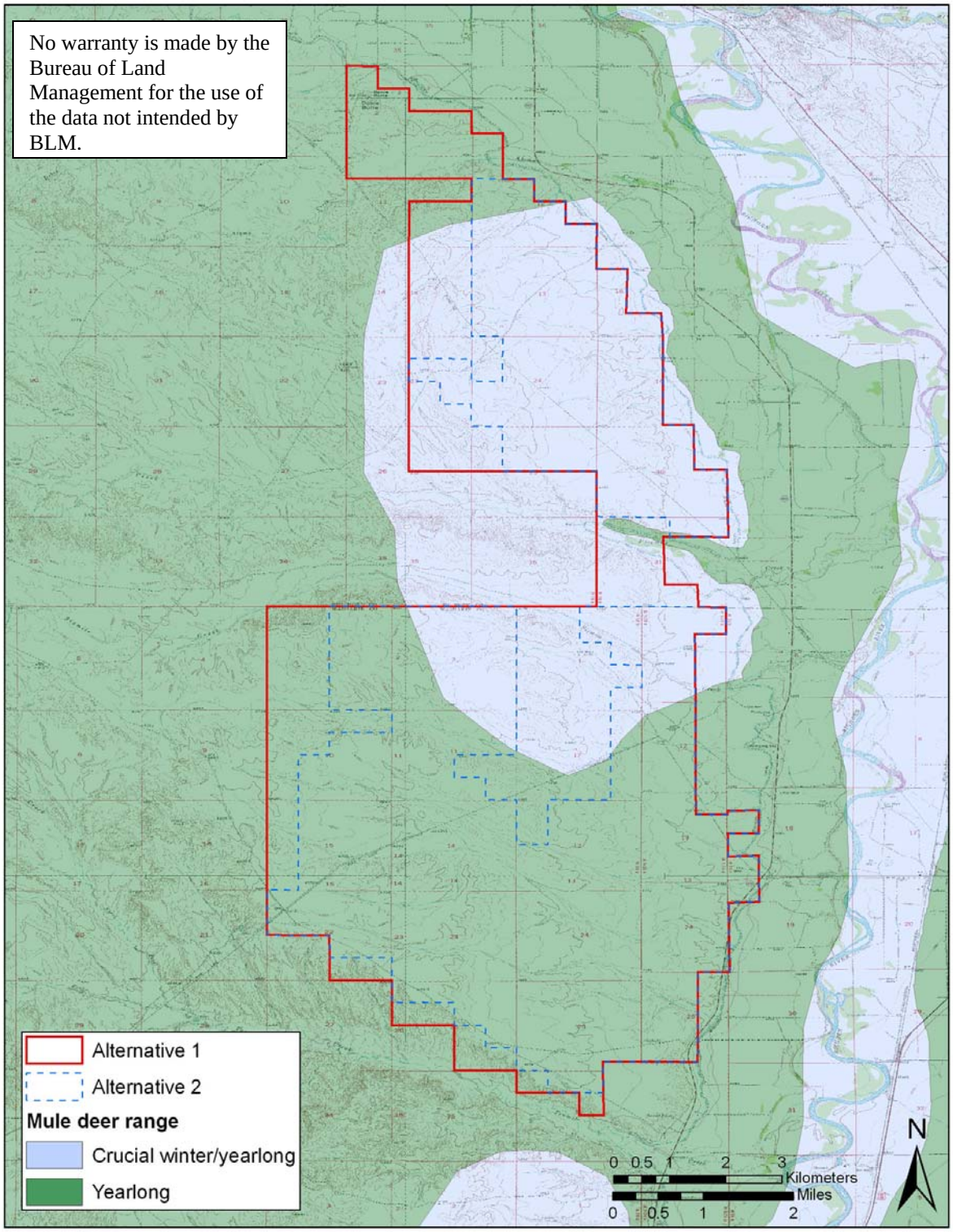
During the late 1970's and early 1980's, there were severe winters with significant snowfall in the project area. The deep snow forced pronghorn antelope to utilize the sagebrush benches in the project area during the winter. These events were the primary reason the sagebrush benches west of the Bighorn River are now mapped as crucial antelope winter range.



Map 3-6. Seasonal ranges for pronghorn antelope (WGFD 2005).



Map 3-7. Seasonal ranges for white-tailed deer (WGFD 2006b).



Map 3-8. Seasonal ranges for mule deer (WGFD 2006a).

The project area contains areas designated as crucial pronghorn and mule deer winter range (WGFD 2005; Table 3-7). Additionally, winter and yearlong ranges for mule deer and white-tailed deer occur within the project area (Table 3-7). The WGFD manages big game species by herd units, which are large geographic regions that contain distinct (<10% interchange) populations. The WGFD assigns each herd unit a number (e.g., #204) and a name (e.g., Fifteen Mile). Table 3-7 identifies the size and relative amount of seasonal range for each herd unit that occurs in the project area.

Table 3-7. Big game seasonal ranges available and potentially affected by alternatives, by herd unit.

Species (Herd Unit)	Herd Unit Total Occupied Habitat (acres)	Acres of Seasonal Range Available in Herd Unit / Acres of Seasonal Range Potentially Affected by Project		
		Crucial Winter/Yearlong	Winter/Yearlong	Yearlong
Action Alternative 1 (16,050 acres)				
Pronghorn (HU #204, Fifteen Mile)	2,019,995	241,211 / 11,374	996,491 / 4,966	177,687 / 0
Mule Deer (HU #209, Basin)	779,722	264,654 / 6,215	5,108 / 0	509,960 / 10,127
White-tailed Deer (HU #201, Bighorn Basin)	8,143,508	0 / 0	0 / 0	857,208 / 1,298
Action Alternative 2 (11,500 acres)				
Pronghorn (HU #204, Fifteen Mile)	2,019,995	241,211/8,394	996,491 / 3,177	177,687 / 0
Mule Deer (HU #209, Basin)	779,722	264,654 / 4,132	5,108 / 0	509,960 / 7,439
White-tailed Deer (HU #201, Bighorn Basin)	8,143,508	0 / 0	0 / 0	857,208 / 765

The WGFD has identified 4,470 acres of parturition range for pronghorn antelope in the Bighorn Basin. The project area contains a total of 1,283 acres identified as parturition range for pronghorn antelope (Map 3-6), all of which are contained in Alternative 1. Approximately half (651 acres) of the parturition range within the project area would be potentially affected by Alternative 2. Additionally, the WGFD identified two parturition areas in close proximity to the west and south of the project area.

3.6.2.2 Raptors

Raptor species that may occur in or around the project area based on species range maps include osprey, bald eagle, northern harrier, sharp-shinned hawk, Cooper's hawk, northern goshawk, Swainson's hawk, red-tailed hawk, ferruginous hawk, rough-legged hawk, golden eagle, American kestrel, merlin, peregrine falcon, and prairie falcon (Dorn and Dorn 1999, WGFD 2004a). Most of these raptors are documented or suspected of being breeders in the project area with the exception of sharp-shinned hawk, northern goshawk, and merlin, which are uncommon in the summer, and rough-legged hawk, which is a common winter resident (Dorn and Dorn 1999). Ferruginous hawk and northern harrier could potentially nest in the Wyoming big sagebrush type, while the rest of the species potentially nest along the Bighorn River riparian corridor. Broad-winged hawk and gyrfalcon are rare migrants and visitors to the region (Dorn and Dorn 1999). Thirteen raptor nests were sighted during 2 aerial surveys (March 22 and April 26, 2005) and incidentally during ground surveys. Of these, 3 were active buteo nests, the rest were unknown species (large nests indicating either raptors or corvids) and unknown status.

3.6.2.3 Other Mammals

The following species were recorded during field surveys; white-tailed prairie dogs, desert cottontail, and coyote. Other mammals likely common in the big sagebrush vegetation type but not recorded during project area visits include white-tailed jackrabbit, northern pocket gopher, Ord's kangaroo rat, deer mouse, prairie vole, porcupine, red fox, raccoon, bobcat and badger.

3.6.2.4 Reptiles and Amphibians

Based on range, habitat affinities, and field observations (Oakleaf et al.1992) 7 species of reptiles and 5 species of amphibians potentially occur within the project areas. Two species of lizard, northern sagebrush lizard and eastern short-horned lizard, and five species of snake, eastern yellow belly racer, pale milk snake, bull snake, wandering garter snake, and prairie rattlesnake potentially occur in the project areas based on habitat and range.

The tiger salamander, plains spadefoot, Woodhouse's toad, northern leopard frog, and boreal chorus frog potentially occur in the project area based on known ranges. These species would be tied to the wetlands and Bighorn River corridor due to life history requirements.

3.6.3 Aquatic Resources

3.6.3.1 Fisheries

Water from the Bighorn River is used extensively for irrigation through the use of irrigation diversion dams and numerous smaller ditch headgates (WGFD 2003, website). Irrigation dams are barriers to upstream spawning and natural dispersion of fish populations. According to the WGFD, regulation of the water flow from the Boysen Reservoir and various irrigation diversion dams has altered the natural course of the Bighorn River (WGFD 2003, website). The river has been modified to accommodate crop production through timed releases and diversions, thus modifying the river hydrographs, timing and movements of silt loads, river depth, island formation, and bank stability (WGFD 2003, website). These changes result in the loss of meanders, side channels, and backwater habitat, reducing the available habitat for several aquatic species and those with multiple life stages.

The above described modification of the Bighorn River through regulated flows has had an impact on native fish, specifically sauger, shovelnose sturgeon, and sturgeon chub. The WGFD identifies the loss of meanders, side channels, backwaters, and slower water behind large wood debris, as potentially affecting the success of these species and especially success of juvenile fish (WGFD 2003, website). One of the few pure strains of sauger exist in the Bighorn River, but the population is small and of low density when expressed as the number of fish per mile (WGFD 2003, website). The WGFD is currently attempting to reintroduce the shovelnose sturgeon which essentially disappeared from the system (WGFD 2003, website). The sturgeon chub is rare, having not been seen for many years until 2001 (WGFD 2003, website).

Seasonal movements and habitat use of the Bighorn River by sauger between Worland and Yellowtail Reservoir were studied by WGFD during 1999-2000 (Welker et al. 2002). Sauger marked with radio transmitters or visual tags at Worland tended to move shorter distances compared to fish marked at Basin or the ML boat ramp (approximately 4 linear miles upstream

of Yellowtail Reservoir). The study concluded that Yellowtail Reservoir may be important wintering habitat for sauger.

The Bighorn River between Worland and Manderson supports a diverse, warm-water game fish population. This segment of the Bighorn River is bounded by private property on both banks, and has limited public access, so very little fish population and angler return creel census data are available.

The WGFD conducted seining surveys of the Bighorn River in July-September of 2000-2002 between Worland and Greybull (WGFD 2002). They identified 20 species during surveys over a 3-year period including plains minnow and sturgeon chub (2 specimens were collected at a site downstream of the town of Basin). No western silvery minnows were detected.

To confirm if the river contained species of concern, the EIS Team conducted a fish survey in the area of the river potentially affected by the proposed action (Appendix E, WEST 2006). The study area started 3.6 river miles north of the town of Worland, Wyoming, and extended to the bridge at Manderson, including three reaches each approximately six river miles in length. The three reaches include an upstream site (upstream of proposed diversion-1, approximately half mile upstream of gravel pit), impact-2 site (between proposed diversion-1 and diversion-2), and impact-3 site (proposed diversion-2 to Manderson). The physical nature of the river was characterized as a run (water flowing swiftly, 0.5->1.5m deep), pool (eddy or deep part of the river with little or no current), side channel (generally intermediate to pool and run, with slow current), or riffle (water flowing swiftly over gravel or cobble, 0.1-0.5m deep) in accordance with Platts, et al 1983. In the study reach the river is characterized by extensive runs, with some side channels, pools, and riffles. Substrates were varied and ranged from cobbles and some boulders to deep silt. The sample period (28-31 August 2005) was during the time of year when the Bighorn River typically experiences very low flows due to irrigation withdrawals, but due to abundant precipitation during 2005, flows were higher than in the previous 5 years (USBR 2005, website). These high flows likely made some normally occurring side channel and pool habitats unavailable.

The study was designed to detect fish species that occur in the areas that are classified by the WGFD as sensitive, including the sturgeon chub, plains minnow, and western silvery minnow. Fifteen reaches of suitable habitat and 2 areas of potential habitat were sampled during the study period. Suitable habitat for the target species is generally turbid, shallow water (<3ft [91cm]), with swift flows (~ 0.3-3 ft/sec [9-91 cm/sec]) over sand, gravel, or rock substrates, or shallow protected areas adjacent to such habitats. Each area was sampled with a 25-ft (7.6-m) bag seine; a 15-ft (4.6-m) straight seine was used when the habitat area was small or had obstructions. Mesh size for both seines was 3/16-in (7.5mm). A seine haul was initiated from the downstream end of the reach and progressed upstream. In some cases, multiple haul-outs were necessary to cover the sample area, but no backtracking downstream occurred. All fish were transferred to 5-gallon buckets filled with river water (at least four buckets were available along shoreline). Fish were processed and returned to water after 50 meters of river was seined; however, all fish were returned to the river below the sampled reach before seining the upper reach, reducing the likelihood that individuals would be recaptured.

The EIS Team identified 12 fish species between Worland and Manderson (WEST 2006; Table 3-8), including sauger, which was not detected by WGFD in their 2000-2002 surveys. No sturgeon chub, plains minnow, or western silvery minnow were detected by the EIS Team.

Table 3-8. List of fish species caught by seining in the Bighorn River 28-31 August 2005.

Common Name	Scientific Name	Habitat
River carp sucker	*Carpiodes carpio*	Pool/Side Channel
Fathead minnow	*Pimephales promelas*	Pool/Side Channel
Sand shiner	*Notropis stramineus*	Pool/Side Channel, Riffle
Channel catfish	*Ictalurus punctatus*	Pool/Side Channel
Yellow perch	*Perca flavescens*	Pool/Side Channel
White sucker	*Catostomus commersoni*	Pool/Side Channel
Longnose dace	*Rhinichthys cararactae*	Riffle
Flathead chub	*Platygobio gracilis*	Pool/Side Channel
Common shiner	*Notropis cornuta*	Pool/Side Channel
Shorthead redhorse	*Moxostoma macrolepidotum*	Pool/Side Channel, Riffle
Sauger	*Stizostedion canadense*	Pool/Side Channel
Common carp	*Carassius carassius*	Pool/Side Channel
Unidentified minnow		Pool/Side Channel, Riffle

Another species that is of interest is the burbot, a freshwater codfish that is native to the Bighorn-Wind, Tongue, and Powder River drainages. The burbot has been illegally introduced to other drainages in Wyoming, namely the Green River drainage. This species is adapted for cold water, occupies riverine and standing water, avoids waters above approximately 55°F, and is most abundant in native lakes and reservoirs, including Boysen Reservoir. The burbot is most active in the late-fall and early spring, therefore it is typically not detected by normal fish population sampling techniques. The WGFD has initiated a study to gain more information regarding the population of this species throughout the state (WGFD 2007, website).

3.6.3.2 Invertebrate Community

Little data are available on benthic macroinvertebrate species in the Bighorn River. During the seining surveys conducted by the EIS Team, invertebrates were noted on overturned rocks and in the nets. Larvae of Hydropsychids (caddisfly sp.), Baetids (mayfly sp.), and Libellulids (dragonfly sp.) were abundant.

3.6.4 Wetlands

Wetlands are protected under the CWA as special aquatic sites. These areas have important functional values for wildlife and in the maintenance of a healthy riparian ecosystem. Wetlands provide resting, feeding, nesting, and brooding habitat for a variety of fish and wildlife, function in water quality enhancement by filtering pollutants and sediments from runoff, provide protection from erosion, and store flood waters.

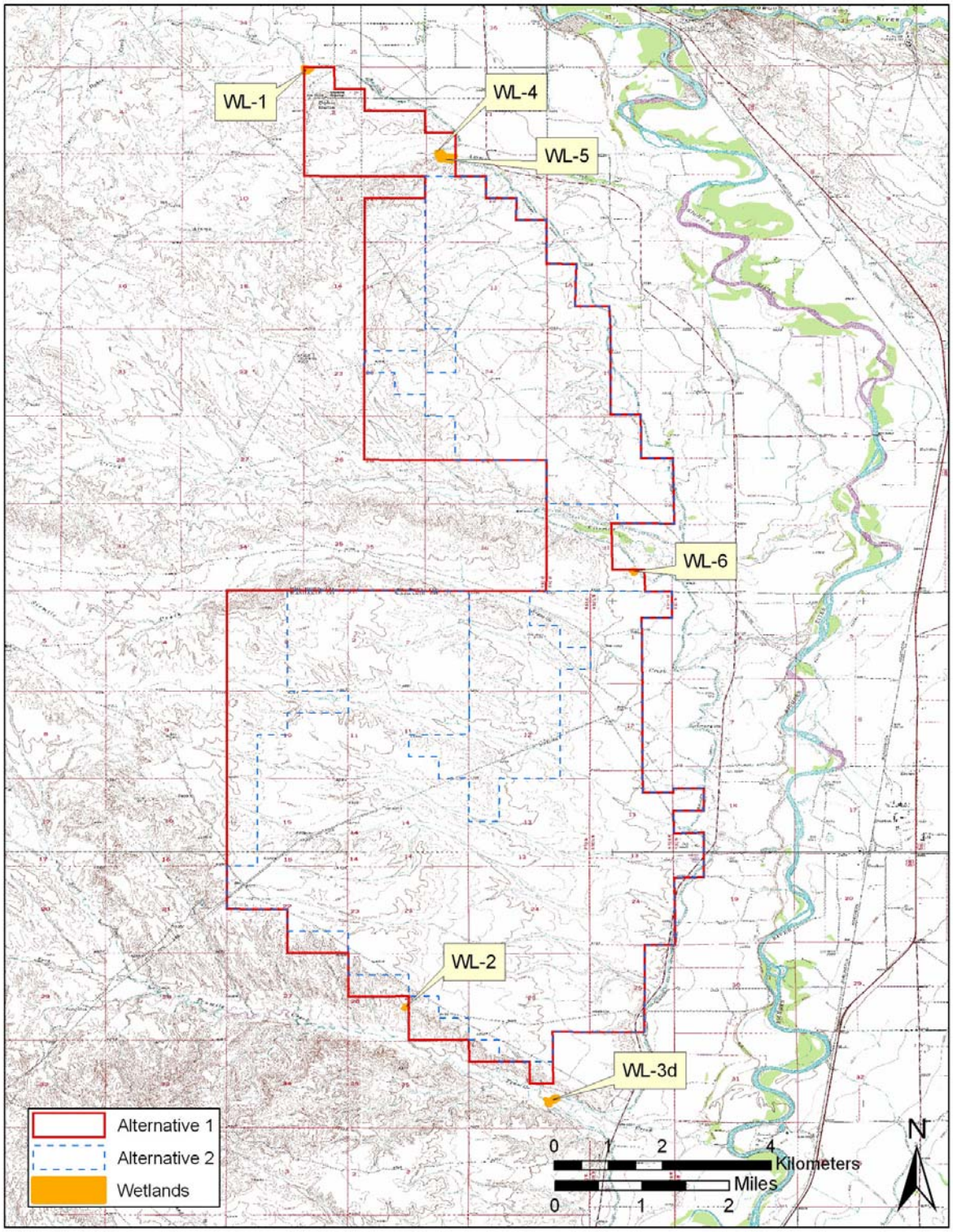
National Wetland Inventory maps identify few wetlands within the land to be conveyed. Scattered stockponds form some palustrine wetland habitat in the area. The majority of wetland habitat in the project area is associated with the portion of the Big Horn Canal around Fivemile

Creek. Seepage and diversions along the Big Horn Canal support cottonwoods, willows, and shrub-scrub wetland vegetation.

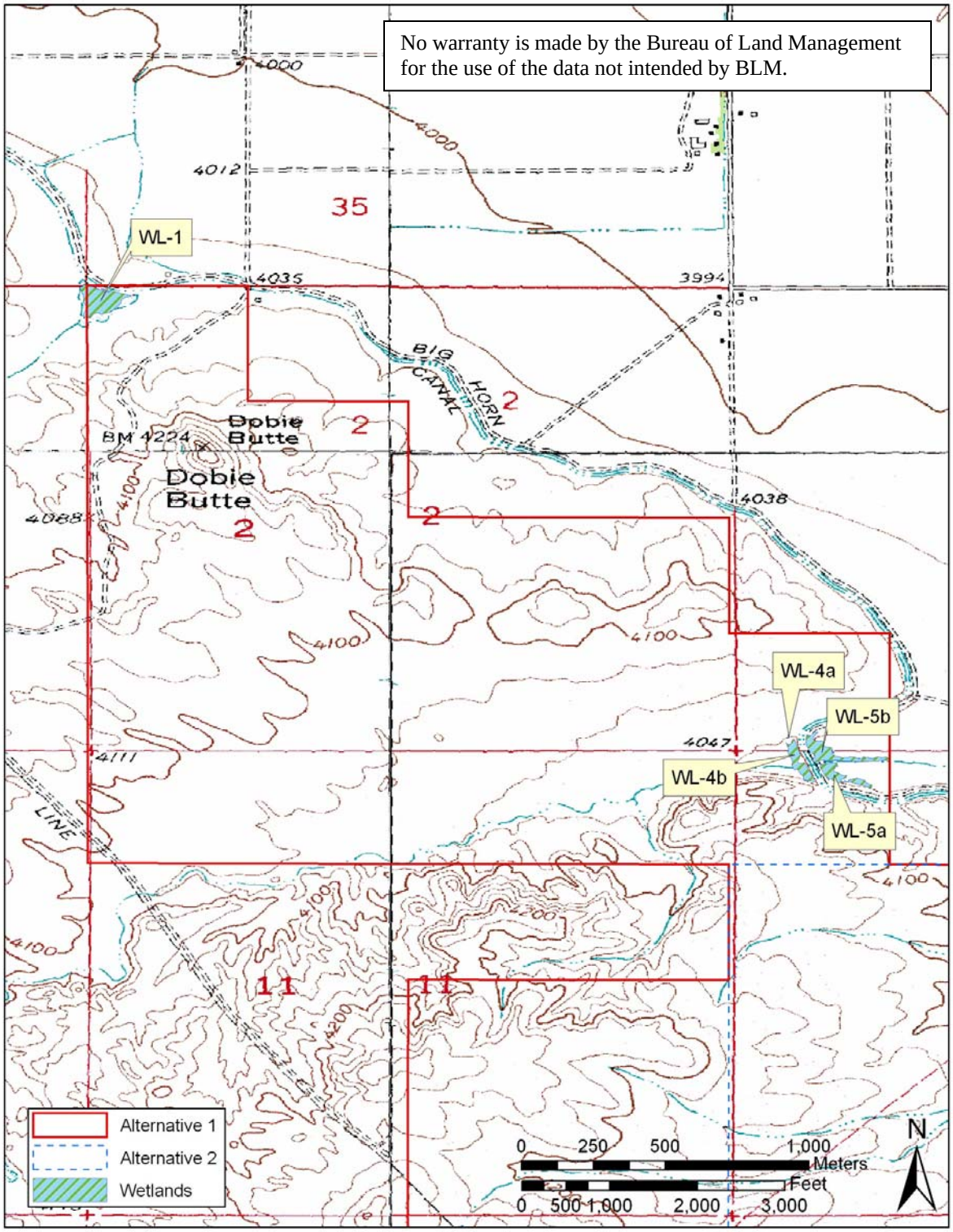
A survey of vegetation and wetland habitats was conducted September 12-15, 2005 throughout the project area and the drainage immediately south of the project area and resulted in the identification and delineation of 7.57 acres of wetlands (Table 3-9, Map 3-9) (Appendix F, WEST 2005). All but one of the wetlands identified within the project area were in the immediate vicinity of, and associated with, the Big Horn Canal. An isolated shrub-scrub wetland, dominated by small plains cottonwoods (*Populus deltoides*), whiplash willow (*Salix lasiandra*), and broadleaf cattail (*Typha latifolia*), occurred within an impoundment on a tributary to Tenmile Creek, along the southern boundary of the project area (WL-3d), and is outside of the project area. This area was surveyed as the map of the project area utilized during the wetland survey contained an additional piece that extended past the current southern boundary. Wetland number WL-2d is located on the boundary of the project area and is being counted as being within the project area, based on its close proximity. Therefore, only 6.16 acres of wetlands are considered within the project area. The diversion points were not delineated for wetlands as exact location and access were not available, but generally both diversion points have narrow fringe wetlands along the river's edge.

Table 3-9. Wetlands identified in the project area.

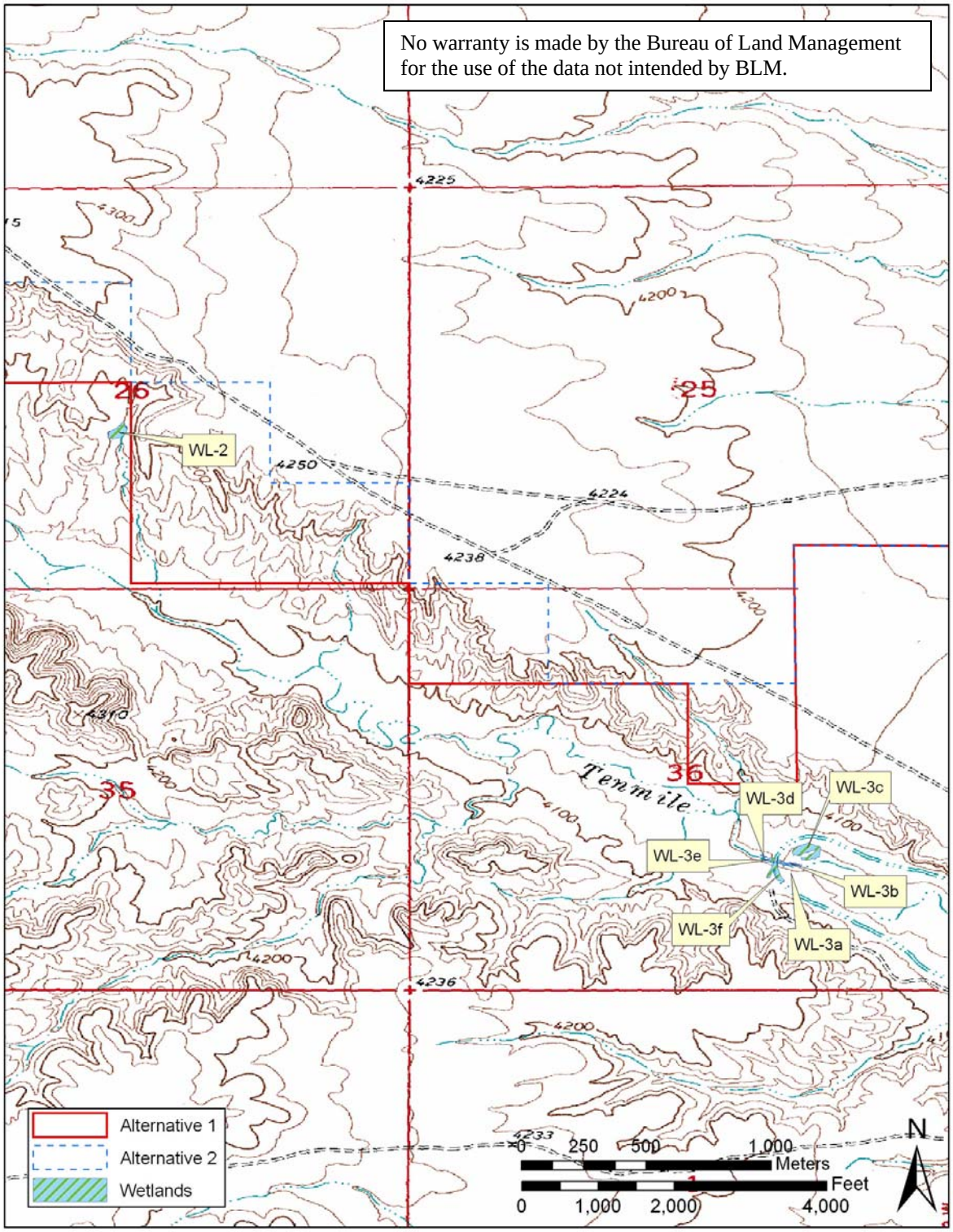
Wetland Type	Vegetation	Hydrology	Wetland Number	Size (acres)
Palustrine forested	Tree-dominated (forested) wetland: Russian olive, whiplash willow; features emergent vegetation in understory and in small, open patches	Associated with: seepage from levee, high water table, and/or located along drainage channel	4b	0.85
Palustrine scrub-shrub	Shrub-dominated wetland: plains cottonwood (saplings), whiplash willow, sandbar willow, tamarisk, prickly rose; features emergent vegetation in understory and in small, open patches	Associated with: seepage from levee, high water table, and/or located along drainage channel	2 3a 3b 3e 5a 5b	0.52 0.06 0.06 0.1 0.81 1.36 Total = 2.91
Palustrine emergent	Wetland dominated by emergent herbaceous vegetation (includes wet meadow, fringe wetland, and shallow marsh): slender wheatgrass, creeping bentgrass, meadow foxtail, beaked sedge, foxtail barley, Baltic rush, reed canarygrass, curly dock, common threesquare, sofstem bulrush, broadleaf cattail	Associated with: seepage from levee, high water table, and/or located along drainage channel	1 3c 3d 3f 4a 6	1.94 0.82 0.02 0.35 0.01 0.67 Total = 3.81



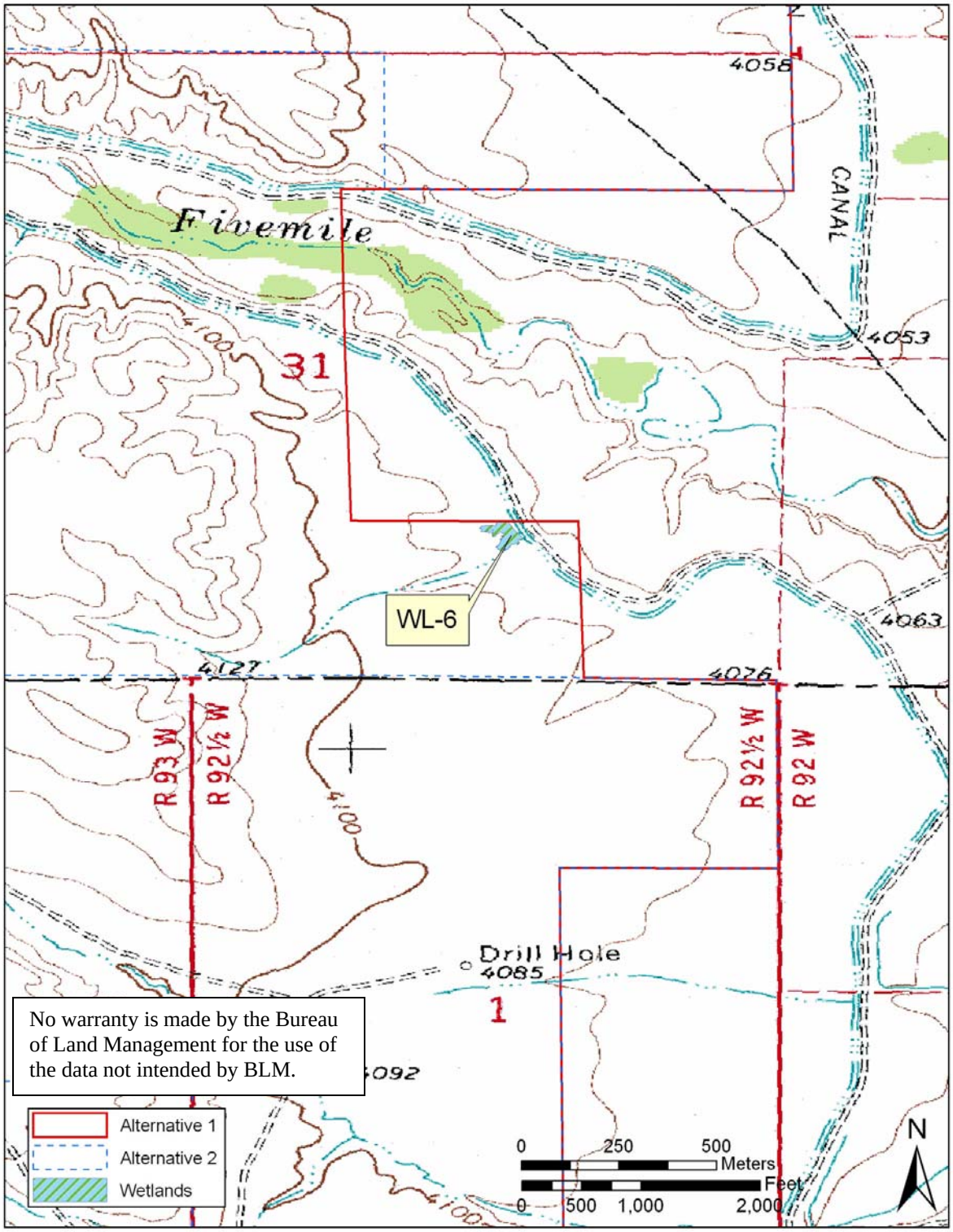
Map 3-9. Wetlands identified during survey efforts.



Map 3-10. Location of wetlands 1 and 4.



Map 3-11. Location of wetland 2 and 3.



Map 3–12. Location of wetland 6.

3.6.5 Special Status Species

Based on the results of the scoping process special status species determined important for analysis in the EIS process included federally protected species listed under the Endangered Species Act (ESA), migratory birds protected under the Migratory Bird Treaty Act (MBTA), and BLM sensitive species.

3.6.5.1 USFWS Threatened, Endangered

The United States Fish and Wildlife Service (USFWS) provided a list of species that are provided protection through the ESA and are potentially occurring in the project area, including two threatened and one endangered species (Table 3-10). The greater sage-grouse was also included in this category because the USFWS considers this species as sensitive and has received several petitions to list the greater sage-grouse under the ESA.

Table 3-10. Federally protected species potentially occurring in project area.

Species	Status
Bald eagle (*Haliaeetus leucocephalus*)	Threatened
Black-footed ferret *(Mustela nigripes)*	Endangered
Ute ladies'-tresses orchid (*Spiranthes diluvialis*)	Threatened
Greater sage-grouse (*Centrocerrcus urophasianus*)	Sensitive

3.6.5.1.1 Bald eagle

Bald eagles historically occurred over most of North America in a variety of landscapes. Generally, they require areas in proximity to water for nesting, and during winter, areas with readily available, abundant food sources (fish, carrion, or waterfowl) and secure roost sites. Roosts are generally old, large trees with good visibility and little human disturbance. In Wyoming, bald eagles are listed as an uncommon resident, and usually occur in coniferous forests and cottonwood/riparian plant communities in the northwestern portion of the state. In the winter, the population of bald eagles in Wyoming increases due to an influx of migrants from the north. Currently, it is estimated that more than 100 pairs of bald eagles nest in Wyoming, with the majority of these occurring in Yellowstone and Grand Teton National Parks and along the major river drainages in the state.

Records of wintering bald eagles are common in the project area (WGFD 2004a). Of 43 bald eagle observations recorded by WOS (2004a), 37 of those were during December and January. BLM personnel confirm that bald eagles use the Bighorn River near the project area for winter roosting, and numerous roosting birds were observed during a site visit in February 2005. No bald eagle nests were found along the Bighorn River during a raptor nest survey conducted on March 22 and April 26, 2005 (Map 3-13).

3.6.5.1.2 Black-footed ferret

The black-footed ferret is a federally listed endangered species that was historically distributed across the western plains of North America wherever prairie dogs occurred (Anderson et al. 1986). Black-footed ferrets are very specialized in their habitat requirements and are dependent on prairie dog colonies for survival (Biggins et al. 1985). Prairie dogs compose more than 90 percent of black-footed ferret diets (Campbell et al. 1987). Because of large-scale reductions in

prairie dog populations, black-footed ferrets were nearly extirpated by the 1980s. Recovery and reintroduction programs have established at least six experimental populations in seven states throughout the west.

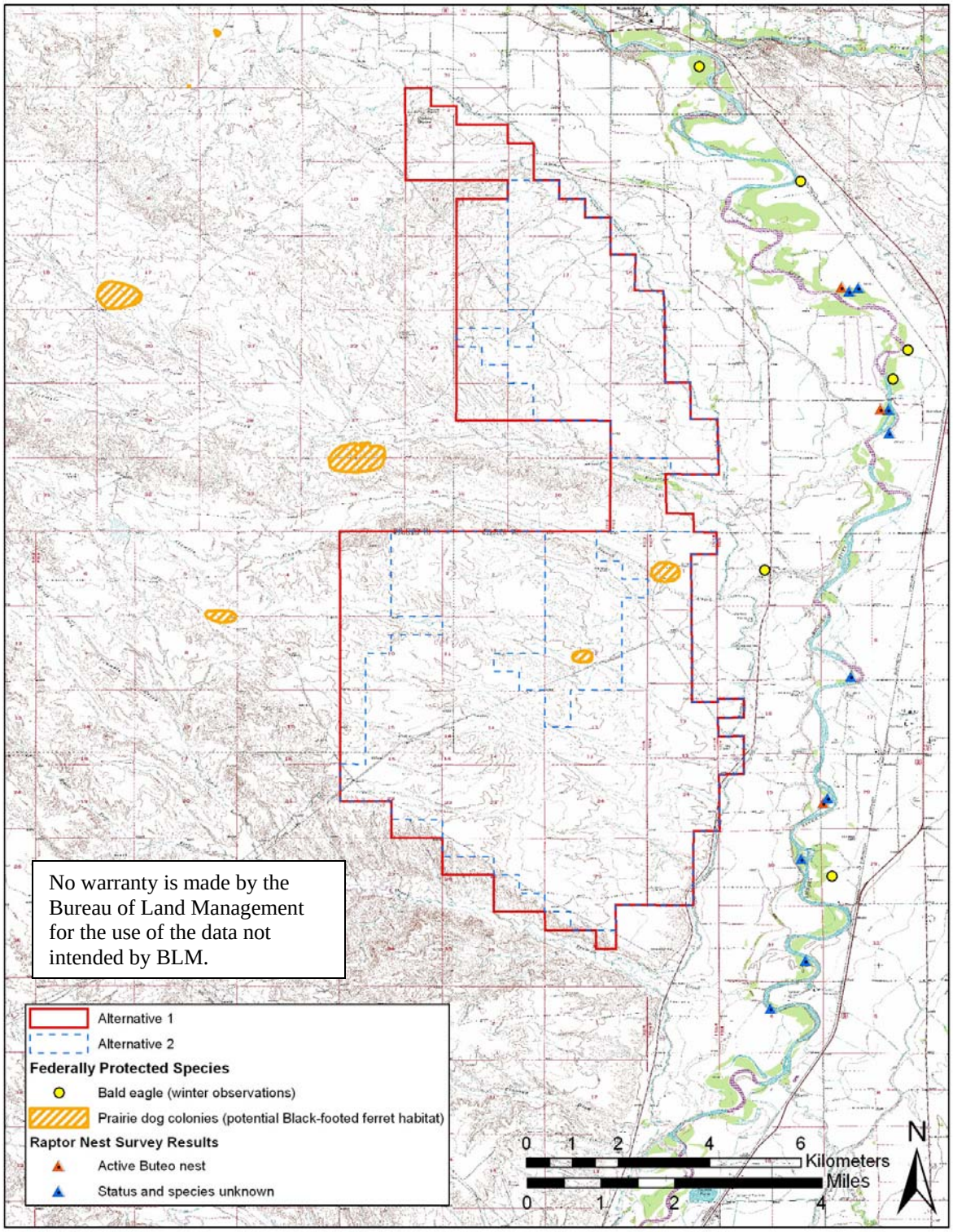
White-tailed prairie dogs have been reported in the WOS database and WYNDD. Even though the project area falls within an area that has been block-cleared of the need for black-footed ferret surveys, the EIS Team conducted surveys on February 23, May 18, and June 3 and 15, 2005 to locate prairie dog colonies. Four relatively small white-tailed prairie dog colonies were located in or near the project area (Map 3-13). These colonies qualify as a complex based on guidelines set forth by the USFWS (USFWS 1989) as they are within 7 km of each other.

3.6.5.1.3 Ute ladies'-tresses

The Ute ladies'-tresses is a perennial orchid that is a wetland obligate. Flowering season is from early August to early September (Fertig 2000), although individual plants may not flower every year with only the underground parts persisting in association with micorhizal fungi (Fertig 2000). Ute ladies'-tresses are found in the Intermountain and Rocky Mountain west in the elevation range of 4300-7000 ft (USFWS 1995). In Wyoming, the orchid has been documented in Converse, Goshen, Laramie, and Niobrara Counties. Threats to Ute ladies'-tresses include competition with exotic species, trampling and soil compaction by livestock and recreation, herbicides and pesticides, and loss of habitat due to urbanization and anthropogenic changes in wetland hydrology (USFWS 1995, Fertig 2000).

In Wyoming, Ute ladies'-tresses grow in wet meadows, open marshes, and early successional riparian habitats associated with perennial streams. Some individuals have been found in agricultural landscapes, typically wet areas used for grazing or haying. This orchid grows in association with low grasses and forbs and does not tolerate tall surrounding vegetation or shade (USFWS 1995).

The EIS Team conducted surveys on September 12-15, 2005 for Ute ladies'-tresses within or near the project area (WEST 2005). No individuals were located and the wetlands identified provide marginal habitat for Ute ladies'-tresses as they are 1,000 feet below the known elevation range of the species.



Map 3-13. Federally protected species and raptor nest locations identified during survey efforts.

3.6.5.1.4 Greater sage-grouse

The USFWS has received several petitions to list the greater sage-grouse (*Centrocerrcus urophasianus*) under the ESA and considers it a sensitive species. The causes of the range-wide decline in sage-grouse are not completely understood and may be influenced by local conditions. However, habitat loss and degradation, disease and loss of population connectively are considered important factors (Schroeder et al. 1999). Greater sage-grouse are dependent on sagebrush habitats year-round.

A MOU to conserve the greater sage-grouse and its habitat exists between the U.S. Forest Service, the BLM, and the USFWS and the Western Association of Fish and Wildlife Agencies. The MOU requires that actions that affect sagebrush habitats be evaluated to determine the importance of the area to greater sage-grouse, such as the presence of breeding habitat (leks, nesting or brood rearing habitat).

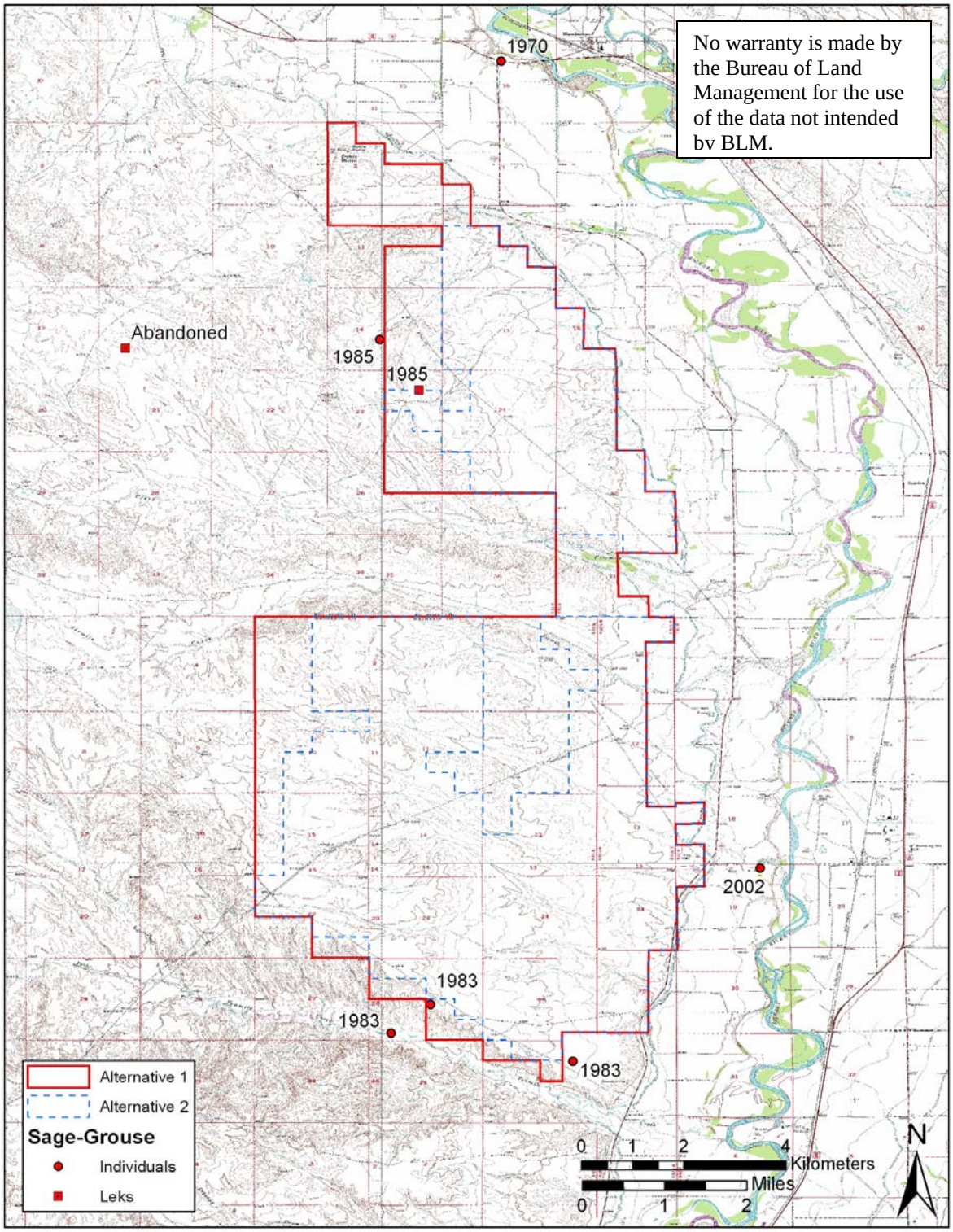
The EIS Team conducted aerial surveys for sage-grouse leks on March 22 and April 26, 2005. No individuals or leks were located during survey efforts. The sagebrush vegetation type in the project area is generally sparse with little to no herbaceous ground cover, thus it is not considered suitable nesting habitat. Some studies have shown that the majority of sage-grouse generally nest within 2-3 miles of a lek, although this is variable depending on migratory status of a sage-grouse population. Therefore, it is possible that sage-grouse may nest within the project area if a lek occurs within a few miles to the west. Due to the poor nesting habitat available, it is expected that the number of sage-grouse utilizing the project area is low because the sagebrush is too sparse. A historic abandoned lek has been recorded by the WGFD to the northwest of the project area. There are three WOS records from 1983 of individual birds on the southern end of the project area, one of which is within the Alternative 1 boundary. Additionally, there are two records from 1985 of individual birds along the northwestern edge of the project area, one of which is on the boundary of Alternative 1 and the other within Alternative 2 (Map 3-14). The most recent sighting of sage-grouse recorded in this area was east of the project area in 2002.

3.6.5.2 Migratory Birds

The Bighorn River corridor may be important for some migrants such as waterfowl, shorebirds, or other waterbirds, or migrating passerines. The number of avian species in the area is expected to be greatest during spring and fall migration periods. Several species are likely to spend the winter in the project areas, having moved from higher elevations in the mountains or more northern latitudes.

Migratory birds are protected under the MBTA, which prohibits the taking of any migratory birds, their parts, nests, or eggs, except as permitted by regulations. With the exception of sage-grouse, the BLM sensitive species of birds (Table 3-11) are protected under the MBTA.

Another migratory bird of concern, mountain plover (*Charadrius montanus*) was previously proposed for listing under the ESA; however, the USFWS found that the threats to the species were not as great as previously believed and withdrew the species from consideration. Mountain plovers utilize sparsely vegetated flat habitat types for nesting including; sparsely vegetated



Map 3-14. WGFD and WOS records of sage-grouse in relation to the project area.

grasslands or shortgrass prairie, mixed grassland shrub-steppe plains, alkali flats, agricultural or cultivated lands, and prairie dog towns. The project area may be considered suitable habitat and during field investigations conducted by WEST, Inc. one individual was sighted northwest of the project area.

Golden eagles (*Aquila chrysaetos*) and bald eagles are provided protection under the Bald and Golden Eagle Protection Act (BGEPA). Bald eagles are discussed in Section 3.6.5.1.1 as they are listed by the USFWS as a threatened species. Golden eagles are considered year round residents in Wyoming and occur in most habitats throughout the state (WFGD 2004b). Golden eagles forage for small and medium sized mammals in open areas and nest in trees or cliffs and are considered common in Wyoming (WGFD 2004b). The project area may be considered suitable habitat, however no individuals were located during field investigations.

3.6.5.3 BLM Sensitive Species

The BLM monitors a list of sensitive species with the goals of maintaining the components of functional ecosystems, ensuring sensitive species consideration in land management decisions, preventing species from needing to be listed under the ESA, and emphasizing habitat conservation. The EIS Team conducted a database search of the WYDD, which is part of the Natural Heritage Program, and the WOS, maintained by the WGFD, to identify BLM monitored species that potentially may occur in the project area. The requested area used for the database searches was T48 to 49N R92 to R93W; however each database provides a buffer to a requested area. The WYNDD placed a 4-mile buffer around the requested area, while the WOS provided a varying buffer up to approximately 5.7 miles. The database searches located twenty BLM sensitive species that potentially occur within the requested area of which eleven species have been documented within the requested area. During field investigations, four of the twenty species were documented, including white-tailed prairie dog, sage thrasher, Brewer's sparrow and sage sparrow. Additionally, one species, the burrowing owl, was observed approximately 2 miles west of the project area during field investigations. Based on the high mobility of birds and bats it is likely that these species utilize the project area.

Table 3-11. WYNDD and WOS database records for BLM sensitive species.

Species	Habitat	Database Search Results*		
Mammals		**WYNDD**	**WOS**	**Project Area**
Long-eared myotis *Myotis evotis*	Conifer and deciduous forests, caves and mines	X		Potential Resident
Townsend's Big-eared Bat *Corynorhinus townsendii*	Forests, basin-prairie shrub, caves and mines			Potential Resident
Spotted Bat *Euderma maculatum*	Low deserts to coniferous forests; cliffs over perennial water			Potential Resident
White-tailed prairie dog *Cynomys leucurus*	Basin-prairie shrub, grasslands	X	X	Potential Resident
Birds				
White-faced ibis *Plegadis chihi*	Marshes, wet meadows			Potential Migrant
Trumpeter swan *Cygnus buccinator*	Lakes, ponds, rivers			Potential Migrant

Northern goshawk *Accipiter gentilis*	Conifer and deciduous forests			Potential Migrant
Ferruginous hawk *Buteo regalis*	Basin-prairie shrub, grassland, rock outcrops	X		Potential Resident
Peregrine falcon *Falco peregrinus*	Tall cliffs			Potential Migrant
Greater sage-grouse *Centrocercus urophasianus*	Basin-prairie shrub, mountain-foothill shrub	X	X	Potential Resident
Long-billed curlew *Numenius americanus*	Grasslands, plains, foothills, wet meadows		X	Potential Migrant
Yellow-billed cuckoo *Coccyzus americanus*	Open woodlands, streamside willow and alder groves	X		Potential Migrant
Burrowing owl *Athene cunicularia*	Grasslands, basin-prairie shrub	X		Potential Resident
Sage thrasher *Oreoscoptes montanus*	Basin-prairie shrub, mountain-foothill shrub	X	X	Potential Resident
Loggerhead shrike *Lanius ludovicianus*	Basin-prairie shrub, mountain-foothill shrub	X	X	Potential Resident
Brewer's sparrow *Spizella breweri*	Basin-prairie shrub	X	X	Potential Resident
Sage sparrow *Amphispiza belli*	Basin-prairie shrub, mountain-foothill shrub	X	X	Potential Resident
Baird's sparrow *Ammodramus bairdii*	Grasslands, weedy fields			Potential Migrant
Amphibians				
Northern leopard frog *Rana pipiens*	Beaver ponds, permanent water in plains and foothills			Potential Resident
Fish				
Yellowstone cutthroat trout *Oncorhynchus clarki bouvieri*	Yellowstone drainage, small mountain streams and large rivers			Does not occur in Project Area

* Request area for WOS and WYNDD data was T48-49N R92-93W in Big Horn and Washakie Counties, Wyoming. WYNDD included results in this area plus a 4-mi buffer; WOS included this area plus a buffer of varying widths up to 5.7 mi.

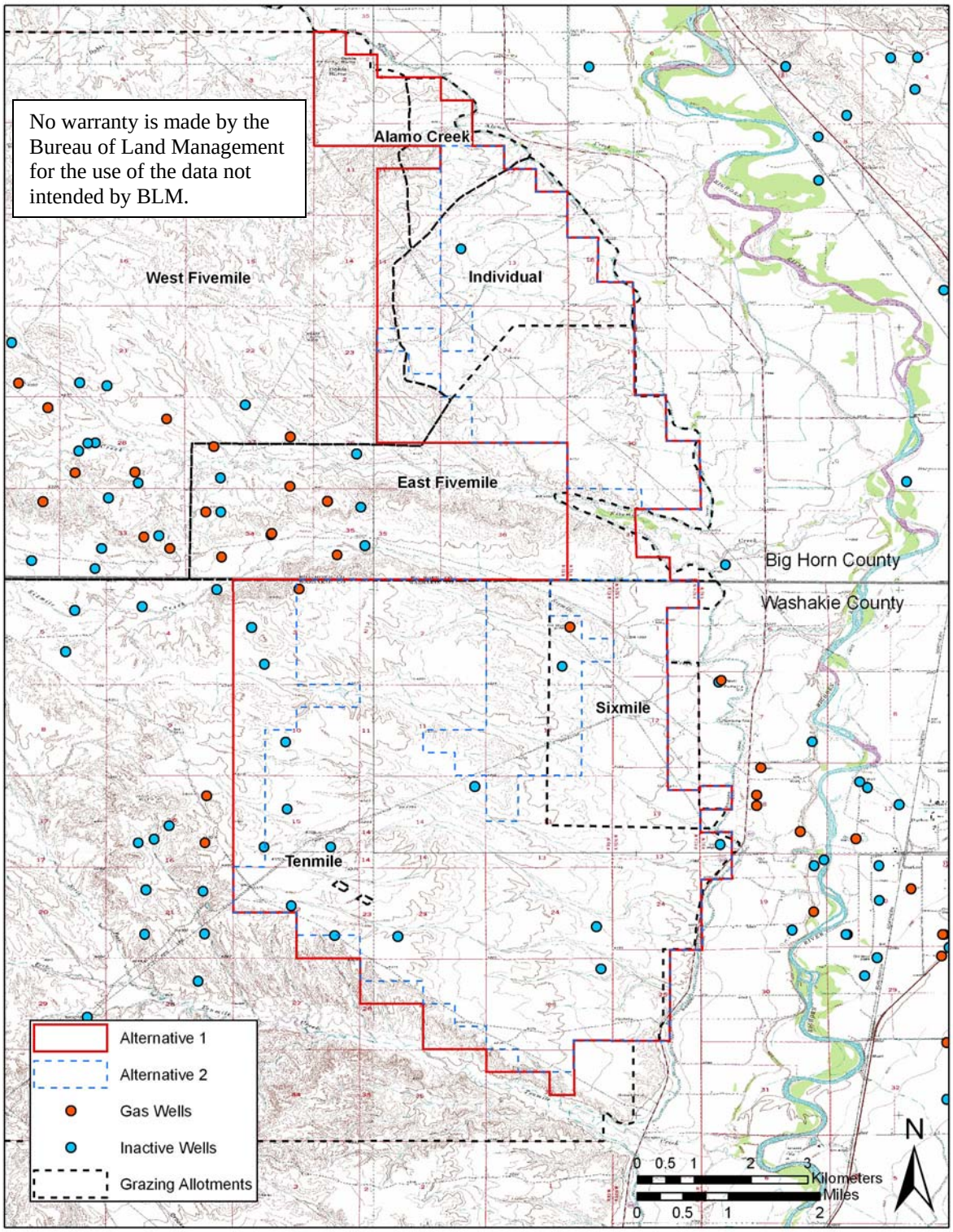
One BLM sensitive plant species, persistent sepal yellowcress, potentially occurs in the project area along wetlands or the Bighorn River corridor. Persistent sepal yellowcress formerly had Federal Status as a Category 2 (C2) species, defined as taxa for which current information indicates that proposing to list as endangered or threatened is possible, but more biological information is needed. Persistent sepal yellowcress is currently considered a sensitive species by the BLM in Wyoming (Worland and Rawlins Field offices). Survey efforts by the EIS Team (Appendix G) to determine the presence of this species did not result in locating any individuals.

3.7 LAND USE

The project area is located primarily in the Grass Creek Resource Planning Area (GCRPA) of the Worland office of the BLM, which encompasses 968,000 acres of public land surface. The Wyoming BLM manages these lands in adherence to their mission statement; which is to sustain the health, diversity and productivity of public lands for use and enjoyment of present and future generations. The primary use by the public of the lands in the project area is pronghorn antelope,

deer, and upland bird hunting, and off road vehicle use. Refer to Section 3.10 for additional information regarding recreational use.

Economic uses of the parcel include grazing and oil and gas production (Map 3-15). Currently, there are six grazing allotments that extend onto the land proposed for conveyance: Alamo Creek, Individual, West Fivemile, East Fivemile, Sixmile, and Tenmile. These grazing allotments equate to 200 animal units per month (AUM). Additionally, there are three producing wells and associated pipeline rights-of-ways (ROW) on the land proposed for sale. A list of the existing ROW is provided in Appendix H.



Map 3-15. Economic uses of project area.

3.8 SOCIOECONOMICS

The project area, for purposes of describing socioeconomic conditions, is assumed to be Big Horn and Washakie Counties. Socioeconomic issues of importance identified during scoping deal primarily with the financial viability of the project and its impact on the local economy. The description of the affected socioeconomic environment was developed using these issues as guidelines. There is no meaningful distinction among the alternatives with respect to the affected socioeconomic environment, and the descriptions that follow are not distinguished by project alternative.

3.8.1 Population

The project is located in Big Horn and Washakie Counties in Wyoming. This two-county area is sparsely populated, even by Wyoming standards. Big Horn County has an estimated population of 11,333, or an average of 3.6 persons per square mile. Washakie has an estimated population of 7,933, or an average of 3.5 persons per square mile. The equivalent figures for the State of Wyoming are 509,300 persons and 5.2 persons per square mile. Only four communities in the area have populations over 1,000 persons. The largest community is Worland, with population of about 5,000. The other larger communities are Lovell (2,300), Greybull (1,800), and Basin (1,200). (State of Wyoming 2006a, website)

Historical population data show that the area has experienced only modest population growth over the past 35 years, with Big Horn County's population increasing 11.1 percent during that period and Washakie County's population increasing 4.8 percent (Table 3-12). This small amount of growth has occurred primarily in smaller communities and rural areas. Basin is the only community of 1,000 or more that experienced population growth over the past 35 years. The other larger communities in the area experienced modest population declines during that period. (State of Wyoming 2006a, website)

Table 3-12. Historic population data.

Area Name	1970	1980	1990	2000	2005	Percentage Change (1970-2005)
Big Horn County	**10,202**	**11,896**	**10,525**	**11,461**	**11,333**	**11.1%**
Basin	1,145	1,349	1,180	1,238	1,224	6.9%
Burlington	--	--	184	250	248	--
Byron	397	633	470	557	548	38.0%
Cowley	366	455	500	560	582	45.9%
Deaver	112	178	199	177	177	58.0%
Frannie	103	121	142	180	182	76.7%
Greybull	1,953	2,277	1,789	1,831	1,752	(9.0%)
Lovell	2,371	2,447	2,131	2,361	2,277	(4.0%)
Manderson	117	174	83	104	101	(13.7%)
Washakie County	**7,569**	**9,496**	**8,388**	**8,292**	**7,933**	**4.8%**
Ten Sleep	320	407	311	304	315	(1.6%)
Worland	5,055	6,391	5,742	5,250	4,967	(1.7%)
Source: State of Wyoming (2006a, website)						

Area residents tend to be older, on average, than other Wyoming residents. The median in the two-county area is 40, contrasted to a statewide median age of 36. Residents over 64 years of age comprise 16.8 percent of the area's population, contrasted with 12.1 percent for all Wyoming residents. Although area residents constitute 3.8 percent of Wyoming's population, public school enrollments are only 1.7 percent of the state total. (State of Wyoming 2006a, website)

3.8.2 Employment and Income

The area economy is partially dictated by land ownership patterns. Both Big Horn and Washakie counties are classified as Federal Lands Counties by the U.S. Department of Agriculture's Economic Research Service (ERS). This designation refers to the extensive federal land holdings in the two counties, which account for 72 percent of their land area (State of Wyoming 2006b). This federal ownership pattern is reflected in local employment statistics, with government and government enterprises constituting the largest source of employment with almost 2,400 jobs (Table 3-13). Other large employment categories include retail trade, mining (including oil and gas production), and agriculture, each with about 1,000 employees (including sole proprietors).

Table 3-13. Local full and part time employment by industry (2003).

Employment Category	Number of Employees and Proprietors	Percentage of Total
Farming	950	7.8
Mining	1,027	8.4
Construction	824	6.7
Manufacturing	697	5.7
Retail Trade	1,014	8.3
Transportation and Warehousing	388	3.2
Finance, Insurance, and Real Estate	654	5.4
Professional and Technical Services	392	3.2
Accommodation and Food Services	754	6.2
Other Services	674	5.5
Government and Government Enterprises	2,389	19.6
All Other Categories	2,445	20.0
Totals	**12,208**	**100.0**

Wages and incomes in the two-county area are somewhat below state averages. Average annual wages in the year 2004 were $28,756 in Big Horn County and $28,301 in Washakie County. The statewide average that year was $31,210 (State of Wyoming 2006b). In the year 2000, 11.4 percent of Wyoming households had incomes below the poverty level. That same year 14.1 percent of all households in the two-county area had incomes below the poverty level. Unemployment rates in the area are also somewhat higher than statewide averages. In 2004, the unemployment rate was 4.7 percent in Big Horn County and 4.1 percent in Washakie County. The Wyoming unemployment rate was 3.9 percent during that year.

3.8.3 Irrigated Agriculture

Irrigated agriculture is an important component of the area economy. According to the 2002 Census of Agriculture, there were 583 irrigated farms covering approximately 140,000 acres in the two-county area (U.S. Department of Commerce 2002). The 950 persons employed directly

in agriculture constitute almost eight percent of the local workforce. The corresponding figure for the State of Wyoming is only 3.6 percent. (State of Wyoming 2006b)

Most irrigated land in the area is located along the Bighorn River and its tributaries, such as Owl Creek, and relies upon surface water diversions for irrigation. Traditional irrigation techniques involve flood or gated pipe applications, but some center pivot sprinklers have been installed in recent years. A description of current surface water diversions in the Upper Bighorn River Basin shows that an average of more than 475,000 acre-feet of surface water is diverted annually in the basin (Table 3-14). A large portion of that total is diverted into the Big Horn and Upper Hanover Canals that serve numerous irrigators along the upper Bighorn River.

Table 3-14. Average annual irrigation water diversions in the upper Bighorn River Basin.

Diversion Name	Average Annual Diversion (Acre-feet)
Ackerman	1,516
Baylor-Purvis-Thompson-Farmer	1,521
Big Horn Canal	148,437
Bluff Canal	33,375
Brassington	2,166
Caledonia	1,944
Chessington-Wilson	1,514
Hale	1,185
Highland Ditch	9,484
Highland Hanover	30,409
Kirby Canal	18,416
Lower Hanover Canal	48,810
Lower Lucerne Canal	11,183
Padlock	1,781
Sliney and Mikkleson #1	3,268
Tenderfoot	2.023
Upper Hanover Canal	151,046
Upper Lucerne Canal	10,177
Woodward-Johnson	1,454
Total	**477,688**

Source: MWH Americas, Inc. (2003).

The primary irrigated crops grown in the area are alfalfa, corn, dry beans, malting barley, sugar beets, and grass hay mixtures. Much of the irrigated crop production is sold for cash, but some of the alfalfa and grass hay is fed to irrigator's livestock and marketed in that manner. According to 2002 Census of Agriculture, the annual value of all agricultural products (crops and livestock) sold in the two-county area is approximately $62.5 million (U.S. Department of Commerce 2002). Estimated returns to irrigated crop production for a modern irrigated farm with above-average management indicate a modest positive return (Table 3-15). The data is based upon crop enterprise budgets published by the University of Wyoming and updated to reflect current crop prices and yields. (Watts & Associates 2006).

Table 3-15. Estimated gross returns for irrigated crop production (Above Average Management).

Crop	Cropping Percentage	Estimated Per Acre Yield	Average Price ($)	Estimated Gross Return Per Acre ($)
Alfalfa	12.6	5.5 tons	92.10/ton	506.55
Alfalfa Establishment	4.2	NA	NA	0.00
Corn for Grain	10.8	160 bu.	2.36/bu.	337.60
Corn Silage	10.8	25 tons	25.00/ton	625.00
Malting Barley	31.7	130 bu.	3.81/bu.	495.30
Sugar Beets	29.9	25 tons	43.00/ton	1075.00
Total/Weighted Average	**100.0**			**$646.22**

3.8.4 Local Infrastructure

3.8.4.1 Housing

Housing in the project area is affordable relative to statewide averages. In 2004 there were 8,873 housing units in the project area, with a median value of $76,700. This figure contrasts the statewide median housing of $96,600 in the same year. Only 7.7 percent of the area's housing units are in multi-unit structures, while 15.2 percent of Wyoming's housing units are in such structures. Home ownership rates in the area are somewhat higher than statewide averages. The area's home ownership rate is 74 percent, compared to a 70 statewide average ownership rate. (U.S. Department of Commerce 2004)

3.8.4.2 Transportation

The area is served by a relatively extensive system of U.S. and state highways and county roads. The primary north-south route through the area is U.S. Highway 20, also designated Wyoming Highway 789. This highway connects the community closest to the affected lands, Worland, with Shoshoni and Thermopolis to the south, and Basin and Greybull to the north. The area proposed for irrigation is served by Wyoming Highway 433, which is located on a bench above the west bank of the Bighorn River northwest of Worland.

The Burlington Northern Railroad also serves the two-county area. A rail line runs along the Bighorn River from north to south through the area.

3.8.4.3 Local Public Services

Local public services in the area are provided by Big Horn and Washakie County governments and by incorporated communities in the two-county area. The county governments are responsible for law enforcement and rural road maintenance in the immediate area that is proposed for irrigation. The nearby City of Worland, school districts, and other special districts provide the other public services needed in the area. The fact that Worland's population has declined from a high of almost 6,400 in 1980 to fewer than 5,000 today is an indication that public services in the area have not been strained by rapid growth.

3.8.5 Public Revenues

The two largest sources of revenue for local governments in Wyoming are sales and use taxes and ad valorem (property) taxes. In fiscal year 2003, Wyoming counties, municipalities, schools, and special districts levied a total of $669 million in ad valorem taxes. Of this amount, $124.1 million went into the state school foundation fund, while the rest was spent locally. Local governments in Big Horn and Washakie counties levied a total of about $17.1 million in property taxes in 2003, or about 2.6 percent of all property taxes levied statewide. Of that amount, $14.3 million was kept locally and $2.8 million went to the school foundation fund. (State of Wyoming 2003)

In fiscal year 2003, a total of 158,900 irrigated acres were listed on the local ad valorem tax roles in the area. The total valuation of this acreage for tax purposes was $13.5 million, or an average valuation of $85 per acre. Another 625,200 acres were assessed as rangeland, with a total valuation of $2.4 million, or about $4 per acre. (State of Wyoming 2003)

Sales and use tax collections form the second largest source of revenue to local governments. The base four percent sales tax is collected locally and divided between the State and local governmental units according to formulas established by the legislature. Counties may levy up to two percent in additional sales taxes upon voter approval. In fiscal 2003, local sales and use tax distributions in the two-county area totaled $4.2 million. During that year, the sales tax rate was five percent in Big Horn County and four percent in Washakie County. (State of Wyoming 2003)

There are a number of other sources of revenue for local governments, including state distributions of mineral severance taxes, lodging taxes, grazing lease revenues and federal payments in lieu of taxes. Local revenues from each of these other sources are small relative to that generated by ad valorem, sales, and use taxes.

3.9 CULTURAL AND PALEONTOLOGICAL RESOURCES

3.9.1 Prehistoric Periods

The Bighorn Basin and surrounding mountains contain many prehistoric archaeological sites that have been the focus of archaeological research for many years. Most of the work has occurred in the Bighorn Mountains on the east side of the basin. The Medicine Lodge Creek site near Ten Sleep (Frison 1991) and the Mummy Cave on the Shoshone River (McCracken et al. 1978) contain stratified deposits ranging as far back as the Paleo-Indian Stage. These sites and others in the region, demonstrate that the Big Horn Basin and surrounding mountains have been occupied for at least 11,500 years (Appendix I).

3.9.2 Protohistoric to Historic Periods

Though Euro-American groups did not reach the region of what is now known as Wyoming and the Bighorn Basin until the nineteenth century, their arrival in the Americas and their subsequent expansion westward affected the Native American cultures significantly earlier. The introduction of the horse via the Spanish in the southwest and intervening tribes (Ewers 1955), the northwest fur trade, the subsequent diffusion of European manufactured goods, and the introduction of guns and foreign diseases were all factors in changing and disrupting Native cultures long before any Euro-American group set foot in Wyoming.

Late prehistoric/early Protohistoric groups that may have occupied the Bighorn Basin included Shoshone, Crow, Athapaskans, and Kiowa (McNees et al. 1999). The Crow were in the Powder River Basin and Bighorn Mountains as early as A.D. 1400 (McNees et al. 1999). The uppermost levels of the Medicine Lodge Creek site (48BH499) yielded European glass trade beads in association with tri-notched projectile points (Frison 1991) illustrating the Euro-American influence prior to the 19th century.

3.9.3 Historic Stage

Beginning in the early 1800s, Euro-American fur traders entered the region. This event spelled the end of Native American domination of the western United States and eventually resulted in

the Native Americans in the region being placed on reservations and the settlement of the Bighorn Basin by people immigrating to the area from the east (Table 3-16, Appendix J).

Table 3-16. Summary of historic stages in Bighorn Basin region.

Industry	Date	Comment
French Fur Traders	18th century	Entered the western side of Powder River Basin
Explorers	Circa 1804	Coulter leaves Lewis and Clark and explores mountains, valleys, and basins of northwestern Wyoming
Emigrants	1864	Bridger emigrant trail established through Bighorn Basin
Gold Exploration	1864	First attempts at gold mining in Bighorn Basin
Transportation		
Railroad	1907	Chicago, Burlington, & Quincy Railroad branched south and reached Worland
Automobile	1924	Modern highways penetrated Bighorn Basin
Agriculture		
Cattle	1879-1883	First large cattle herds enter basin
Sheep	1876	Sheep utilize basin
Irrigated crops	1890's	Beginning of irrigation for crop production in basin
Carey Act	1894	Federal aid to irrigation projects
Newlands Act	1902	Federal aid to reclamation projects – Shoshone Project in Basin to cultivate sugar beets
Fossil Fuel		
Coal mining	1890's	Small scale until railroad extended
Oil and gas development	Mid 1880's	Began; the area's prolific deposits of natural gas were tapped for industrial and domestic use beginning in 1916

3.9.4 Previous Archaeological Investigations

A number of previous archaeological investigations have been undertaken in and around the project area. Most have been small well pad and pipeline cultural resource inventories. The Office of the Wyoming State Archaeologist (OWSA) conducted a Class III cultural survey of the WID between June 23 and November 16, 1985 (Eckles and Scott 1986). The area investigated consisted of 11,072 acres, and included 10,642 acres of BLM land and 430 acres of private land. About 600 acres of the project was under agricultural production at the time and were not surveyed. The survey resulted in the documentation of 253 sites, including 243 newly recorded sites and 11 previously recorded sites. Of this total, OWSA recommended 55 sites as eligible for inclusion in the National Register of Historic Places (NRHP). The remaining sites were determined not to be eligible. This project was followed up in 2005 by a Class I report (Eckles 2005). This Class I cultural resource survey covered 16,050 acres proposed for conveyance and three buffer areas comprising approximately 3,330 acres.

The previous inventories recorded small prehistoric lithic scatters and lithic scatters associated with fire-cracked rock. A few of these sites contained cultural features, primarily the remains of fire-hearths. These sites are thought to have functioned as root processing sites (M. Bies, BLM, pers. comm.), but this hypothesis has yet to be tested. Two lithic landscapes have been recorded in the project area, the Fifteen Mile Creek lithic landscape (48WA1289/48BH1820) and the Five

Mile Creek lithic landscape (48BH1762). Historic sites included small trash scatters and the Big Horn Canal.

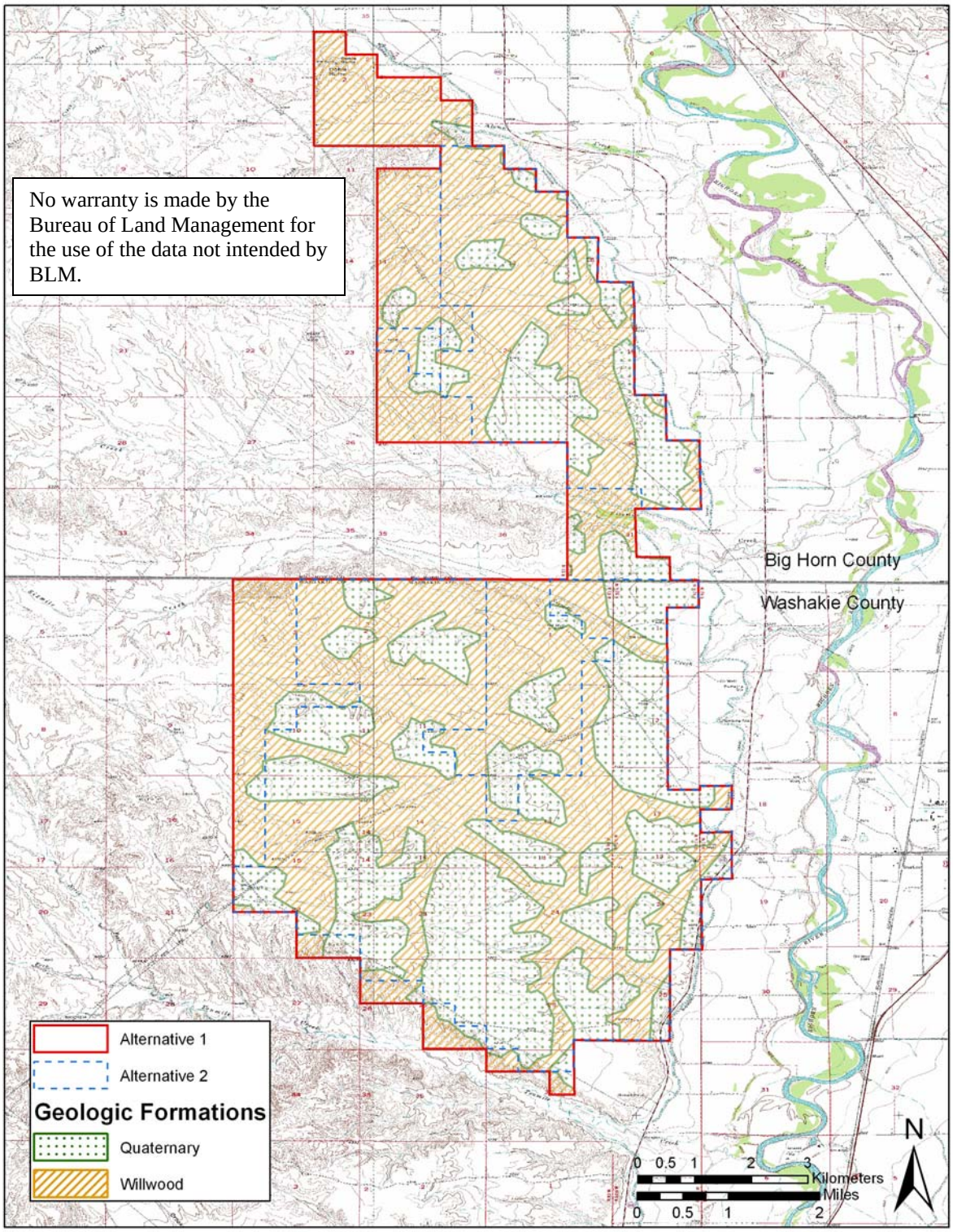
In 2005 and 2006, crews from Cultural Resource Analysts, Inc. (CRAI) resurveyed the 16,500 acre unit originally surveyed by OWSA. This inventory located 322 prehistoric and historic sites, 22 of which were recommended as eligible for nomination to the NRHP, or were considered important by the Northern Arapaho tribe, and 300 were recommended as not eligible for nomination to the NRHP (Hall et al, 2007). CRAI found the same site types as had been recorded by OWSA. In order to determine if the project area held soils and sediments that may contain buried archaeological sites, a geoarchaeological study was conducted to model archaeological sensitivity (Eckerle, in prep). The model divided the project area in five sensitivity levels that indicated if soils or sediments, suitable in age and location to contain intact buried archaeological deposits, occurred in the project area. Low and Very Low areas accounted for approximately 51% of the project area, Moderate areas included approximately 23% of the area, and High and Very High accounted for approximately 26% of the project area. Limited testing in each of the sensitivity areas failed to locate any buried cultural deposits (Hall et al. 2007).

The CRAI investigation also included Native American consultations. These consultations were initiated and organized by the BLM and included the Northern Arapaho and Shoshone-Bannock tribes. To date, the Northern Arapaho consultation has been completed and Shoshone-Bannock consultation is scheduled for November 2006. The purpose of the consultations is to determine if any of the tribes have any concerns with conveyance of any of the sites.

3.9.5 Paleontological Resources

The project area contains the geological formation referred to as the Willwood formation which contains important fossil resources (Map 3-16). The Willwood formation consists of immature fluvial sandstones, conglomerates, and varicolored mudstones. The Willwood is primarily Eocene in age and vertebrate fossils commonly found in this formation include turtles, crocodilians, and mammals (Gingerich and Clyde, 2001). Mammalian fossils of the Willwood formation have been studied by paleontologists since the late nineteenth century and early twentieth century expeditions of Walter Granger and William J. Sinclair. These studies have made important contributions to our understanding of early mammal evolution, as well as the environmental changes that occurred within the Bighorn Basin. Additionally, the Willwood formation contains dense accumulations of fossil plant debris (Kraus and Sian Davies-Vollum 2004). Approximately, 9,735 surface acres of Willwood formation occur within Alternative 1, whereas Alternative 2 contains approximately 6,105 surface acres of Willwood formation.

Research publications regarding these paleontological deposits begin in the early 1880’s and continue to present. In 1896, J. L. Wortman published a paper on the Hyracotherium or first horse based in part on materials from this area. Current research focuses on documenting and understanding the climatic shifts that occur during this period. The Willwood formations’ rich deposits of both plant and vertebrate fossils allow detailed analysis of the changes in the environment. Many researchers believe that this data will contribute to our understanding of current environmental factors.



Map 3-16. Location of Willwood formation within project area.

3.10 RECREATIONAL RESOURCES

3.10.1 Non-Consumptive Use

The project area is located within the Extensive Special Recreation Management Area for GCRMP. Approximately half of the project area is considered "back country" with natural appearing landscape having modifications not readily noticeable. Recreation use of this area consists of site seeing, hunting, camping, driving for pleasure (off road vehicles and 4 wheel drive), destination travel for viewing the area, and general remote dispersed recreation. The GCRMP manages the travel in the area by directing visitors to remain on existing roads and trails. The typical group size is two to four people per group and encounters with other users may exceed three per day, but are usually less than five on motorized travel routes. Encounters off motorized routes are less. The BLM provides basic maps and minimal on site signing for the users.

3.10.2 Fishing

Wyoming has the highest per capita rate of fishing participation in the U.S. (over 50 percent), and fishing is an important recreational activity in Wyoming's Bighorn Basin. Approximately 2,300 miles of streams occur in the basin, of which an estimated 1,800 miles are classified as Class 1 (fisheries of national importance), Class 2 (fisheries of state importance), or Class 3 (fisheries of regional importance) by the WGFD (WGFD 1987). The basin also contains approximately 22,200 acres of natural lakes, reservoirs, and farm ponds which are productive fisheries. The Bighorn River and a few small lakes/ponds provide warm water fishing opportunities to anglers in the basin.

The WGFD is acquiring access the Bighorn River for walk-in hunting and fishing opportunities by the public. Currently, between Worland and Manderson there are five areas that provide approximately five miles of river bank open to public fishing. Additionally, the BLM has two tracts of land providing approximately 1.25 miles of river bank. There are three public boat ramps along this stretch of the Bighorn River; one in Worland, one in Manderson, and another in between the two towns on the BLM property. These boat ramps provide access for float fishing, which is increasingly popular in the basin.

In the year 2000, over 51,000 fishing licenses were sold in the five-county area comprising the Wind/Bighorn River Basin. According to WGFD estimates, these license sales correspond to approximately 445,000 angler days of fishing activity. About 71 percent of the angling activity is by Wyoming residents and the remainder by non-residents. Angling activity in the Basin is projected to grow to between 488,000 angler days (low-growth scenario) and 722,000 angler days (high-growth scenario) by the year 2030. (BRS Engineering 2003a)

About 8,300, or 16 percent, of the Basin-wide license sales occurred in the Big Horn/Washakie County project area. The WGFD does not routinely estimate angling activity for specific waters in the Bighorn Basin, but the Bighorn River between Worland and Manderson probably receives only very light angling pressure. One reason is that public access is limited by private ownership of the banks except for a few public access areas. Another reason is that the fishery in this stretch

of the river is limited to warm water game fish such as catfish and perch. Viable trout fisheries are available for anglers in the higher elevations of the Bighorn Mountains in both counties. The Bighorn River upstream of the project area in Hot Springs County is also a viable trout fishery.

3.10.3 Hunting

Big game, upland gamebirds, and waterfowl hunting opportunities are available in the project area along the Bighorn River and adjacent lands in Big Horn and Washakie counties (BRS Engineering 2003b). The project area is in Antelope Hunt Area 77, which covers a large area north and west of Worland, and is bounded by the Greybull River to the north. During the three-year period from 2003 through 2005, an average of 155 pronghorn antelope hunting days annually were estimated for this area by the WGFD. The number of hunting days specific to the project area is unknown, but probably quite small given its size relative to the entire hunt area. Hunter success rates for Area 77 are estimated to be about 93 percent. (WGFD 2003-2005, Harvest Reports, website)

The project area is located in Deer Hunt Area 125, which covers an even larger geographic area stretching generally north and west of the Gooseberry Creek drainage south of Worland. The WGFD estimates that an average of 620 deer hunting days of activity occurred in this area annually during the period from 2003 through 2005. Again, no site-specific estimates of hunting activity are available for the project area. The hunter success rate for Deer Hunt Area 125 is approximately 68 percent. (WGFD 2003-2005, Harvest Reports, website)

A lack of habitat for waterfowl and upland game birds in the project area suggests that bird-hunting opportunities are limited under present conditions. Although sage-grouse may occasionally occupy the area, habitat is marginal and no leks were found nearby, suggesting that few sage-grouse would occur in the project area. Hungarian partridge and ring-necked pheasant may also occur in the project area but are likely more commonly associated with nearby agricultural lands. It is unlikely that the project area receives many upland game bird hunters.

3.11 VISUAL/AESTHETICS

The project area consists of flat terraces separated by relatively short eroded slopes with nothing extraordinary for the area. Under the BLM Visual Resource Management (VRM) classification, the project area occurs in a Visual Resources Management Class III with some Class IV (D. Ogaard, BLM pers. comm.). Class III areas are those adjacent to the agricultural corridor, while Class IV areas are primarily the agricultural lands along the western edge of the entire parcel. Under the VRM plan, the objective for Class III areas is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape. The objective for Class IV areas is to provide for management activities that require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to

minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

3.12 HAZARDOUS MATERIAL

According to officials with Wyoming Department of Environmental Quality, there is no record of hazardous material or waste ever being stored or spilled on the land that is scheduled to be conveyed (C. Anderson, WDEQ, pers. comm.) Visual and olfactory inspections of the project area during visits revealed no stained soil, disturbed ground, debris, or odors which might indicate the presence of hazardous material or waste.

Chapter 4.0 - Environmental Consequences

4.1 INTRODUCTION

The previous chapter described the physical, biological, social, and economic characteristics of the environment that may be affected by implementation of the proposed action and the alternatives. Direct, indirect, connected and cumulative effects are described in this chapter. This chapter examines how each of these characteristics may be affected (beneficially or adversely) by implementation of each of the alternatives, including the No Action Alternative. No other proposed action(s) were identified that may be anticipated to occur in the reasonably foreseeable future within the project area or within the geographic scope of the EIS's resource effects analysis. Therefore, the cumulative effects analysis primarily includes past actions, current actions, and the proposed action and its alternative.

4.1.1 No Action Alternative

The No Action Alternative would result in the land remaining under BLM ownership and management which would eliminate the sale of the land to private interests and the connected action of crop production. Current land management regimes that are in place would remain and continue to affect the environment as it currently exists. Therefore, this alternative would likely result in no positive or negative change to the current environment. This alternative however, does not comply with Public Law 106-485 (Nov. 9, 2000; 114 Stat. 2199) (Appendix A).

4.2 LAND FEATURES

4.2.1 General Setting

4.2.1.1 Location

Alternative 1

Land ownership would be transferred from federal lands to private ownership. Alternative 1 would result in 16,050 acres being placed into private ownership. The connected action would result in the sale of a portion of these acres to be developed for crop production.

Alternative 2

Alternative 2 would differ from Alternative 1 in that only 11,576 acres would be transferred from federal to private ownership. The connected action would result in the sale of a portion of these lands to be developed for crop production.

4.2.1.2 Climate

Alternative 1 and 2

The microenvironment climate will be altered by the conversion of native vegetation to cropland associated with Alternative 1 and 2. An increase in humidity and evapotransporation are predicted to occur within the agricultural fields as the local area is converted from an arid environment to a more mesic environment. Although these changes to the microenvironment are anticipated, they are not quantifiable at this time.

4.2.2 Geology and Soils

Alternative 1 and 2

Previous studies have provided estimates of soil losses from wind and water erosion. The estimates are based on the "Wind Erosion Equation" and the "Universal Soil Loss Equation," both of which require parameter inputs associated with crop types, crop rotations, and management practices. At this time, crop and agricultural practice details remain uncertain for this project, however it is predicted that crops selected would be similar to existing crops in the Bighorn Basin and would include alfalfa, corn, dry beans, malting barley, sugar beets, and grass hay mixtures. Previous studies utilized crop rotations of malt barley, sugar beets, alfalfa, and pasture to calculate an estimated average soil loss of 4.1 tons per acre per year (USDOI, 1988). Based on these calculations it is estimated that 38,130 tons per year of soil would be lost if all 9,300 acres were irrigated. However, this number may be reduced due to the predicted grading of sloping fans, swales, and drainages into the surrounding terraces that would be required to render the area irrigable. It is estimated that this process will effectively reduce the net effects of both wind and water erosion. Certain conservation measures recommended by the NRCS can be implemented to prevent excessive soil losses and to ensure long-term sustainability of agriculture in the project area.

The high salinity of the soils in the project area (e.g., Rairdent-Uffens) would greatly restrict productivity unless the salts are sufficiently leached in order to make them fully productive and suitable for long-term irrigation. Water and soil amendments applied in an agronomic manner, in accordance with crop needs, soil water holding capacities, climatic characteristics, soil infiltration rates, and leaching requirements should not lead to saturated conditions such that a continuous wetting front is established with the regional groundwater system. Sufficient water application for leaching purposes would merely ensure that salts do not accumulate within the root zone. Thus, mass wasting of salts to groundwater and to the Bighorn River should be minimized.

Reclamation of the saline soils would lead to gradual salt wasting and possible trace amounts of selenium in return flows as these constituents are transported with the water fraction that migrates downward by dispersion into the groundwater. Several small wetlands west of the Bighorn River lay down-gradient of the project area. Selenium in irrigation return flows could reach the wetlands and fall stagnant, leading to gradual selenium accumulations that would endanger wildlife habitat. The precise nature and degree of this potential problem would be difficult to foresee without an extensive exploratory well drilling program that is beyond the scope of this study. Selenium and salts may also reach the Bighorn River, but accumulation should not be an issue, and concentrations would be negligible, assuming responsible farming practices, according to the USDOI report (1988).

4.2.3 Mineral Resources

Alternative 1 and 2

Geologic mineral resource extraction or utilization is unlikely to conflict with surface agricultural activities. It is not anticipated that sand and gravel demand would exceed the availability of alternative reserves. Coal and coal bed methane development prospects are low as

the lateral extent and thickness of reserves in the Basin Coal Field are limited and deemed "low priority" for development. There are currently no coal mining operations in the Bighorn Basin. Oil and gas development is active in the area, and it is possible that additional development may proceed under the auspices of federal leasing regulations. The BLM provides oversight of federal lease development and negotiates with affected surface land owners through "Surface Use Agreements". The purpose of these agreements is to minimize undesirable effects of drilling and operational activities and provide reasonable mitigation measures and/or just compensation through the development of federal leases.

4.3 WATER RESOURCES

4.3.1 Surface Hydrology

Alternative 1 and 2

The projected water demands for the project were based on system capacities of 50 cfs (3,000 acre-feet per month) for the Washakie County System (Diversion 1) and 33 cfs (2,000 acre-feet per month) for the Big Horn County System (Diversion 2). The maximum total monthly demand for both systems is estimated to be 83 cfs (5,000 acre-feet per month), which will occur during July. The total water demand for crop production during an irrigation season is estimated to be 18,600 acre-feet per year. Return flows associated with the system capacities described above are estimated at 25% of the applied water, resulting in 12.5 cfs for Washakie County, 8.25 cfs for Big Horn County, and a maximum return flow in July of 20.75 cfs.

The "Kirby Area Water Supply Level I Study" (Anderson Consulting Engineers, Inc., 2005) analyzed the water supply available for proposed projects in the Kirby area, which is immediately upstream from Worland. The results determined that there is ample water in the Bighorn River to meet the future requirements associated with the WID Project. It is not anticipated that additional flows would have to be released from Boysen Reservoir to meet project needs. The available flows in the Bighorn River are sufficient to support the project. Consequently, effects on Boysen Reservoir would not occur.

The project impacts to the Bighorn River have been estimated for the irrigation season. Existing and anticipated Bighorn River flows for both dry years and normal years have been summarized in Table 4-1. The existing flows reported in Table 4-1 were measured at the confluence of Fifteenmile Creek and the Bighorn River. The winter maintenance flows for the Bighorn River, as maintained by Bureau of Reclamation, are 18,600 acre-feet per month. No summer maintenance flows have been formulated.

Table 4-1. Existing and anticipated Bighorn River flows in relation to WID for dry and normal years.

DRY YEARS	May (cfs)	June (cfs)	July (cfs)	August (cfs)	September (cfs)
Existing	958	977	940	798	523
With WID	911	898	849	732	498
NORMAL YEARS					
Existing	1,219	1,596	2,132	1,373	1,123
With WID	1,172	1,517	2,041	1,308	1,097

4.3.2 Water Quality

Alternative 1 and 2

The conversion of native vegetation to crop land proposed in the connected action would result in an approximate increase of 37 tons/year of sedimentation to the Bighorn River. This increase was calculated by extrapolating results generated by the USDOI study (1988). The USDOI reported that flood irrigation of 4,068 acres of undisturbed land, which occurs within the project area of this EIS, would result in 16 tons/year (~10 percent higher than conditions in 1988) increased sedimentation to the Bighorn River based on the Universal Soil Loss Equation. The USDOI report concludes that the estimated increases would have an insignificant effect on the municipal water supply at Basin, unnoticeable effects on turbidity, and aquatic species would be unaffected. Considering that the scale of the difference is orders of magnitude less than overall Bighorn River sediment load, it is deemed reasonable to assume that the same conclusions hold for both of the current proposed alternatives.

Reasonable and recommended application of pesticides associated with the proposed crop production would not likely result in a significant increase to the current concentrations in the Bighorn River. The existing extensive crop production that occurs along the Bighorn River has only resulted in trace amounts of pesticides being detected, therefore it is reasonable to conclude that the addition of 9,300 acres of crop production will not likely result in a large increase in the concentration of pesticides in the Bighorn River. Loading of trace constituents from runoff on the Bighorn River at Basin was modeled in the USDOI 1988 report. All concentrations were orders of magnitude below ambient water quality. Assuming appropriate and recommended application practices are followed, increase in pesticide concentrations in the Bighorn River would pose no threat to human or aquatic life (USDOI, 1988).

4.3.3 Groundwater Resources

Alternative 1 and 2

Potential impacts to groundwater resources associated with Alternative 1 and Alternative 2 were evaluated by extrapolating the analyses conducted in the USDOI (1988) report. The USDOI analysis (1988) included a mass balance assessment of groundwater quality in relation to additional application of water through sprinkler irrigation to the project lands. The analysis considered effects of trace constituents/metallic elements, pesticides and nitrate along a 15.5 mile eastern project boundary (which closely approximates the present proposed project boundary). Constituents potentially exceeding the Environmental Policy Act (EPA) standards include arsenic and iron. The USDOI report (1988) estimated that resultant iron concentrations in the adjoining alluvial groundwater system would exceed Federal Secondary Drinking water standards. Other trace metal constituents remained within standard limits. These conclusions hold true in the extrapolation of these results to account for the additional irrigated acreage under the present Alternative 1 and 2 (Table 4-2).

Table 4-2. Groundwater quality estimation.

Constituent (ppb)	EPA Standard Concentration of acute toxicity	Existing Irrigation/ Current Conditions[1]	USDOI (1988) Additional Acres[2] (4,068 Acres)	Alternative 1 and 2[3] (9,300 Acres)
Arsenic	10	2	19	23
Cadmium	5	0	3	4
Iron	300	508	1492	1737
Selenium	5	4	5	5
Aldicarb	3,000	253	337	358
Dicamba	28,000	5	6	6
Carbaryl	330	not applicable--never more than 0.05 percent of the annual applied would be leached below the crop rooting zone.		
Nitrate	10	141	must be assessed in advanced planning phases.	

[1]Irrigated acreage below the Big Horn Canal between Tenmile and Alamo Creeks, including canal seepage, and groundwater quality estimated from Bighorn River data.

[2]Mass balance analysis from USDOI 1988 report.

[3]Mass balance extrapolated from USDOI 1988 report..

The use of pesticides associated with crop production would not likely result in degradation of groundwater. Aldicarb in soil rapidly degrades to nontoxic sulfide and sulfone products. Dicamba when applied at the recommended rates would not present a hazard to human or livestock use of the groundwater. Carbaryl leaching would be limited to no more than 0.05 percent of the annually applied amount, and no adverse effects would be anticipated to occur (USDOI, 1988). At the low predicted concentrations (which are either broken down to nontoxic constituents, do not bioaccumulate, or do not leach below the root zone), the responsible use of these typical pesticides would not likely result in hazardous or toxic conditions to the groundwater.

There are several domestic wells in the area. The State Engineer's Office records indicate 15 domestic (or domestic/stock) wells west of the Bighorn River that are less than 50-feet deep. Although precise recharge characteristics and the overall groundwater flow regime are unknown, it is possible that these wells would suffer adverse impacts. The precise nature of these impacts cannot be stated beyond the estimates provided in the Table 4-2. It may be prudent to document the baseline water quality of potentially affected wells in the area. Additionally, installing a suite of up-gradient monitor wells in order to document that the level of leached chemicals and pesticides do not increase inordinately nor approach levels of toxicity may be required.

4.3.4 Water Rights

Alternative 1 and 2

It is has been estimated that Wyoming has over 1,500,000 acre-feet of water available in the Bighorn Basin for future uses. (BRS, Inc., 2003) Of this amount, the WID would divert to the project area a total of about 18,600 acre-feet per year. This diversion amount is based upon the actual crop demand schedule developed for the proposed project and is substantially less than typical for a full irrigation requirement (30,000 acre-feet).

Due to the amount of proposed diversion relative to availability, no impacts to existing water users are anticipated as a result of Alternative 1 or 2. Those existing water users who may be concerned about potential impacts must request water right regulation from the Water Division III Superintendent of the State Board of Control. The Superintendent will then make a determination if the proposed project is impacting existing senior appropriations downstream and will remedy the situation through their regulatory authority.

4.4 AIR QUALITY

Alternative 1 and 2

The effects from the land transfer and connected actions on air quality would be seasonal as crop production cycles through the tilling, planting, growing, and harvest stages. While the land is being tilled to create cropland, there may be an increase in fugitive dust resulting from the barren land. After the land is converted into cropland, fugitive dust would be an issue during planting and harvest seasons when the vegetation cover is minimal. While the soil is exposed during these periods, dust storms are likely to occur.

Vehicle emissions are a potential source for reducing the air quality of the area. Increased emissions would primarily be generated from the use of farming equipment. Due to topography of the area and the prevailing atmospheric conditions the potential increase in emissions would readily dissipate to a level that is insignificant.

The potential increase in fugitive dust and vehicle emissions are anticipated to occur at levels that are insignificant and would not result in an adverse effect to the region.

4.5 NOISE

Alternative 1 and 2

The primary sources of existing noise in the region are farm equipment and intermittent highway traffic. The increase of agriculture activities resulting from the connected actions would not differ between the two alternatives because there would be no additional farming activities on the larger parcel sold. Either alternative would result in a slight increase in the noise levels associated with agriculture activities and vehicle travel. However, farm equipment is used on a seasonal basis, thus the increase in noise levels would not result in a new source of constant noise levels.

Sensitive noise receptors that may be adversely affected by increases to ambient noise levels are sage grouse leks, big game on crucial winter ranges, and nesting raptors. No sage grouse leks or nesting raptors were located within the project area. The closest raptor nests were along the Bighorn River where croplands dominate the landscape and nesting raptors have either acclimated to the farm noise that occurs or have already vacated the region. The area proposed for transfer does contain crucial winter range for pronghorn antelope and mule deer. However, farm equipment generally is not utilized in the winter months when big game would be utilizing the winter ranges. Increase in noise levels associated with the project would not affect animals on the winter ranges.

4.6 BIOLOGICAL RESOURCES

4.6.1 Vegetation

Alternative 1 and 2

The conversion of native vegetation into cropland associated with Alternative 1 and 2 would result in the loss of native plant communities. The total loss of native vegetation would be identical for either alternative as the overall amount of irrigable land, and those most likely to be converted from native vegetation to cropland, is the same. Other activities associated with the alternatives, such as road construction, infrastructure development, and fencing would not likely result in a direct loss of habitat as these features are expected to occur within the area identified as irrigable.

The conversion to cropland associated with Alternative 1 and 2 would result in a permanent loss of approximately 9,300 acres of Wyoming big sagebrush. This equals approximately 0.62 percent of the Wyoming big sagebrush plant community that occurs within the Bighorn Basin (Map 3-1). This loss would not likely result in a significant impact to the Wyoming big sagebrush plant community.

Both alternatives require the creation of two diversion pumping stations along the Bighorn River. The installation of the pumps will result in the loss of approximately five acres of vegetation at each location. The northern diversion point will result in the loss of emergent vegetation associated with a fringe wetland. The southern diversion point will result in the loss of riparian vegetation that consists of trees and herbaceous vegetation. The construction of pipelines from the diversion points to the edge of the land conveyed will result in temporary disturbance to vegetation. The pipelines will follow roads as much as possible, but it is likely there will be some lengths of the pipeline that will cross irrigated crop land. Areas along road sides that would be disturbed by trenching would likely be revegetated with invasive species if not reseeded.

4.6.2 Wildlife

4.6.2.1 Big Game

Alternative 1 and 2

The conversion of native vegetation into cropland associated with Alternative 1 and 2 would result in a loss of seasonal habitat for pronghorn antelope, mule deer, and white-tailed deer (Table 4-3). Other activities associated with the alternatives, such as road construction,

infrastructure development, and fencing would not likely result in a direct loss of habitat as these features are expected to occur within the area identified as irrigable. Fence construction could restrict pronghorn antelope and mule deer, therefore fencing recommendations of the WGFD could be employed. Proper fence design would insure that big game animals may move through the property during periods of severe winter when access to crucial winter range in essential.

The conversion to cropland associated with Alternative 1 and 2 would result in a loss of crucial winter/yearlong range for pronghorn antelope and mule deer, as well as parturition range for pronghorn antelope. The pronghorn antelope herd unit that occupies the project area would lose an estimated 3.5% of the total crucial winter/yearlong habitat available to the herd as a result of the conversion (see Map 3-7). Additionally, the pronghorn antelope would lose approximately 0.3% of the total winter/yearlong range identified in the unit and approximately 14.6% of the identified parturition range. At the present time parturition range is not considered a limiting resource such that it controls the capacity of the area to support pronghorn. It is unknown if the loss of 14.6% of the identified parturition range would result in a change in this condition. Mule deer would lose approximately 1.6% of the total crucial winter/yearlong habitat available in the region. Mule deer and white-tailed deer would both lose yearlong habitat equaling 1.5% and 0.09%, respectively, of the total available yearlong habitat. It is difficult to predict the impact to a herd due to a partial loss of crucial winter habitat. However, it is anticipated that over the long term, there would be a reduction in population based on the reduction in carrying capacity during a severe winter, when available crucial winter range limits the number of surviving individuals. The loss of crucial winter range reduces the capacity of the herd unit to support animals and therefore, over the long term, the population size of the herd would be expected to decline.

Table 4-3. Quantity of seasonal range lost due to conversion to cropland.

Species and Seasonal Range	Number of acres available in herd unit	Number of acres lost	Percent of seasonal range lost
Pronghorn Antelope (HU #204, Fifteen Mile)			
Crucial winter/yearlong	241,211	8,394	3.5%
Winter/yearlong	996,491	3,177	0.3%
Parturition	4,470	651	14.6%
Mule Deer (HU #209, Basin)			
Crucial winter/yearlong	264,654	4,132	1.6%
Yearlong	509,960	7,439	1.5%
White-tailed Deer (HU# 201 Bighorn Basin)			
Yearlong	857,208	765	0.09%

Alternative 1 and 2 will result in a loss of public ownership and multiple use management of these seasonal ranges. Due to the greater number of acres conveyed in Alternative 1, there will be a greater loss associated with Alternative 1 (Table 4-4). Alternative 2 contains no additional acres of seasonal ranges other than those considered for conversion to cropland, therefore the percentages for Alternative 2 did not change. The noticeable differences between Alternative 1 and Alternative 2 regarding loss of seasonal range management occurs in the pronghorn antelope crucial winter/yearlong range (4.7% versus 3.5% loss), pronghorn antelope parturition (28.7% versus 14.6%), and mule deer crucial winter/yearlong (2.4% versus 1.6%). The other seasonal ranges showed 0.5% or less difference between the two alternatives.

Table 4-4. Quantity of seasonal range removed from public ownership and multiple use management.

Species and Seasonal Range	Number of acres available in herd unit	Alternative 1 Percent of seasonal range lost	Alternative 2 Percent of seasonal range lost
Pronghorn Antelope (HU #204, Fifteen Mile)			
Crucial winter/yearlong	241,211	4.7%	3.5%
Winter/yearlong	996,491	0.5%	0.3%
Parturition	4,470	28.7%	14.6%
Mule Deer (HU #209, Basin)			
Crucial winter/yearlong	264,654	2.4%	1.6%
Yearlong	509,960	2.0%	1.5%
White-tailed Deer (HU# 201 Bighorn Basin)			
Yearlong	857,208	0.15%	0.09%

Depending upon the crops selected for planting, there may be an available forage source created to some degree in particular during the mid to late summer months when all green native range vegetation has cured. However, the increase in forage during the crop growing season would not offset the loss of forage during the winter season. Also, the utilization of the crops by wildlife may result in a reduction in the amount of crops harvested, resulting in damage under state statute (Law 23-I-901). There is the potential that damage to crops by big game will result in an increase in depredation harvests by the WGFD of the animals in this area. A reduction in the herd unit population would be the likely outcome of the increased depredation harvests.

4.6.2.2 Raptors

The land conveyed and the connected actions associated with Alternative 1 and 2 would not result in the loss of any known nest sites for raptors. No cottonwood trees along the Bighorn River would be lost and the land to be conveyed, while in the breeding range and habitat for ferruginous hawk and northern harrier, provides little suitable nesting habitat. No impacts to nesting raptors are expected from either alternative.

Currently, raptor foraging opportunities on the site are minimal. There are low density populations of ground squirrels, cottontail or jackrabbits, two small prairie dog colonies and likely other small rodents within the land proposed for transfer. However, should the land be converted to irrigated agriculture, the current small mammal community would likely change as species that are common in croplands are likely to invade from nearby fields east of the Big Horn Canal. Over time the prey base of small mammals on the site is expected to change, although it is not certain whether abundance and overall prey biomass would increase or decrease. Quantifying change in small mammal abundance and biomass is difficult, however, it is expected that foraging opportunities for raptors would be impacted equally by either alternative.

4.6.2.3 Mammals

<u>Alternative 1 and 2</u>

Conversion of native vegetation into irrigated cropland is the same for Alternative 1 and 2 and would result in a loss of 9,300 acres of Wyoming big sagebrush habitat for mammals in the area. The area impacted by the conversion represents 0.62 percent of that habitat type available in the Bighorn Basin. This loss would not likely result in a significant impact to any mammalian

populations in the basin. Larger, mobile mammalian species such as rabbits, foxes and coyotes would be displaced due to the conversion, however the habitat loss is not crucial to effected populations of mammals excluding big game species discussed in Section 4.6.2.1, thus displacement should not reduce their abundance. Small, burrowing mammals may be killed during the tilling process to convert the native vegetation into irrigated cropland. This may possibly alter the composition and relative abundance of small, burrowing mammals in the area. However, these species are typically abundant in established agricultural areas, thus impacts would be considered insignificant.

4.6.2.4 Reptiles and Amphibians

Alternative 1 and 2

Tilling activities associated with crop production would cause a decrease in the number of reptiles and amphibians that occupy the area. However, the area impacted by the conversion represents only approximately 0.62% of Wyoming big sagebrush plant community available in the Bighorn Basin (refer to Section 4.6.1). In general, due to the limited availability of wetlands and habitat, few amphibians occur in the project area. Therefore, impacts to amphibians from conversion of the land from native plant communities to crops would be minimal.

Some species of reptiles (snakes and lizards) that can live in dry environments are expected to be more common in the project area. The conversion of land into irrigated cropland may cause a decrease in the number of these species that occupy the area; however, the change to irrigated cropland would be expected to increase the small rodent population over time which is used by a variety of snakes for prey. These types of impacts are difficult to quantify, however, it would be expected that the reptile and amphibian community of the site would change over time in terms of species composition and numbers and could potentially increase as a result of the land conversion.

4.6.3 Aquatic Resources

4.6.3.1 Fisheries

Water to be used for irrigation of the conveyed land would be from currently unappropriated water from the Bighorn River estimated at 18,600 acre-feet per year (see Section 4.3.1 and 4.3.4) with a maximum monthly depletion of approximately 5,000 acre-feet per month (83 cfs) during July. These depletions are not measurable losses as they will occur during the growing season when there are large fluctuations already occurring within the river. During dry years, the water flow in the Bighorn River is variable during the irrigation season (May through September) and is estimated to vary from 523 cfs to 977 cfs (see Section 4.3.1). Irrigation of the converted land would reduce these flows by approximately 25 cfs to 91 cfs (see Section 4.3.1), which falls well within the existing range of variability of flows. The fish populations that occur in the Bighorn River exist within the already fluctuating water levels. The additional depletions due to the irrigation of the WID lands will not result in a measurable change in water volume in the river over existing conditions. It is not expected that fish in the Bighorn River would be impacted by a reduction in water volumes greater than the existing conditions.

Increased sediment loads and degradation of the Bighorn River are not expected to be significant (see Section 4.3.2). In summary, it was determined that there would be unnoticeable effects on

sediment loads or water quality. Thus, it is anticipated that there would be no significant impact to the fish populations in the Bighorn River due to changes associated with the land conversion**.**

There is potential for individual fish, primarily young-of-the-year and downstream migrants, to be pulled into the water intake valves of the pumps that would be located in the Bighorn River. However, it is standard practice to equip intake valves associated with irrigation systems with screens to minimize the amount of debris and aquatic life that enters the system (V. Anderson, President SWWRC, pers. comm.).

4.6.3.2 Invertebrate Community

As with fisheries, there will be no anticipated net change in the amount of water in the Bighorn River and no significant impacts to the aquatic invertebrate community are anticipated.

4.6.4 Wetlands

Alternative 1 and 2

The connected action of crop production would not likely impact the existing fringe wetlands along the Bighorn River. The amount of water that will be utilized to irrigate the acres identified in Alternative 1 and 2 would diminish the Bighorn River existing flow rate approximately 25 cfs to 91 cfs during the irrigation season (see Table 4-1) (see Section 4.3.1). Additionally, it is not anticipated that any change in flooding out of the river bank would occur that might impact wetlands within the flood plain due to the activities associated with Alternative 1 and 2.

Both alternatives would require the installation of two pumps at the Bighorn River. It is estimated that 5 acres at each location would be disturbed during the installation of the pumps. The areas that would be disturbed during construction of the pump stations would over time revert back to near present conditions. Permanent structures that will be constructed to install and operate the pumps, such as access roads, culverts and pump stations will result in a permanent loss to wetlands that occur within the 5 acres. Wetlands that do occur at these two locations are limited to narrow fringe wetlands along the river. Once installed, the operation of these pumps would not result in any continued disturbance to existing fringe wetlands.

Wetlands that have been identified within the project area were all within the boundaries of Alternative 1 (Table 4-5). No wetlands occurred within the Alternative 2 boundaries. Direct impacts to these wetlands would not occur as the wetlands are outside of the identified irrigable land. Indirect impacts to these wetlands would potentially result from changes in runoff patterns, contaminants in the runoff, and migration of chemicals utilized in crop production. However, chemicals and pesticides utilized in crop production are not expected to result in a significant impact to the return flow (see Section 4.3.2); therefore, it is not anticipated that these chemicals will impact the wetlands. Activities associated with the reclamation of high saline soils could potentially result in selenium accumulation in wetlands (see Section 4.2.2).

Table 4-5. Wetlands affected within Alternative 1 or Alternative 2 boundaries.

Wetland Type	Wetland Number	Alternative 1 (acres)	Alternative 2 (acres)
Palustrine forested	4b	0.85	0
Palustrine scrub-shrub	2	0.52	0
	3a	0.06	0
	3b	0.06	0
	3e	0.1	0
	5a	0.81	0
	5b	1.36	0
		Total = 2.91	Total = 0
Palustrine emergent	1	1.94	0
	3c	0.82	0
	3d	0.02	0
	3f	0.35	0
	4a	0.01	0
	6	0.67	0
		Total = 3.81	Total = 0

4.6.5 Special Status Species

4.6.5.1 USFWS Threatened, Endangered, and Sensitive Species

4.6.5.1.1 Bald eagle

Alternative 1 and 2

There are no known winter concentrations of bald eagles in the vicinity of the proposed project area; however bald eagle sightings in the area all occurred during the winter. Crop production activities generally do not occur within winter months; therefore, the potential to displace foraging and roosting activities of the wintering populations is not likely to occur. Additionally there is suitable habitat throughout the Bighorn Basin and the bald eagle population has been increasing over the last 20 years. It is expected that bald eagles would continue to use the project area as wintering habitat and would likely increase in numbers over time.

4.6.5.1.2 Black-footed ferret

Alternative 1 and 2

No impacts to black-footed ferret are expected because they are unlikely to occur in the area due to lack of habitat.

4.6.5.1.3 Ute ladies'-tresses

Alternative 1 and 2

No Ute ladies’-tresses were located in the project area and none of the wetlands found were considered suitable habitat for Ute ladies’-tresses (WEST 2005). Therefore, it is unlikely that either of the alternatives would result in impacts to Ute ladies’-tresses.

4.6.5.1.4 Greater sage-grouse

Alternative 1 and 2

No sage grouse leks were documented within the land proposed for conveyance and the habitat on the site is not considered conducive to nesting due to poor ground cover and sagebrush density conditions. No impacts to sage grouse leks or nesting are expected from either alternative.

4.6.5.2 Migratory Birds

Alternative 1 and 2

Conversion of native vegetation into irrigated cropland would result in the loss of approximately 9,300 acres of Wyoming big sagebrush habitat for birds in the area. The conversion from a sagebrush community to agriculture would eliminate potential nesting and perching sites that a shrub dominated plant community offers migratory birds. This loss of the sagebrush community represents approximately 0.62 % of the available Wyoming big sagebrush plant community in the Bighorn Basin and would not likely result in a significant impact to the bird population of the area.

Studies have shown that mountain plovers will occupy agricultural fields for several months (Shackford and Leslie 1995, Young and Good 2000) during the nesting season and are presumed to be breeding. The conversion from Wyoming big sagebrush to cropland associated with Alternative 1 and Alternative 2 will not likely result in a negative impact to the mountain plover.

Nesting opportunities in the project area for golden eagles are limited to trees along the Bighorn River. The land transfer and the subsequent conversion to cropland are not anticipated to result in the removal of existing trees along the river corridor. Therefore, potential nesting sites for golden eagles will not be altered. Foraging opportunities for golden eagles are less clear and may increase or decrease depending on the type of agriculture practiced and its impact on the small mammal populations of the area.

4.6.5.3 BLM Sensitive Species

Alternative 1 and 2

The BLM sensitive species that have been documented in the project area or within the region consist mainly of bird species, plus long-eared myotis and white-tailed prairie dog. The conversion from Wyoming big sagebrush to irrigated cropland would result in the loss of potential nesting and perching sites for these species. This loss of the sagebrush community represents approximately 0.62% of the available Wyoming big sagebrush plant community in the Bighorn Basin, and would not likely result in a significant impact to the populations of these bird species. Ferruginous hawks occur in sagebrush vegetation types in the Bighorn Basin but nesting opportunities are limited and no nests were found in the project area. Foraging opportunities for ferruginous hawk may increase if the project results in an increase in the small mammal populations of the area. Sage grouse are not expected to occur in the project area and no impacts from the project are anticipated. Long-billed curlews may occupy nearby agricultural lands particularly during migration. Use of the project area may increase following the conversion from shrub community to crop land. Yellow-billed cuckoo could occupy habitat along the Bighorn River, but are not expected to be affected by the project.

Two white-tailed prairie dog colonies occur within the project area (Map 3-13). One of the colonies within the project area occurs within the boundary of Alternative 2 and would be destroyed due to tilling and planting activities associated with the connected action. The remaining colony within the project area does not occur on or near the area that would be converted to cropland, therefore it is anticipated that it would not be affected by the proposed actions. Long-eared myotis are believed to primarily occupy forest vegetation types and could

potentially occur along the Bighorn River riparian corridor. It is not expected that they would be affected by the project.

One BLM sensitive plant species, persistent sepal yellowcress, has the potential to occur along the Bighorn River within the project area. If the plant occurs within the areas where construction will occur for the installation of the pumps and associated infrastructure needs, then there is the potential for loss of individuals. Persistent sepal yellowcress that may occur between the two diversion points or downstream from the project area are not likely to experience any negative impact as the project is not anticipated to result in a measurable effect to the stream flow in the Bighorn River (see Section 4.3.1 and 4.6.3.1)

4.7 LAND USE

Alternative 1 and 2

The primary land uses of the project area are grazing and recreation administered through the BLM. Both alternatives would result in the conversion of public land into private land to be utilized for crop production, thus reducing the public use of the project area for grazing and recreation. Currently, there are 968,000 acres of public land in the GCRPA. The conversion of 16,050 (Alternative 1) or 11,576 (Alternative 2) acres from public to private land would be approximately 2% and 1%, respectively, of the existing public land in the GCRPA. Although these percentages seem small, the local population would notice the reduced access to public land, primarily for hunting.

There are six grazing allotments that would be affected by the conversion of land ownership. Three of the six allotments, Individual, Sixmile, and Alamo Creek, are primarily contained within the Alternative 1 and 2 boundaries. The conversion of native land to cropland would considerably reduce the viability of these areas as grazing allotments (Table 4-6). Only portions of the remaining three allotments, East Fivemile, Tenmile, and West Fivemile, would be affected by either Alternative 1 or 2 (Table 4-6). These three grazing allotments could be utilized as grazing allotments on the remaining portions, but with a reduced animal unit month (AUM). Currently, these allotments provide 200 AUMs.

Table 4-6. Grazing allotments affected by Alternative 1 and Alternative 2.

Allotment	Allotment Size (acres)	Alternative 1		Alternative 2	
		acres affected	percent affected	acres affected	percent affected
Individual	1854.04	1718	92.66%	1393	75.13%
Sixmile	2008.87	1736	86.42%	1404	69.89%
Alamo Creek	594.64	466	78.37%	160	26.91%
East Fivemile	4861.19	1903	39.15%	1490	30.65%
Tenmile	25262.21	9025	35.73%	6958	27.54%
West Fivemile	15964.28	969	6.07%	30	0.19%

Any transfer of land to the WID would be made so as to protect the valid existing rights of the holders of current authorizations. In the project area, this consists primarily of ROW. There is one Recreation and Public Purposes lease in the area for a landfill, however it is inactive and the landfill was closed in 1988. There are also several oil and gas leases, some currently producing.

Since the minerals would remain in Federal ownership, rights under the leases would not be affected and they would be managed post-transfer under the BLM's procedures related to split-estate lands.

Existing ROW holders (Appendix H) would be offered the following options at the time of any land transfer:

- Maintain the ROW under the current terms and conditions, including expiration date. The patent would be issued "Subject To" the ROW, and the patentee would succeed to the interest of the United States.
- Negotiate an easement with the patentee that would become effective prior to the time of patent issuance.
- Submit an application to the BLM to amend the ROW to a term of perpetuity (30 years for Mineral Leasing Act (MLA) grants, and in perpetuity for Federal Land Policy and Management Act (FLPMA) grants.)
- Submit an application to the BLM to amend the ROW to a perpetual easement (30-year term for MLA grants, and in perpetuity for FLPMA grants.)

4.8 SOCIOECONOMICS

4.8.1 Population and Employment

Alternative 1

This alternative would have a modest positive impact on area employment and population. Construction of a water delivery system for the irrigable land would create some new jobs. Approximately 35 construction workers would be employed for a period of six months, and 15 of the 35 jobs would last another six months (V. Anderson, SWWRC, pers. comm.). However, these employment opportunities are unlikely to have any significant impacts upon area population. As shown in Table 3-13, there are over 800 workers in the local construction workforce, and the project would probably be built using local labor without the need to import workers or their families.

Irrigation of project lands would increase employment opportunities in several sectors of the local economy. A 1998 study by the University of Wyoming College of Agriculture estimated that the Westside Irrigation Project, as then envisioned, would support up to 216 additional local jobs (University of Wyoming 1998). That estimate was based on an assumption that the project would bring 17,000 acres of land under irrigation. Scaling that estimate to the 9,300 acre irrigable land base in Alternative 1 and 2 results in an estimated 118 new jobs in the local economy.

Most of those new jobs would be available to area residents that are either unemployed or under employed and would have no significant impact upon long-term population trends in the area. For example, in 2004 there were 435 individuals on the unemployment rolls and seeking work in the two-county area, and an unknown number of additional workers that are underemployed in their present jobs (State of Wyoming 2006b). Although unemployment rolls may shrink in the future as Wyoming's energy economy continues to grow, it is doubtful that new jobs in

agriculture and related sectors would trigger significant immigration because of relative low wage rates. The primary population impact associated with this alternative is likely to be a slowing in the trend of population decreases that Worland has experienced in recent decades.

Alternative 2
The primary difference between Alternative 1 and Alternative 2 is that the latter would leave 4,474 acres of non-irrigable land in BLM grazing allotments and management for wildlife habitat rather than in WID ownership. This distinction between the alternatives would have no significant effect on local population or employment.

The transfer of 11,576 acres to the WID would result in population and employment impacts that are very similar to those for the Proposed Action Alternative. The irrigation project would cover the same acreage, and the same number of construction workers would be required to build it. In the long run, about 118 new jobs would be created in the local economy as a result of increased crop production. The primary population impact associated with these new jobs would likely be a slowing in the trend of population decreases that Worland has experienced in recent decades.

4.8.2 Income

Alternative 1
The 1998 University of Wyoming study estimated that the Westside Project, as then envisioned, would significantly increase local labor earnings. The project description at that time involved irrigating 17,000 acres. That additional agricultural activity would have put an estimated $4.9 million in earnings into the local economy each year. Alternative 1 would transfer 16,050 acres to the WID, but only 9,300 have been proposed for irrigation. Scaling the University of Wyoming earnings estimate to the 9,300 irrigated acres in Alternative 1, and updating to current dollars, gives an estimated $3.23 million in annual earnings that would be generated by the project. These earnings reflect both direct employment in irrigated agriculture on project lands and indirect employment in other sectors of the local economy. Averaged between the projected 118 new jobs that would be created by the project, the earnings are the equivalent of an average annual wage rate of about $27,400 (2004 dollars).

The annual earnings projected at $3.23 million generated by this project would be slightly lower than estimated because of the offsetting effects removing 16,050 acres of grazing land out of production. This effect is not expected to be significant, however, because the ability of the lands to produce forage under current conditions is limited by the arid climate and lack of irrigation water.

Alternative 2
Alternative 2 would result in income effects similar to Alternative 1. The primary difference between Alternative 1 and Alternative 2 is that the latter would leave 4,474 acres of non-irrigable land in BLM grazing allotments and management for wildlife habitat, rather than in WID ownership. This distinction between the alternatives would have no significant effect on local earnings.

Thus, approximately $3.23 million in earnings would be generated by the project annually, spread across 118 new jobs with an average annual wage of $27,400 (2004 dollars). As with Alternative 1, the annual earnings would be slightly lower than estimated above because of the offsetting effects of taking acreage out of grazing allotments. Alternative 2 would result in 4,474 acres remaining in grazing allotments rather than being converted to WID ownership, thus the offset to annual earnings would be slightly less for Alternative 2. The effect of grazing allotments offsetting the estimated annual earnings is not expected to be significant, however, because the ability of the lands to produce forage under current conditions is limited by the arid climate and lack of irrigation water.

4.8.3 Irrigated Agriculture

Alternative 1

Under this alternative, 16,050 acres of federal land would be conveyed to the WID with the goal of eventually developing 9,300 acres of irrigated cropland using water pumped from the Bighorn River and applied using low-pressure center pivot sprinklers. Development of this irrigated land would increase the 140,000 irrigated acre land base in the two-county area by almost seven percent. Although cropping patterns for the 9,300 acres of irrigable land have not been finalized, the project proponent has indicated that crops will likely include some combination of alfalfa, corn, barley, and sugar beets. Table 3-15 in Section 3.8.3 shows that with above average management, such a cropping rotation could generate gross returns of up to $646 per acre annually. Total gross returns of the irrigation of these 9,300 acres could approach $6.0 million annually, which represents an almost 10 percent increase in the annual value of all agricultural production in the two-county area.

The economic and financial viability of developing newly irrigated acreage using water pumped from the Bighorn River centers on whether irrigators would generate enough income after production expenses to repay costs associated with land acquisition, water delivery systems, and on-farm irrigation systems. Production expense estimates for the lands proposed for development were derived from crop enterprise budgets prepared by the University of Idaho for center pivot crop production in south central and southeastern Idaho (University of Idaho 2001a, University of Idaho 2001b). Cropping patterns, yields, and irrigation systems in these areas were deemed to be the most representative of conditions that might be expected in the project area (Table 4-7). Cropping percentage estimates are based upon University of Wyoming studies, while the production cost estimates are based upon the Idaho data (Table 4-6). University of Wyoming studies were not used for production cost estimates because they assume non-center pivot irrigation. The current production cost estimates are updated to 2004 dollars using production costs indices for Wyoming published by the Wyoming Agricultural Statistics Service (Wyoming Agricultural Statistics Service 2005).

Table 4-7. Center pivot production cost estimates.

Crop	Cropping Percentage[1]	Estimated Production Costs Per Acre (2001)	Estimated Current Production Costs Per Acre (2004)
Alfalfa	12.6	$ 278.38	$ 306.22
Corn for Grain	10.8	345.32	379.85
Corn Silage	10.8	429.52	472.47
Malting Barley	31.7	232.25	255.48
Sugar Beets	29.9	732.32	805.55
Total/Weighted Average	95.8%	$ 411.35	$ 452.48

[1]Percentages do not add to 100.0 because some lands are newly seeded to alfalfa each year and non-productive. Amortized production costs for these lands are included in the alfalfa production cost estimate.

The results in Table 4-7 show an estimated overall average production cost of $452 per acre. This figure does not include any expenses associated with land, water delivery, or irrigation system acquisitions. It does, however, include all other materials and equipment expenses, as well as labor and management charges for an owner-operator and any needed hired help. The $452 per acre production cost estimate is $194 per acre less than estimated gross returns of $646 per acre. This net return would be available to reduce project costs associated with land acquisition, water delivery and on-farm irrigation systems, as well as ongoing pumping costs.

The WID's intent is to develop the irrigated lands with financial assistance from the WWDC. According to current guidelines, the WWDC would not provide financial assistance for land acquisition or on-farm irrigation systems, but might provide up to a 67 percent grant for a water delivery system. The remaining 33 percent of this cost could be financed over 20 years at four percent interest. The financial implications of a WWDC funded project to irrigate the lands are summarized in Table 4-8.

Table 4-8. Alternative 1 costs* and returns.

Item (Per Acre)	Washakie County	Big Horn County
Irrigable Land Acquisition Cost **	$200	$200
Land Leveling and Irrigation System Cost	1,100	1,100
Water Delivery System Cost	1,256	1,464
Local Investment Per Acre	**2,556**	**2,764**
Annual WWDC Debt Service (20 yrs. @ 4%)	92	108
Annual Private Debt Service (20 yrs. @ 7%)	123	123
Annual Pumping Cost	71	60
Annual Cost Per Acre	**286**	**291**
Annual Return Per Acre	**194**	**194**
Net Return to Land and Water	**(92)**	**(97)**

*All cost estimates except land acquisition were developed by States West Water Resources (2006a and 2006b). Land acquisition cost estimate was provided by Roger Bower of the Wyoming Business Council.
** Cost of irrigable land includes repayment to the WID for purchasing 16,500 acres and the associated AUMs.

Estimates of the capital costs that irrigators would incur to farm WID land are given in the first four rows of Table 4-8. Raw land acquisition would cost about $200 per acre, and land preparation and sprinkler installation would add another $1,100 per acre to project costs. The land acquisition cost estimate is based upon the assumption that the 9,300 acres of irrigable land would be acquired at an average cost of $125 per acre, while the 6,750 acres of non-irrigable

land would cost $100 per acre, for a total cost of $1.8 million. In order for the WID to recover the cost of purchasing the non-irrigable land, the total cost of the 16,050 acres would be spread across the 9,300 acres of irrigable land when sold to irrigators. This would result in an average cost of $200 per irrigable acre for irrigators.

Total water delivery system costs are $3,805 per acre for the Washakie County part of the system, and $4,435 per acre for the Big Horn County portion of the system. The water delivery system cost estimates in Table 4-8 assume a 67 percent WWDC grant, leaving 33 percent of the cost to be borne locally. Total local investment requirements for irrigators would range from $2,556 per acre for the Big Horn County portion of the project to $2,764 per acre for the Washakie County portion.

Assuming that water delivery system costs would be financed by the WWDC over 20 years at four percent interest, and land and irrigation system costs would be financed at market rates, the resulting annual costs range $286 to $291 per acre, which exceeds the estimated annual return of $194 per acre. These results indicate that the financial viability of the project is dependent upon either obtaining more favorable funding terms than are currently available from the WWDC or private sources, or possibly diversifying into higher valued specialty crops that could support the capital and operating costs of the project.

The WID has considered applying for Pick-Sloan electric power that is supplied by the Bureau of Reclamation at less than market rates. An assessment of the financial ramifications of Pick-Sloan power reduces the negative return on a per acre bases by approximately 30-35% (Table 4-9). Although acquisition of Pick-Sloan power would improve project finances, financial viability would still require more favorable funding terms or alternative crops.

Table 4-9. Alternative 1 costs and returns with Pick-Sloan Power.

Item (Per Acre)	Washakie County	Big Horn County
Irrigable Land Acquisition Cost	$200	$200
Land Leveling and Irrigation System Cost	1,100	1,100
Water Delivery System Cost	1,256	1,464
Local Investment Per Acre	**2,556**	**2,764**
Annual WWDC Debt Service (20 yrs. @ 4%)	92	108
Annual Private Debt Service (20 yrs. @ 7%)	123	123
Annual Pumping Cost	40	30
Annual Cost Per Acre	**255**	**261**
Annual Return Per Acre	**194**	**194**
Net Return to Land and Water	**(61)**	**(67)**

Alternative 2

The irrigation impacts of transferring 11,576 acres of primarily irrigable land to the WID would be very similar to those for Alternative 1 because the amount of irrigated acreage would be the same for both alternatives. One difference is that with Alternative 2 the WID's financial commitment for non-irrigable land acquisition would be smaller (2,276 acres). Assuming an average price of $100 per acre for non-irrigable land and $125 for irrigable land (9,300 acres), the WID's financial commitment for land acquisition would be $1.4 million under this alternative. The WID would spread the total cost for land acquisition across the 9,300 acres resulting in an average acre price of $150 for irrigable land.

The lower land costs associated with this alternative translate into an average annual savings of about $5 per acre when amortized over 20 years at 7 percent interest (Table 4-10 and Table 4-11). Although Alternative 2 would improve project finances relative to Alternative 1, financial viability would still require more favorable funding terms or alternative crops.

Table 4-10. Alternative 2 costs* and returns.

Item (Per Acre)	Washakie County	Big Horn County
Irrigable Land Acquisition Cost**	$150	$150
Land Leveling and Irrigation System Cost	1,100	1,100
Water Delivery System Cost	1,256	1,464
Local Investment Per Acre	**2,481**	**2,689**
Annual WWDC Debt Service (20 yrs. @ 4%)	92	108
Annual Private Debt Service (20 yrs. @ 7%)	118	118
Annual Pumping Cost	71	60
Annual Cost Per Acre	**281**	**286**
Annual Return Per Acre	**194**	**194**
Net Return to Land and Water	**(87)**	**(92)**

*All cost estimates except land acquisition were developed by States West Water Resources (2006a and 2006b). Land acquisition cost estimate was provided by Roger Bower of the Wyoming Business Council.
** Cost of irrigable land includes repayment to the WID for purchasing 11,576 acres and the associated AUMs.

Table 4-11. Alternative 2 costs and returns with Pick-Sloan Power.

Item (Per Acre)	Washakie County	Big Horn County
Irrigable Land Acquisition Cost	$150	$150
Land Leveling and Irrigation System Cost	1,100	1,100
Water Delivery System Cost	1,256	1,464
Local Investment Per Acre	**2,481**	**2,689**
Annual WWDC Debt Service (20 yrs. @ 4%)	92	108
Annual Private Debt Service (20 yrs. @ 7%)	118	118
Annual Pumping Cost	40	30
Annual Cost Per Acre	**250**	**256**
Annual Return Per Acre	**194**	**194**
Net Return to Land and Water	**(56)**	**(62)**

4.8.4 Local Infrastructure

4.8.4.1 Housing

Alternative 1 and 2

No significant impact upon local housing prices or availability is expected to result from Alternative 1 or 2. Most of the relatively small peak construction workforce of 35 persons for the water delivery system would be hired locally and not require housing. A few non-local workers could be accommodated in local motels or apartments.

Full irrigation development would eventually create 125 new jobs, but most of these jobs would be available to currently unemployed or underemployed residents and would not significantly affect area population or housing demand. The project would inject $3.43 million in new annual earnings into the area, which could have some upward pressure on housing prices. Housing

prices are currently below statewide averages, however, and any such pressures would not be significant.

4.8.4.2 Transportation

Alternative 1

Construction of a water delivery system for the project would result in a minor temporary traffic increase near the project site. At peak, 35 construction workers would be commuting from nearby communities and rural areas, and there would be some truck traffic hauling construction materials and equipment to and from the site. Most of this activity would be along State Highway 433, which is lightly traveled and the increased activity should pose no significant safety problems.

Long-term transportation impacts include the need for access roads to farmhouses and the irrigable land, along with some local highway traffic increases associated with increased farming activity. Access roads could vary from primitive four-wheel drive paths to irrigated fields to graded all-season roads to farmhouses. Assuming two miles of access road would be needed for each 640-parcel means that approximately 30 miles of new rural roads would need to be constructed. Primitive access paths could be developed with little expense, while all season road construction would cost an estimated $50,000 per mile (SWWRC, pers. comm.). Assuming that 30 miles of new roads would be needed means that an additional $1.5 million in expenses for road construction could be incurred under this alternative.

Alternative 2

Alternative 2 would also result in a minor temporary traffic increase near the project site. At peak, 35 construction workers would be commuting from nearby communities and rural areas, and there would be some truck traffic hauling construction materials and equipment to and from the site. Most of this activity would be along State Highway 433, which is lightly traveled and the increased activity should pose no significant safely problems.

Long-term transportation impacts for this alternative would be similar to those for Alternative 1, although almost 5,000 fewer acres would be transferred to private ownership. The reduction in acres would be land that is non-irrigable, thus access roads would not be needed, and therefore Alternative 1 and 2 would require the same amount of access roads.

4.8.4.3 Local Public Services

Alternative 1 and 2

No significant impacts upon local public services would be expected to result from the construction or operation of Alternative 1 or 2. Worland’s population has been declining for some time, leaving excess capacity in most public services. Furthermore, the area has not experienced impacts from the recent energy boom that have affected other parts of the state. While most project jobs would be filled locally, there is enough excess capacity in most public services to handle a small influx of workers if needed (Baker 2006). One exception may be electric power. Additional facilities may be needed to supply electric power for pumping water to project lands. There should be adequate lead-time to address this need, however, given the lengthy permitting process involved in developing newly irrigated lands.

4.8.5 Public Revenues

Alternative 1

Alternative 1 would have a short-term positive impact on sales and use tax revenues. The water delivery system for this alternative is estimated to cost $38.2 million dollars (States West 2006a). Of this amount, about 35 percent, or $13.4 million would be spent for materials and equipment subject to sales and use taxes. The on-farm irrigation systems for the 9,300 acres of irrigable land would cost another $10.2 million, of which about 55 percent, or $5.6 million, would be subject to sales and use taxes. Sales and use tax rates are currently five percent in Big Horn and Washakie Counties. The $19 million in materials and equipment for the project would thus generate about $950,000 in additional sales and use tax revenue during project construction. The total additional revenue would be even higher because some unknown portion of construction worker payroll would also be spent on taxable items. This additional revenue would be shared among governmental entities based upon formulas established by the State of Wyoming.

Alternative 1 would have a long-term positive impact on sales and use taxes in the area due to increased purchases of equipment, materials, and supplies for farming an additional 9,300 acres of land. Purchased materials alone, such as fertilizer, pesticides, and seed, can range from $25 per acre for alfalfa to over $200 per acre for sugar beets. Assuming an average expenditure of $75 per acre on taxable items means that sales tax revenues would increase by about $35,000 annually. Some of the additional money spent for farm labor would also be captured in the form of sales and use taxes.

Another long-term positive impact due to Alternative 1 would be an increase in property tax revenues. In fiscal year 2003, there were 158,900 acres of irrigated land on local tax roles in the area with an assessed valuation of $13.5 million. Assuming an average valuation for 9,300 acres of irrigable land in this alternative means that total irrigated land valuations would increase to $14.3 million. Although 6,700 acres of rangeland would also be added to property tax roles with this alternative, the revenue impacts of this addition would not be significant. The average assessed valuation of rangeland in the area is less than $5 per acre (State of Wyoming 2003).

Transferring 16,050 acres of BLM land to private ownership would have a minor negative impact upon grazing lease revenues received by the BLM as a direct loss from the AUM's being retired. It would also negatively affect payments in lieu of taxes (PLIT) for federal land that the federal government makes to state and local governments. Estimates developed by the BLM indicate that foregone grazing lease revenues would average roughly $3,200 annually, while PLIT payments would be reduced by about $9,000 annually (D. Ogaard, BLM, pers. comm.).

Alternative 2

Alternative 2 would have almost the same public revenue impacts as Alternative 1. That is, the $19 million in materials and equipment for the project would generate about $950,000 in additional sales and use tax revenue during project construction. The total additional revenue would be even higher because some unknown portion of construction worker payroll would also be spent on taxable items. This additional revenue would be shared among governmental entities based upon formulas established by the State of Wyoming.

Alternative 2 would also have a long-term positive impact on sales and use taxes in the area due to increased purchases of equipment, materials, and supplies for farming an additional 9,300 acres of land. Purchased materials alone, such as fertilizer, pesticides, and seed, can range from $25 per acre for alfalfa to over $200 per acre for sugar beets. Assuming an average expenditure of $75 per acre on taxable items means that sales tax revenues would increase by about $35,000 annually. Some of the additional money spent for farm labor would also be captured in the form of sales and use taxes.

The assessed valuation of irrigated land in the area would increase from about $13.5 to $14.3 million, and the assessed valuation of rangeland would remain largely unchanged because there would be no transfer of rangeland ownership under this alternative.

Transferring 11,576 acres of BLM land to private ownership would have a minor negative impact upon grazing lease revenues received by the BLM as a direct loss from the AUM's being retired. It would also negatively affect PLIT for federal land that the federal government makes to state and local governments. Estimates developed by the BLM indicate that foregone grazing lease revenues would average roughly $2,300 annually, while PLIT payments would be reduced by about $6,300 annually (D. Ogaard, BLM, pers. comm.).

4.9 CULTURAL AND PALEONTOLOGICAL RESOURCES

4.9.1 Cultural Resources

Alternative 1 and 2

Under both alternatives the transfer of ownership from public to private represents an irretrievable resource commitment. Once the land is transferred, the significant cultural resources will not be afforded any protection by the federal government. In order to mitigate this adverse effect, a data recovery plan will be designed and implemented to mitigate the impact caused by the land transfer.

Alternative 1

Alternative 1 would result in a total of 22 cultural sites potentially being affected by the land conveyance. The sites potentially impacted include five sites the Northern Arapaho tribe consider important and need to be protected along with the Big Horn Canal. The other 17 sites are 14 prehistoric sites, two historic sites, and one site with prehistoric and historic components. A total of 26.5 percent of the acreage associated with Alternative 1 falls within the high or very high sensitivity zone.

Alternative 2

Alternative 2 would potentially adversely affect a total of eight cultural sites as a result of the connected actions associated with the land conveyance. These sites include three sites the Northern Arapaho tribe consider important and need to be protected along with the Big Horn Canal. The other sites include four prehistoric sites and one site with historic and prehistoric components. The locations of these sites are within the area to be converted to croplands, thus the sites would be destroyed due to the tilling and equipment operation. A total of 23.7 percent of the acreage associated with Alternative 2 falls within the high or very high sensitivity zone.

4.9.2 Paleontological Resources

Alternative 1 and 2
Under both alternatives the transfer of ownership from public to private represents an irretrievable resource commitment. Once the land is transferred, paleontological resources will not be afforded any protection by the federal government. Additionally, there would be a loss of paleontological research opportunities in areas that are converted into cropland.

Alternative 1
Alternative 1 proposes to transfer approximately 9,735 acres of Willwood Formation surface exposure. The land that is converted to cropland would directly impact this resource through farming practices. Those areas not converted and are not involved with infrastructure development may be affected in regards to the fossil record found in the Willwood Formation by unauthorized collecting or physical damage due to unregulated activities.

Alternative 2
Alternative 2 proposes to transfer approximately 6,105 acres of Willwood Formation surface exposure. The entire 6,105 acres potentially would be directly impacted by their conversion to cropland through tilling, planting and harvesting.

4.10 RECREATIONAL RESOURCES

4.10.1 Non-Consumptive Use

Two critical recreation resource values associated with this area; remoteness and scenery, would be altered due to either Alternative 1 or 2. Currently, users of the area experience less than five human encounters per day. The number of human encounters will likely increase due to the increase of farming activity in the area. The current natural state is influenced by the existing oil field and nearby agriculture. The conversion to more agricultural fields associated with Alternative 1 or 2 in the area will further reduce the natural state and alter the viewing of natural state scenery. The degree of impact will be the same for either alternative as the amount of irrigable land does not differ. Thus, users pursuing an area that is remote and unaffected will lose this area as a possible option.

4.10.1 Fishing

No significant impacts to the fish population in the Bighorn River are anticipated and therefore, it is anticipated that neither Alternative 1 nor 2 would alter the current recreational fishing that occurs along the Bighorn River.

Access to the Bighorn River will not be altered by this project. The only activity associated with the project that will occur adjacent to the Bighorn River is the creation of two diversion points. It is estimated that the area required for constructing the pumps and necessary facilities will be five acres for each diversion location. Therefore, the project will only affect an estimated ten acres along the Bighorn River in relation to public access for fishing and hunting.

4.10.2 Hunting

The current local pronghorn antelope and mule deer herd sizes would potentially be reduced over time due to the loss of crucial winter/yearlong range as a result of the connected actions associated with the conveyance of land. The hunting area for pronghorn antelope and mule deer that includes the project area consists of 720,000 and 620,000 acres, respectively, and provides seasonal range for pronghorn antelope, mule deer and white tailed deer according to information from the WGFD. The amount of animals that are actually harvested off the project area is unknown, but is considered very small. Therefore, based on the size of the hunt area and the number of animals that utilize that area, it is anticipated that the land transfer and conversion to cropland would not have a significant impact on big game hunting activities around the project area.

The land transfer and connected actions will likely result in an increase in upland game bird-hunting opportunities as species such as ring-necked pheasant and Hungarian partridge invade the new croplands. The availability of this opportunity to the general public will be based largely on the willingness of the policies of the WID and the new landowners to accommodate hunting.

4.11 VISUAL/AESTHETICS

Alternative 1 and 2

There would be a visual difference on the landscape as a result of Alternative 1 and 2 due to the conversion of native vegetation to cropland. The change would result in an extension of the already existing cropland along the Bighorn River corridor, which borders the land proposed for conveyance on the east. Therefore, the visual change would not be a drastic change or considered obtrusive or out of the ordinary, thus it is anticipated that there would be no significant impact as a result of the conversion to cropland.

4.12 HAZARDOUS MATERIAL

Alternative 1 and 2

The conversion from native vegetation to irrigated cropland would result in an increase in use of hazardous materials associated with crop production. These materials include pesticides, herbicides, fuels, lubricants, coolants, and miscellaneous hazardous materials such as solvents and paints. The increased use of these materials presents a potential for spills or misuse to create localized hazardous conditions.

4.13 ADVERSE EFFECTS WHICH CANNOT BE AVOIDED

Implementation of the land conveyance and the connected action of converting the native vegetation to cropland would result in some unavoidable adverse effects. Implementation of mitigation measures would be unsuccessful in minimizing these effects.

The land that would be conveyed would be removed from Federal ownership and eventually sold to private individuals.

Crop production would result in microclimate and nutrient cycling changes in the vicinity of the agricultural fields.

The cultivation of previously untilled soils would result in changes in the soil carbon inventories.

The land that would be converted into cropland would be graded and leveled from the current topography.

Air quality of the region is considered good, but tilling activities would have minor and temporary effect on air quality.

Noise levels would be increased due to the additional use of farm equipment and vehicle traffic in the area.

Both alternatives would convert native vegetation into irrigated cropland. This would result in permanent loss of 9,300 acres of Wyoming big sagebrush for both alternatives.

Trenching along roads for the irrigation pipeline would result in a disturbed area that is likely to revegetate with invasive plant species.

The conversion would result in a change in the appearance of the landscape by increasing the amount of cropland present adjacent to the Bighorn River corridor.

Pronghorn antelope and mule deer would lose 3.5% and 1.6%, respectively, of available crucial winter/yearlong habitat due to the conversion of native vegetation into irrigated cropland.

Wildlife would lose the Wyoming big sagebrush community and associated values such as perching and cover sites, nesting sites, and foraging opportunities.

Some small mammals, reptiles, and passerines will be destroyed due to tilling and farming practices.

Wetlands within the project area would be indirectly impacted by the alteration of the surface runoff and potential contaminants.

A white-tailed prairie dog colony would be destroyed due to tilling of the soil.

Loss of BLM land ownership would result in the loss of grazing rights for six grazing allotments equaling 200 AUMs.

Cultural sites have been identified that would be lost to public ownership and/or adversely impacted by the connected action.

A loss to the public of paleontological resources would occur, either due to the loss of research opportunities or conveyance to private ownership.

The project will displace recreational users currently using this area for a remote and solitudinous experience.

4.14 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

A permanent loss or reduction of a resource, for at least the foreseeable future, is considered an irreversible and irretrievable commitment of resources. This project would result in the loss of federal public land. This loss of public land would result in the loss of six grazing allotments administered by the BLM. Additionally, cultural resource sites and paleontological resources would lose their current protection from unauthorized collecting. The connected actions would result in the conversion of native vegetation to cropland. The conversion would result in the loss of Wyoming big sagebrush plant community and the associated habitats for wildlife species, specifically crucial winter range for pronghorn antelope and mule deer. The irrigated fields would alter the recreation value of the area and displace those users using the area for its primitive scenic settings for the feeling of remoteness and solitude. The conversion to cropland would also result in the destruction of cultural resource sites and paleontological resources within the irrigable land.

Chapter 5.0 -Mitigation

5.1 INTRODUCTION

The previous chapter described potential environmental consequences from implementing each of the alternatives, including the No Action Alternative. This chapter describes mitigation measures designed to offset adverse environmental impacts that may result from implementing either of the action alternatives. The chapter also discusses additional potential conservation measures the WID might take to further reduce the impacts of the transfer of federal lands to private ownership and the connected actions. The mitigation measures proposed to offset adverse impacts are those associated with the transfer of the land from public ownership to private ownership, or the BLM federal action. The potential conservation measures are those associated with the private action of conversion of the land to agricultural purposes. The measures associated with the WID's private actions are primarily land management recommendations to help offset impacts and are voluntary.

5.2 PRIMARY MITIGATION

Public Law 106-485 (November 9, 2000; 114 Stat. 2199), that directs the BLM to convey to the WID approximately 16,500 acres Public Lands located in Big Horn and Washakie Counties, Wyoming, and authorizes the proceeds from the sale to be held in a special account and used for acquisition of land and interests in land in the Worland BLM District that will benefit public recreation, public access, fish and wildlife habitat, or cultural resources. Based on this guidance, the acquisition of land is the primary mitigation measure proposed to offset identified adverse impacts from the BLM action.

Adverse environmental impacts identified in Chapter 4 associated with the transfer of the land include:

- land ownership would transfer from federal public land to private land;
- loss of Wyoming big sagebrush and riparian vegetation;
- loss of crucial winter range for pronghorn antelope and mule deer due to conversion of native habitat to cropland;
- loss of public land recreational opportunities such as hunting, hiking and wildlife watching due to conversion of public land to private ownership;
- impacts related to the visual changes due to the loss of public land and ultimate conversion to cropland from native vegetation;
- impacts to historic and prehistoric sites within the project area.

5.2.1 Land Ownership

Using the proceeds to acquire additional public lands would help offset the loss of public lands associated with this land transfer. Proceeds from the sale may be utilized for the acquisition of land and interests in land in the Worland District of the BLM in the State of Wyoming that will benefit public recreation, public access, fish and wildlife habitat, or cultural resources. It is unlikely that the proceeds from the sale would allow complete

replacement of all lands transferred; however, the functional values associated with public lands that are lost to the private ownership would be replaced at least partly by acquisition of additional public land.

5.2.2 Biological Resources

5.2.2.1 Vegetation

Alternative 1 would result in the maximum loss of native vegetation from federal protection while Alternative 2 transfers those lands suitable for irrigation to private ownership and reduces the amount of native plant community in the area that would be removed from BLM management. The loss of these plant communities could be partially alleviated by the acquisition of private lands with similar vegetation.

Additional mitigation of the impacts could be achieved if the BLM specifically manages the newly acquired lands to increase their functional value to the natural environment.

5.2.2.2 Wildlife

Conversion of the area from native habitat to cropland will result in the loss of approximately 3.5% of the crucial winter range available to the Fifteen Mile pronghorn antelope herd and approximately 1.6% of the crucial winter range of the Basin mule deer herd. Alternative 2, which would only transfer those lands suitable for irrigation to private ownership, would insure that a larger portion of the crucial winter range for both pronghorn and mule deer would remain under BLM management, primarily in the central portion of the WID where these ranges overlap. Pronghorn antelope would lose approximately 14.6% of the identified available parturition range as a result of the conversion to cropland.

Mitigation measures to offset the loss of the crucial winter range would include conversion to public ownership of other crucial winter range held in private ownership with revenue generated from the sale of the WID property. When possible, lands also providing parturition range would be purchased. While the purchase of private lands containing crucial and parturition habitat would not physically offset the lost acres, converting these acres to public ownership would provide long-term protection. In addition, the acquired lands could be managed to improve the functional value of the land as crucial winter and parturition range through land management strategies that improve wildlife habitat.

5.2.3 Cultural Resources

Under Alternative 1 and 2, 22 and 9 sites, respectively, may be adversely impacted by the land transfer. The potential adverse effects to sites with prehistoric and/or historic components can be mitigated by 1) excluding the properties from the land transfer, or 2) developing and implementing a data recovery plan prior to the transfer. Consultations with the Northern Arapaho should be undertaken to determine how to best protect the sites they regard as important. Pending consultations with the Shoshone-Bannock will also have to be taken into consideration once the consultations are completed.

In accordance with the cultural resource Programmatic Agreement (PA) regarding the land transfer, the BLM, prior to the transfer of any lands, will meet with the consulting and concurring parties to the PA and discuss treatment options available for the historic properties affected by the transfer, based on the final cultural resources report. Treatment options will include but not be limited to recovery of scientific information, retention in federal ownership, alternative site location, or other measures. There are nine cultural sites that have been identified for possible mitigation. Five of the nine sites are located on the edge of the preferred alternative and can possibly be avoided. The remaining four are located in the middle of the preferred alternative and are not easily avoided, therefore it is anticipated that recovery of scientific information will be required for these four sites. It is estimated that the cost of developing a data recovery plan, excavating the sites, laboratory analysis and report writing for the four sites as one project would be approximately $358,800. If the sites are recovered individually the estimated cost for each site would be approximately $128,000, resulting in a total for recovering all four sites of approximately $512,000.

Based on the results of the discussions regarding treatment options, the BLM will provide information to be incorporated into a Treatment Plan formulated by the WID. The Treatment Plan, as described in Item II of the PA, will address all historic properties for which effects are anticipated. The Treatment Plan will include, but not be limited to: specification of all historic properties and portions of historic properties to be affected by the project, including a description of the nature of the effects; a detailed description of the treatments proposed for historic properties eligible for the National Register with an explanation or rationale provided for the choice of the proposed treatments; an archaeological research design developed for those historic properties which are eligible for the National Register; a listing of all historic properties that will be affected by the project for which no further treatment is proposed, with a justification or rationale; and an explanation of the methods for involving the interested public in the data recovery, and for disseminating the results of the data recovery to the interested public.

5.2.4 Recreational Resources

The conversion of public lands to private ownership will result in the loss of public recreational opportunities such as non-consumptive uses and hunting. This impact would be mitigated by acquiring new public land or access rights to other lands for public recreation from the proceeds of the land sale.

5.3 POTENTIAL VOLUNTARY CONSERVATION MEASURES

The connected actions of the WID associated with conversion of the land from native rangeland to irrigated agriculture will also have adverse environmental impacts. Some adverse impacts identified may be avoided or reduced by implementing conservation practices for protecting resources or through land management practices associated with the land conversion. Impacts that may be offset by conservation or land management practices include:

- impacts from increased soil erosion due to grading of topography and water application;
- impacts from mass wasting of salts during reclamation of the high saline soils;
- impacts to roadside vegetation due to trenching;

- loss of individual small mammals, birds, and herpetofauna due to tilling and farming activities;
- loss of habitat for a variety of wildlife;
- impacts to seasonal ranges of big game;
- impacts to wetlands in close proximity of the project area; and
- impacts to recreational resource values.

5.3.1 Geology and Soils

Soil losses resulting from wind and water erosion, due to the conversion to cropland and associated activities, can be reduced through conservation measures recommended by the NRCS. These practices would ensure long-term sustainability of agriculture in the project area.

In areas with highly saline soils, soil treatment in some capacity would be necessary to insure adequate agricultural production. One option includes adequately flooding the area to leach salts to below the root zone. Addition of soil amendments such as gypsum or sulfuric acid is a common agricultural practice for soils with shallow, relatively impermeable clay layers within the root zone which inhibits the effectiveness of leaching efforts. In theory, soil mitigation strategies can be accomplished with minimal effects on the groundwater system or to downstream users by systematically leaching the salts down to a specific soil horizon. Technical assistance for determining appropriate and cost-effective soil management strategies may be requested of the Soil Conservation Service or the State Extension Service. A useful reference also includes a 1990 ASCE Manual (No. 71), “Agricultural Salinity Assessment and Management.”

Even with best management practices, it remains possible that leaching of salts in the area can affect the local groundwater system or result in salt loading to down-gradient lands and waters. Groundwater monitoring should be conducted prior to project development to establish baseline standards, with additional monitoring once agricultural production is in place to assess any adverse effects. Agricultural drains could be installed if problems develop.

5.3.2 Surface Hydrology

No measurable reduction in water volume in the Bighorn River is anticipated due to implementation of the WID project. However, Boysen Reservoir storage water is available which could be used to offset water quantity impacts such as instream flow requirements during years of extreme drought conditions.

5.3.3 Biological Resources

5.3.3.1 Vegetation

Maintenance of section corners outside the reach of the center pivot irrigation structures in native vegetation communities.

Reseeding disturbed areas, such as areas associated with pipeline construction, with native species.

5.3.3.2 Wildlife

Where fencing would be installed or needed around the WID, fencing recommendations of the WGFD could be employed to allow movement of pronghorn antelope and mule deer. Proper fence design would insure that big game animals may move through the property during periods of severe winter when access to crucial winter range is essential.

In most years under normal winter conditions, access to crucial winter range is not essential to the survival of individual animals which may over-winter on winter range or yearlong range. Acquisition and retirement of 200 AUMs from surrounding grazing allotments would allow habitat recovery from domestic livestock grazing and presumably provide additional forage for big game species.

The WID has indicated a further condition of the sale of land may include a requirement that all persons who purchase lands within the project area to indemnify and hold harmless the WGFD for any wildlife damage to crops, as long as big game populations do not exceed the WGFD's stated population objectives by more than 10 percent. While this action would not serve to offset losses of habitat or wildlife, it would reduce the financial burden on the WGFD to pay for the potential damage to standing crops such as alfalfa.

5.3.4 Aquatic Resources

5.3.4.1 Fisheries and Invertebrate Community

No measurable reduction in water volume in the Bighorn River is anticipated due to implementation of the WID project. However, Boysen Reservoir storage water is available which could be used to offset water quantity impacts such as instream flow requirements during years of extreme drought conditions.

5.3.5 Special Status Species

5.3.5.1 Migratory Birds

To the extent practical, removal of native vegetation from the site should be confined to the non-breeding season for bird species when loss of nests and young nestling birds would not occur.

5.3.5.2 BLM Sensitive Species

To the extent practical, removal of native vegetation from the site should be confined to the non-breeding season to minimize impacts to BLM sensitive bird species that may nest in sagebrush shrubland vegetation.

5.3.6 Recreational Resources

The transfer of public land to private ownership would result in the loss of public recreation opportunities. This impact could be offset by insuring that the WID or at least the non-farmed portions within the WID would remain open to public hunting under management programs of the WGFD such as the Walk-in Access or Hunter Management programs.

The creation of irrigated fields, access roads and facilities will reduce the remoteness and solitude that some recreational users desire. This impact could be slightly reduced by locating roads and facilities in close proximity of the agricultural fields.

Chapter 6.0 – Consultation and Coordination

6.1 INTRODUCTION

The NEPA process requires that all individuals, organizations, agencies or other entities interested in or potentially affected by the proposal be provided the opportunity to participate in the environmental analysis. The following chapter describes: the lead agencies in the NEPA process; the team responsible for preparation of the EIS; the scoping and issues identification employed in the NEPA process; and participating agencies, organizations, individuals, and others.

6.2 TEAM ORGANIZATION

An interdisciplinary team of consultants and government agencies was responsible for the preparation of the Westside Irrigation District Land Conveyance Project EIS. The BLM, Worland District, acted as the primary lead agency with the WWDO acting as a co-lead agencies for the NEPA process. WEST was the lead consultant to the BLM and the WWDO responsible for the preparation of the EIS. A team of consultants supervised by WEST aided in the EIS preparation.

6.2.1 BLM and WWDO Co-Lead Agencies

The land involved in the conveyance is part of the Worland District of the BLM, while the WWDO is providing the financial support and facilitating the project development and implementation under the state water development program. The primary objective of the WWDO in this project is to provide financial support for the NEPA process. Therefore, the involved agencies acted as co-lead for the NEPA process.

6.2.1.1 BLM Primary Lead Agency

The interdisciplinary Team members include the following individuals:

Don Ogaard	BLM, Project Manager, NEPA Compliance
Tim Stephens	Wildlife, Threatened & Endangered Species
Carol Sheaff	Realty
Chet Wheeless	Aquatic Biology, Fisheries
Mike Bies	Cultural Resources
Teryl Shryack	Range, Grazing
Karen Hepp	Vegetation, Special-status Plants
Steve Kiracofe	Soils, Hazmat
Andrew Tkach	Writer/Editor, Public Affairs

6.2.1.2 WWDO

Individuals in the WWDO who contributed to the EIS were:

Barry Lawrence	WWDO, Project Manager
Phil Ogle	River Basin Planning Administrator
Jon Wade	Deputy Director

6.2.2 WEST Consulting Team

WEST organized and managed an interdisciplinary team of experts in preparation of the EIS to provide expertise in areas of concern. Following is a list of preparers and the expertise they provided.

Consulting Team Members:

Western EcoSystems Technology, Inc. (WEST)

Dale Strickland	Team leader, agency liaison, project management, purpose and need, alternative analysis, document preparation and editing
David Young	Purpose and need, alternative analysis, wildlife, threatened and endangered species, mitigation, document preparation and editing
Gretchen Norman	Air quality, noise, visual/aesthetics, recreation, land use, hazardous materials, document preparation and editing
Kurt Flaig	Wetlands, vegetation
Victoria Poulton	Wildlife, fisheries, field surveys, mapping, digitizing
Jay Jeffrey	Fisheries, field surveys

Watts and Associates, Inc.

Gary Watts	Socioeconomics, recreation

States West Water Resources Corporation

Michael O'Grady	Water rights, alternative analysis
Victor Anderson	Alternative analysis, surface hydrology
Chris Jessen	Geology and soils, mineral resources, water quality, groundwater resources, alternative analysis, mapping

Cultural Resource Analysts, Inc.

Ted Hoefer	Project Manager
Christopher T. Hall	Field Director and report co-author
Randall Cooper	Assistant Field Director
Christina Kester-Tallman	Crew member and report co-author
Paul Pironti	Crew member
Matthew McMahon	Crew member
Marc Greenberg	Crew member and report co-author
Gabriel Frazier	Crew member
Kevin Downs	Crew member
Sandy McDaniel	Crew member
Pat Loucke	Crew member
Hanna Romes	Crew member

Western GeoArch Research

William Eckerle	Geoarchaeological analysis

6.3 SCOPING AND ISSUES IDENTIFICATION

6.3.1 Background on Scoping and Public Participation

The scoping process for the Westside Irrigation District Land Conveyance Project was conducted from July 19, 2004 to August 19, 2004 with open houses held in Worland and Basin on August 3 and 4, 2004, respectively. A scoping statement was mailed to 21 government offices, 9 elected officials, 9 Native American Tribes, and 4 public land users and user groups. A media release regarding the project was also sent to all the Bighorn Basin and many statewide print and electronic media outlets.

The scoping meetings were conducted in an open-house format at the BLM Worland Field Office and the Big Horn County Courthouse in Basin, Wyoming. Stations were created around the meeting room that presented information regarding the project including maps, potential alternatives, and identified potential issues. Representatives from the BLM, the WWDO, and the WEST consultant team were present at their respective stations to answer questions, accept comments, and encourage attendees to submit written comments.

Based on comments received during this period, the determination was made to prepare an EIS for the project. A Notice of Intent to prepare an EIS was published in the Federal Register on February 22, 2005 which reopened the scoping period extending the comment period to March 25, 2005. No additional scoping meetings were conducted and comments and information submitted during the original 2004 scoping process were considered and did not have to be resubmitted.

A total of ten comment letters were received during the two comment periods. Comments were received from four individuals, two organizations, and four agencies. Correspondence received is available for review in the Case File (located at the BLM Worland District Office) along with the scoping mailing record, and attendee lists from the public scoping meeting. Names and addresses of individuals may be redacted if the BLM received a request for privacy.

6.3.2 Identified Issues and Synopsis of Comments

The following issues and concerns organized by resource were identified through the scoping process. A scoping analysis report was prepared following the scoping meetings and is available for review (Case File).

Project Description

- General support for the proposed action
- General opposition to the proposed action
- Determine what lands are suitable for cultivation
- Restrictions on post-sale land uses

NEPA Process

- How will the potential post-sale land uses affect the analysis of impacts?
- Alternatives to the proposed action should be considered.

  - An alternative under which only lands suitable for cultivation would be conveyed should be considered.
  - An alternative which excludes high-resource-value land should be considered.
- Post-transfer mitigation should be required.
  - WID should fund a WG&FD position to monitor mitigation and development.
  - Loss of pronghorn antelope habitat could be mitigated by acquiring sheep allotments.
  - Wildlife-friendly farming techniques should be used.
- The EIS should describe how the sale proceeds will be used for mitigation.
  - The analysis should prioritize and describe the lands to be acquired.
  - Priority should be given to addressing access needs.

Environmental Resources

Physical Resources

Surface Water Resources

- There is a potential for adverse impacts to the Bighorn River, both in terms of water quality and quantity.
  - The analysis should consider the cumulative impact with oil and gas development, etc.
- There is a potential for impacts to downstream water users.
- A Section 404 permit may be required for the anticipated future development.

Mineral Resources

- The transfer could affect the development of other minerals, including oil and gas.

Biological Resources

Wildlife and Threatened and Endangered species (T&E)

- Changes in land use following transfer could cause impacts to wildlife.
  - The proposed transfer parcel contains pronghorn antelope parturition habitat and/or crucial winter habitat.
  - Migratory birds protected under the MBTA and the BGEPA, and particularly sensitive species such as the burrowing owl, long-billed curlew, mountain plover and sage grouse should be considered.
  - Reduced streamflow and entrapment/impingement could impact the Bighorn River fishery, in particular sauger, burbot, shovelnose sturgeon, sturgeon chub, plains minnow, and western silvery minnow.
- There is a potential for impacts to Threatened and Endangered and special-status species, including: bald eagles, black-footed ferrets, Ute ladies'-tresses, and persistent sepal yellowcress.
- There is a potential for impact to high-value wetland/riparian habitat.
  - Wetland/riparian habitat should be protected by fenced buffer strips.
- Any fences constructed should allow for wildlife passage.
  - Fences should be constructed to WGFD standards.
- Transfer to private ownership could result in increased cost to WGFD for wildlife damage claims.

Human Resources

Cultural and Paleontological Resources

- The potential for adverse effects to paleontological, cultural, and historic resources should be described.
- Native American Tribal Consultation is required.

Socioeconomics

- New land would allow the production of high-value crops, such as organic produce.
- Additional sugar beet production would help support the Wyoming Sugar facility.
- Additional cultivated acreage will cause losses to present growers by depressing prices.
- Economic feasibility should be analyzed.

Land Use

- Uniform Appraisal Standards for Federal Land Acquisition standards should be used to determine Fair Market Value.
- Fair Market Value should not be discounted by the costs of subdividing.

6.3.3 Agency Correspondence

Among comments received during the scoping process, the following letters from interested governmental agencies note concerns about compliance with statutes, regulations, or process. Copies of the agency letters are located in the Case File.

Wyoming Game and Fish Department	8/27/04
U.S. Army Corps of Engineers	8/16/04
U.S. Environmental Protection Agency	3/25/05
U.S. Fish and Wildlife Service	8/13/04

6.4 CONSULTATION AND COORDINATION

The Bureau of Reclamation and the Corps of Engineers were invited by the lead agencies to participate in the NEPA process, however, they declined. There was no additional consultation or coordination outside of the scoping process with additional agencies by the lead agencies. The WEST consulting team did confer with various local, state, and federal agencies to obtain data, seek input, and clarify concerns. Any necessary permits or actions required by these agencies must be complied with separately.

6.4.1 Participating Agencies

The following agencies were provided a copy of this DEIS for review and comment:

State Agencies	Federal Agencies
Wyoming Department of Transportation	U.S. Fish and Wildlife Service
Wyoming State Planning Coordinator	U.S. Army Corps of Engineers
Wyoming State Engineer	U.S. Bureau of Reclamation

Wyoming Department of Environmental Quality
Wyoming Geological Survey
Wyoming Oil and Gas Conservation Commission
Wyoming Game and Fish Department
Wyoming Business Council
Wyoming Department of Agriculture
Wyoming Department of Revenue
Office of State Lands and Investments
State Trails Program
Wyoming Travel and Tourism
State Historic Preservation Officer

Local Agencies

City of Worland
Town of Basin
Town of Manderson
Big Horn County Commissioner
Washakie County Commissioner

Native American Tribes

Shoshone Business Council
Arapaho Business Council
Shoshone-Bannock Tribes
Ute Tribal Council
Crow Tribal Council
Northern Cheyenne Tribal Council
Oglala Sioux Tribal Council
Rosebud Sioux Tribal Council
Cheyenne River Sioux Tribal Council

Organizations

Western Land Exchange Project
Washakie Development Association

6.4.2 Contributing Individuals

A number of individuals contributed information pertinent to the preparation of this DEIS. Many of these individuals were contacted by phone and issues relevant to their expertise were discussed. Information obtained from individuals that was used in the DEIS is cited as a personal communication in the appropriate location in the text. The name, title, affiliation, and date of the communication are included in Chapter 7.0 References alphabetically by last name.

6.4.3 Elected Officials, Organizations, Businesses, and News Media

The DEIS was provided to local and state elected officials, organizations and interest groups from lists compiled by the lead agencies or which indicated an interest during scoping, and to individuals or businesses providing comments or known to be interested in the WID proposal. In addition to these lists, post cards announcing the availability of the DEIS, opportunities for public comment, and the length of the comment period were provided to local and Wyoming state-wide media.

Chapter 7.0 –References

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7.3 PERSONAL COMMUNICATIONS

Carl Anderson, Program Manager for Hazardous Waste Permitting and Corrective Action, Wyoming Department of Environmental Quality (WDEQ), September 26, 2006.

Victor Anderson, President, States West Water Resources Corporation, March 15, 2007.

Mike Bies, Archeologist, Bureau of Land Management (BLM), Worland, Wyoming, June 16, 2005.

Greg Meeker, Air Quality Division, Wyoming Department of Environmental Quality (WDEQ), September 25, 2006

Estes, Vernon, Secretary, Big Horn Canal Irrigation District, August 12, 2005.

Don Ogaard, Project Manager, Bureau of Land Management, September 25, 2006.

Joe Wildman, President, Westside Irrigation District, November 10, 2006.

APPENDIX A

PUBLIC LAW 106-485

Public Law 106-485
106th Congress

An Act

To direct the Secretary of the Interior to convey certain land under the jurisdiction of the Bureau of Land Management in Washakie County and Big Horn County, Wyoming, to the Westside Irrigation District, Wyoming, and for other purposes. <<NOTE: Nov. 9, 2000 - [S. 610]>>

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. CONVEYANCE.

(a) In General.--On completion of an environmental analysis under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.), the Secretary of the Interior, acting through the Director of the Bureau of Land Management (referred to in this Act as the ``Secretary''), shall convey to the Westside Irrigation District, Wyoming (referred to in this Act as ``Westside''), all right, title, and interest (excluding the mineral interest) of the United States in and to such portions of the Federal land in Big Horn County and Washakie County, Wyoming, described in subsection (c), as the district enters into an agreement with the Secretary to purchase.

(b) Price.--The price of the land conveyed under subsection (a) shall be equal to the appraised value of the land, as determined by the Secretary.

(c) Land Description.--

(1) In general.--The land referred to in subsection (a) is the approximately 16,500 acres of land in Big Horn County and Washakie County, Wyoming, as depicted on the map entitled ``Westside Project'' and dated May 9, 2000.

(2) Adjustment.-On agreement of the Secretary and Westside, acreage may be added to or subtracted from the land to be conveyed as necessary to satisfy any mitigation requirements under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.).

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(d) Use of Proceeds.--Proceeds of the sale of land under subsection (a) shall be deposited in a special account in the Treasury of the United States and shall be available to the Secretary of the Interior, without further Act of appropriation, for the acquisition of land and interests in land in the Worland District of the Bureau of Land Management in the State of Wyoming that will benefit public recreation, public access, fish and wildlife habitat, or cultural resources.

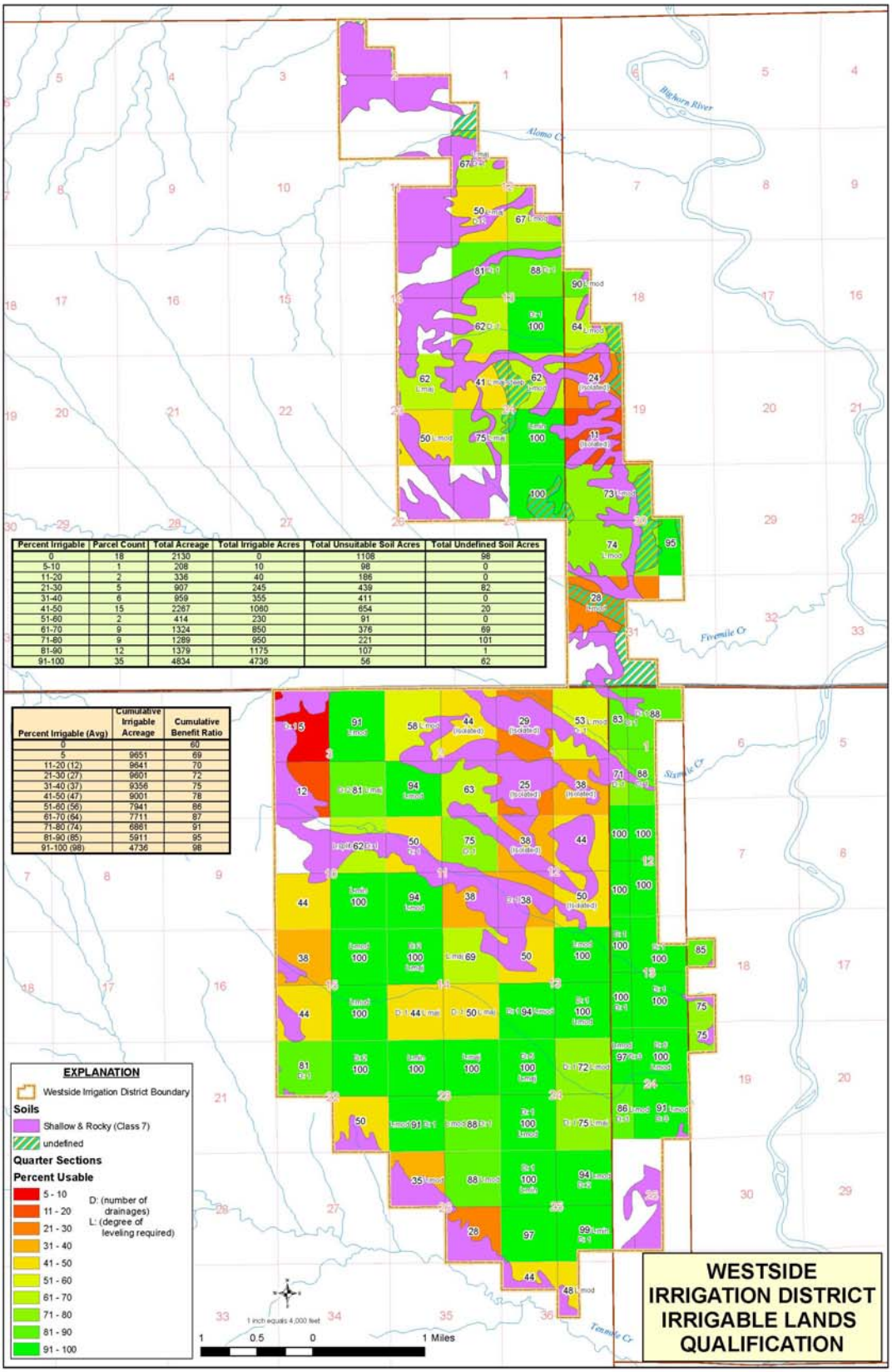
Approved November 9, 2000.

LEGISLATIVE HISTORY--S. 610:

SENATE REPORTS: No. 106-313 (Comm. on Energy and Natural Resources).
CONGRESSIONAL RECORD, Vol. 146 (2000):
July 27, considered and passed Senate.
Oct. 23, considered and passed House.

APPENDIX B

IRRIGABLE SOILS MAP



Percent Irrigable	Parcel Count	Total Acreage	Total Irrigable Acres	Total Unsuitable Soil Acres	Total Undefined Soil Acres
0	18	2130	0	1108	98
5-10	1	208	10	98	0
11-20	2	336	40	186	0
21-30	5	907	245	439	82
31-40	6	959	355	411	0
41-50	15	2267	1060	654	20
51-60	2	414	230	91	0
61-70	9	1324	850	376	69
71-80	9	1289	950	221	101
81-90	12	1379	1175	107	1
91-100	35	4834	4736	56	62

Percent Irrigable (Avg)	Cumulative Irrigable Acreage	Cumulative Benefit Ratio
0		60
5	9651	69
11-20 (12)	9841	70
21-30 (27)	9601	72
31-40 (37)	9356	75
41-50 (47)	9001	78
51-60 (56)	7941	86
61-70 (64)	7711	87
71-80 (74)	6861	91
81-90 (85)	5911	95
91-100 (98)	4736	98

APPENDIX C

SOIL REPORTS

Selected reports generated by the NRCS databases are included in this appendix. A general description of each report and its contents follows:

Component Legend Report: This report provides soil series details for each map unit including percent composition and slope (high, low, and representative value (RV)).

Classification of the Soils Report: This report specifies the Family or higher taxonomic classification of each soil series.

Physical Properties of the Soils Report: This report provides representative ranges of values for certain physical properties of each soil series at various depths. Properties include sand/silt/clay percentages, moisture bulk density, permeability, water capacity, linear extensibility, percent organic matter, water erosion factors (Kw=water erosion factor including rock fragments, Kf=water erosion factor, T=water erosion tolerance in tons/acre/year), and wind erosion factors (Wind Erodibility Groups predetermine the Wind Erodibility Index; see the domain characterization following the table in the Appendix).

Chemical Properties of the Soils Report: This report provides representative ranges of values for certain chemical properties of each soil series at various depths. Properties include cation exchange capacity, pH, percent calcium carbonate, percent gypsum, salinity, and SAR (Sodium Adsorption Ratio).

Water Management Report: This report provides the top five limiting features of each soil series that are likely to be encountered in the development of pond reservoir areas, embankments, dikes and levees, and aquifer-fed excavated ponds. The limiting features are rated from 0 to 1 according to the degree of likelihood of encountering that limitation, “1” being “very likely.”

RUSLE Related Attributes Report: This report assembles soil characteristics that are pertinent to the Revised Universal Soil Loss Equation (RUSLE). RUSLE is a quantitative procedure for estimating soil loss. More information can be found at http://www.iwr.msu.edu/rusle/ .

Prime Farmland Report: This report reveals the two soils (Washakie County only) that are considered “prime farmland” if irrigated.

Component Legend

Big Horn County Area, Wyoming

Map Unit Symbol and Map Unit Name	% Comp-osition	Component	Component Kind	Slope		
				Low	RV	High
43A: LOSTWELLS CLAY LOAM, 0 TO 3 PERCENT SLOPES	85	LOSTWELLS	Series	0	2	3
45AB: LOSTWELLS-YOUNGSTON SOILS, WET, 0 TO 6 PERCENT SLOPES	35	LOSTWELLS, wet	Series	0	3	6
	35	YOUNGSTON, wet	Series	0	3	6
67AC: UFFENS SILTY CLAY LOAM, 0 TO 10 PERCENT SLOPES	85	UFFENS	Series	0	4	8
102: BADLAND	90	BADLAND	Miscellaneous area	1	50	99
315BD: PREATORSON-WORLAND-WILLWOOD ASSOCIATION, STEEP	30	PREATORSON	Series	2	16	30
	25	WORLAND	Series	3	17	30
	20	WILLWOOD	Series	0	5	10
317: MUDRAY VARIANT-MUFF-BRIBUTTE COMPLEX, 0 TO 10 PERCENT SLOPES	40	MUDRAY VARIANT	Variant	2	6	10
	25	MUFF	Series	3	7	10
	15	BRIBUTTE	Series	0	5	10
351AC: LOSTWELLS CLAY LOAM, ALKALI, 0 TO 10 PERCENT SLOPES	85	LOSTWELLS, ALKALI	Series	0	5	10
367AC: RAIRDENT-UFFENS LOAMS, 0 TO 10 PERCENT SLOPES	60	RAIRDENT	Series	0	5	10
	35	UFFENS	Series	0	4	8
368A: LOSTWELLS-KINNEAR SANDY CLAY LOAMS, 0 TO 3 PERCENT SLOPES	40	KINNEAR	Series	0	2	3
	40	LOSTWELLS	Series	0	2	3
368AC: LOSTWELLS-KINNEAR SANDY CLAY LOAMS, 0 TO 10 PERCENT SLOPES	40	KINNEAR	Series	0	5	10
	40	LOSTWELLS	Series	0	5	10

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Component Legend - Continued

Big Horn County Area, Wyoming

Map Unit Symbol and Map Unit Name	% Comp-osition	Component	Component Kind	Slope		
				Low	RV	High
368B: LOSTWELLS-KINNEAR SANDY CLAY LOAMS, 3 TO 6 PERCENT SLOPES	40	KINNEAR	Series	3	5	6
	40	LOSTWELLS	Series	3	5	6
371A: GREYBULL-PERSAYO CLAY LOAMS, 0 TO 3 PERCENT SLOPES	50	GREYBULL	Series	0	2	3
	25	PERSAYO	Series	2	3	3
371AD: GREYBULL-PERSAYO ASSOCIATION, ROLLING	50	GREYBULL	Series	0	15	30
	30	PERSAYO	Series	2	16	30
372CD: WORLAND-PERSAYO COMPLEX, 2 TO 45 PERCENT SLOPES	45	WORLAND	Series	6	18	30
	30	PERSAYO	Series	6	26	45
409A: GLENTON-BAROID SANDY LOAMS, WET, 0 TO 3 PERCENT SLOPES	30	BAROID, WET	Series	0	2	3
	30	GLENTON, WET	Series	0	2	3
471CE: BRIBUTTE-PERSAYO-PAVILLION COMPLEX, 3 TO 60 PERCENT SLOPES	30	BRIBUTTE	Series	6	33	60
	30	PERSAYO	Series	6	26	45
	15	PAVILLION	Series	3	12	20
493BD: EMBLEM-GRIFFY-PREATORSON COMPLEX, 1 TO 30 PERCENT SLOPES	40	EMBLEM	Series	2	6	10
	25	GRIFFY	Series	2	9	15
	20	PREATORSON	Series	3	17	30
570AD: MUFF-UFFENS-PERSAYO COMPLEX, 0 TO 30 PERCENT SLOPES	35	MUFF	Series	0	5	10
	25	UFFENS	Series	0	4	8
	20	PERSAYO	Series	10	20	30

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Component Legend

Washakie County Area, Wyoming

Map Unit Symbol and Map Unit Name	% Comp-osition	Component	Component Kind	Slope		
				Low	RV	High
4: APRON-WORLAND SANDY LOAMS, 1 TO 12 PERCENT SLOPES	45	APRON	Series	1	6	10
	30	WORLAND	Series	1	7	12
14: CLIFTERSON-PERSAYO ASSOCIATION	45	CLIFTERSON	Series	2	16	30
	25	PERSAYO	Series	2	24	45
	10	LOSTWELLS	Series	1	6	10
19: FLUVAQUENTS	85	FLUVAQUENTS	Taxon above family	0	1	2
31: GRIFFY SANDY LOAM, 1 TO 10 PERCENT SLOPES	85	GRIFFY	Series	1	6	10
40: LOSTWELLS CLAY LOAM, 0 TO 3 PERCENT SLOPES	85	LOSTWELLS	Series	0	2	3
42: LOSTWELLS-YOUNGSTON COMPLEX, 1 TO 10 PERCENT SLOPES	40	LOSTWELLS	Series	1	6	10
	25	YOUNGSTON	Series	1	5	8
	10	UFFENS	Series	1	5	8
43: LOSTWELLS-YOUNGSTON COMPLEX, WET, 0 TO 6 PERCENT SLOPES	30	LOSTWELLS	Series	0	3	6
	30	YOUNGSTON	Series	0	3	6
	25	LOSTWELLS	Series	0	3	6
56: PERSAYO-MUFF-ROCK OUTCROP ASSOCIATION	50	PERSAYO	Series	2	4	6
	15	MUFF	Series	1	4	6
	10	ROCK OUTCROP	Miscellaneous area	---	---	---
57: PERSAYO-ROCK OUTCROP ASSOCIATION	40	PERSAYO	Series	15	28	40
	40	ROCK OUTCROP	Miscellaneous area	---	---	---

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Component Legend - Continued

Washakie County Area, Wyoming

Map Unit Symbol and Map Unit Name	% Comp-osition	Component	Component Kind	Slope		
				Low	RV	High
71: UFFENS-RAIRDENT COMPLEX, 1 TO 10 PERCENT SLOPES	40	UFFENS	Series	1	5	8
	30	RAIRDENT	Series	1	6	10
	10	GRIFFY	Series	1	6	10
82: YOUNGSTON SILTY CLAY LOAM, 0 TO 3 PERCENT SLOPES	85	YOUNGSTON	Series	0	1	3
84: YOUNGSTON-UFFENS-LOSTWELLS COMPLEX, 1 TO 10 PERCENT SLOPES	40	YOUNGSTON	Series	0	4	8
	25	UFFENS	Series	1	5	8
	15	LOSTWELLS	Series	1	6	10

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Table Q1. - Classification of the Soils

Big Horn County Area, Wyoming

An asterisk following the soil name indicates a taxadjunct to the series.

Soil Name	Family or Higher Taxonomic Classification
BAROID, WET	Sandy, mixed, mesic Typic Torrifluvents
BRIBUTTE	Clayey, montmorillonitic (calcareous), mesic, shallow Typic Torriorthents
EMBLEM	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Calciorthids
GLENTON, WET	Coarse-loamy, mixed (calcareous), mesic Typic Torrifluvents
GREYBULL	Fine-loamy, mixed (calcareous), mesic Typic Torriorthents
GRIFFY	Fine-loamy, mixed, mesic Typic Haplargids
KINNEAR	Fine-loamy, mixed, mesic Typic Camborthids
LOSTWELLS	Fine-loamy, mixed (calcareous), mesic Typic Torrifluvents
LOSTWELLS, ALKALI	Fine-loamy, mixed (calcareous), mesic Typic Torrifluvents
MUDRAY VARIANT	Clayey-skeletal, montmorillonitic, mesic Lithic Natrargids
MUFF	Fine-loamy, mixed, mesic Typic Natrargids
PAVILLION	Fine-loamy, mixed, mesic Typic Camborthids
PERSAYO	Loamy, mixed (calcareous), mesic, shallow Typic Torriorthents
PREATORSON	Loamy-skeletal, mixed, mesic Typic Haplargids
RAIRDENT	Fine-loamy, mixed, mesic Cambic Gypsiorthids
UFFENS	Fine-loamy, mixed, mesic Typic Natrargids
WILLWOOD	Sandy-skeletal, mixed, mesic Typic Torriorthents
WORLAND	Coarse-loamy, mixed (calcareous), mesic Typic Torriorthents
YOUNGSTON	Fine-loamy, mixed (calcareous), mesic Typic Torrifluvents

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Table Q1. - Classification of the Soils

Washakie County Area, Wyoming

An asterisk following the soil name indicates a taxadjunct to the series.

Soil Name	Family or Higher Taxonomic Classification
APRON	Coarse-loamy, mixed (calcareous), mesic Typic Torriorthents
CLIFTERSON	Loamy-skeletal, mixed (calcareous), mesic Typic Torriorthents
GRIFFY	Fine-loamy, mixed, mesic Typic Haplargids
LOSTWELLS	Fine-loamy, mixed (calcareous), mesic Typic Torrifluvents
MUFF	Fine-loamy, mixed, mesic Typic Natrargids
PERSAYO	Loamy, mixed (calcareous), mesic, shallow Typic Torriorthents
RAIRDENT	Fine-loamy, mixed, mesic Cambic Gypsiorthids
UFFENS	Fine-loamy, mixed, mesic Typic Natrargids
WORLAND	Coarse-loamy, mixed (calcareous), mesic Typic Torriorthents
YOUNGSTON	Fine-loamy, mixed (calcareous), mesic Typic Torrifluvents

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Table J1b. - Physical Properties of the Soils

Big Horn County Area, Wyoming

Entries under "Erosion Factors--T" apply to the entire profile. Entries under "Wind Erodibility Group" and "Wind Erodibility Index" apply only to the surface layer. Absence of an entry indicates that data wer estimated.

Map Symbol and Soil Name	Depth	Sand	Silt	Clay	Moist Bulk Density	Permeability (Ksat)	Available Water Capacity	Linear Extensi-bility	Organic Matter	Erosion Factors			Wind Erodi-bility Group	Wind Erodi-bility Index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	In/Hr	In/In	Pct	Pct					
43A:														
LOSTWELLS	0-8	---	---	20-30	1.15-1.25	0.6-2	0.11-0.16	3.0-5.9	0.5-1.0	.32	.32	5	5	56
	8-60	---	---	20-30	1.25-1.40	0.6-2	0.13-0.16	3.0-5.9	0.0-0.5	.32	.32			
45AB:														
LOSTWELLS, wet	0-8	---	---	27-35	1.15-1.25	0.6-2	0.19-0.21	3.0-5.9	0.5-1.0	.32	.32	5	4L	86
	8-60	---	---	20-30	1.25-1.35	0.6-2	0.14-0.16	3.0-5.9	0.0-0.5	.37	.37			
YOUNGSTON, wet	0-9	---	---	27-35	1.10-1.20	0.6-2	0.19-0.21	3.0-5.9	0.5-1.0	.37	.37	5	4L	86
	9-60	---	---	18-35	1.20-1.30	0.2-0.6	0.19-0.21	3.0-5.9	0.0-0.5	.37	.37			
67AC:														
UFFENS	0-4	---	---	15-20	1.10-1.20	0.2-0.6	0.15-0.17	0.0-2.9	0.5-1.0	.49	.49	5	4L	86
	4-15	---	---	20-30	1.15-1.25	0.2-0.6	0.15-0.17	3.0-5.9	0.0-0.5	.24	.24			
	15-60	---	---	20-30	1.15-1.25	0.2-0.6	0.07-0.11	3.0-5.9	0.0-0.5	.24	.24			
102:														
BADLAND	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
315BD:														
PREATORSON	0-2	---	---	5-12	1.25-1.35	2-6	0.07-0.11	0.0-2.9	0.5-1.0	.15	.32	5	4	86
	2-11	---	---	18-35	1.25-1.40	0.6-2	0.03-0.05	3.0-6.0	0.5-1.0	.05	.32			
	11-60	---	---	18-35	1.25-1.40	0.6-2	0.04-0.06	3.0-6.0	0.0-0.5	.10	.32			
WORLAND	0-3	---	---	10-18	1.25-1.35	2-6	0.11-0.13	0.0-2.9	0.5-1.0	.24	.24	3	3	86
	3-32	---	---	10-18	1.35-1.50	2-6	0.11-0.13	0.0-2.9	0.0-0.5	.32	.32			
	32-42	---	---	---	---	---	---	---	---	---	---			
WILLWOOD	0-8	---	---	5-15	1.25-1.35	2-6	0.09-0.11	0.0-2.9	0.5-1.0	.10	.20	5	4	86
	8-60	---	---	2-8	1.45-1.60	6-20	0.03-0.05	0.0-2.9	0.0-0.5	.02	.15			

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Table J1b. - Physical Properties of the Soils - Continued

Big Horn County Area, Wyoming

Map Symbol and Soil Name	Depth	Sand	Silt	Clay	Moist Bulk Density	Permeability (Ksat)	Available Water Capacity	Linear Extensi-bility	Organic Matter	Erosion Factors			Wind Erodi-bility Group	Wind Erodi-bility Index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	In/Hr	In/In	Pct	Pct					
315BD:														
317:														
MUDRAY VARIANT	0-2	---	---	5-15	1.50-1.60	2-6	0.08-0.09	0.0-2.9	0.0-0.5	.28	.28	1	3	86
	2-15	---	---	30-40	1.20-1.35	0.001-0.06	0.09-0.13	3.0-5.9	0.0-0.5	.32	.32			
	15-19	---	---	---	---	0.0000	---	---	---	---	---			
MUFF	0-3	---	---	5-15	1.25-1.35	2-6	0.13-0.15	0.0-2.9	0.5-1.0	.32	.32	3	3	86
	3-24	---	---	20-35	1.20-1.35	0.06-0.2	0.04-0.16	3.0-5.9	0.0-0.5	.37	.37			
	24-37	---	---	20-30	1.25-1.40	0.2-0.6	0.12-0.14	3.0-5.9	0.0-0.5	.32	.32			
	37-47	---	---	---	---	---	---	---	---	---	---			
BRIBUTTE	0-3	---	---	35-40	1.10-1.20	0.06-0.2	0.10-0.14	6.0-8.9	0.5-1.0	.32	.32	2	4L	86
	3-12	---	---	35-60	1.20-1.30	0.06-0.2	0.10-0.14	9.0-12.0	0.0-0.5	.37	.37			
	12-22	---	---	---	---	---	---	---	---	---	---			
351AC:														
LOSTWELLS, ALKALI	0-3	---	---	27-35	1.20-1.40	0.06-0.2	0.15-0.17	3.0-5.9	0.5-1.0	.32	.32	5	4L	86
	3-60	---	---	18-35	1.40-1.55	0.6-2	0.10-0.14	3.0-5.9	0.0-0.5	.32	.32			
367AC:														
RAIRDENT	0-2	---	---	10-25	1.15-1.25	0.6-2	0.16-0.18	0.0-2.9	0.5-1.0	.32	.32	5	4L	86
	2-60	---	---	18-33	1.25-1.40	0.6-2	0.16-0.20	3.0-6.0	0.0-0.5	.32	.32			
UFFENS	0-4	---	---	15-20	1.10-1.20	0.2-0.6	0.15-0.17	0.0-2.9	0.5-1.0	.49	.49	5	4L	86
	4-15	---	---	20-30	1.15-1.25	0.2-0.6	0.15-0.17	3.0-5.9	0.0-0.5	.24	.24			
	15-60	---	---	20-30	1.15-1.25	0.2-0.6	0.07-0.11	3.0-5.9	0.0-0.5	.24	.24			
368A:														
KINNEAR	0-10	---	---	20-35	1.15-1.25	0.6-2	0.14-0.16	3.0-6.0	0.5-1.0	.32	.32	5	5	56
	10-60	---	---	15-27	1.25-1.35	0.6-2	0.14-0.16	0.0-2.9	0.0-0.5	.37	.37			

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Table J1b. - Physical Properties of the Soils - Continued

Big Horn County Area, Wyoming

Map Symbol and Soil Name	Depth	Sand	Silt	Clay	Moist Bulk Density	Permeability (Ksat)	Available Water Capacity	Linear Extensi-bility	Organic Matter	Erosion Factors Kw	Erosion Factors Kf	Erosion Factors T	Wind Erodi-bility Group	Wind Erodi-bility Index
	In	Pct	Pct	Pct	g/cc	In/Hr	In/In	Pct	Pct					
368A:														
LOSTWELLS	0-8	---	---	20-30	1.15-1.25	0.6-2	0.11-0.16	3.0-5.9	0.5-1.0	.32	.32	5	5	56
	8-60	---	---	20-30	1.25-1.40	0.6-2	0.13-0.16	3.0-5.9	0.0-0.5	.32	.32			
368AC:														
KINNEAR	0-10	---	---	20-35	1.15-1.25	0.6-2	0.14-0.16	3.0-6.0	0.5-1.0	.32	.32	5	5	56
	10-60	---	---	15-27	1.25-1.35	0.6-2	0.14-0.16	0.0-2.9	0.0-0.5	.37	.37			
LOSTWELLS	0-8	---	---	20-30	1.15-1.25	0.6-2	0.11-0.16	3.0-5.9	0.5-1.0	.32	.32	5	5	56
	8-60	---	---	20-30	1.25-1.40	0.6-2	0.13-0.16	3.0-5.9	0.0-0.5	.32	.32			
368B:														
KINNEAR	0-10	---	---	20-35	1.15-1.25	0.6-2	0.14-0.16	3.0-6.0	0.5-1.0	.32	.32	5	5	56
	10-60	---	---	15-27	1.25-1.35	0.6-2	0.14-0.16	0.0-2.9	0.0-0.5	.37	.37			
LOSTWELLS	0-8	---	---	20-30	1.15-1.25	0.6-2	0.11-0.16	3.0-5.9	0.5-1.0	.32	.32	5	5	56
	8-60	---	---	20-30	1.25-1.40	0.6-2	0.13-0.16	3.0-5.9	0.0-0.5	.32	.32			
371A:														
GREYBULL	0-10	---	---	27-35	1.15-1.25	0.2-0.6	0.19-0.21	3.0-5.9	0.5-1.0	.37	.37	3	4L	86
	10-21	---	---	27-35	1.25-1.35	0.2-0.6	0.19-0.21	3.0-5.9	0.0-0.5	.43	.43			
	21-31	---	---	---	---	---	---	---	---	---	---			
PERSAYO	0-1	---	---	27-35	1.35-1.45	0.2-0.6	0.15-0.17	3.0-5.9	0.5-1.0	.37	.37	2	4L	86
	1-10	---	---	20-35	1.25-1.35	0.2-0.6	0.17-0.19	3.0-5.9	0.0-0.5	.37	.37			
	10-20	---	---	---	---	0.06-0.2	---	---	---	---	---			
371AD:														
GREYBULL	0-10	---	---	27-35	1.15-1.25	0.2-0.6	0.19-0.21	3.0-5.9	0.5-1.0	.37	.37	3	4L	86
	10-21	---	---	27-35	1.25-1.35	0.2-0.6	0.19-0.21	3.0-5.9	0.0-0.5	.43	.43			
	21-31	---	---	---	---	---	---	---	---	---	---			

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Table J1b. - Physical Properties of the Soils - Continued

Big Horn County Area, Wyoming

Map Symbol and Soil Name	Depth	Sand	Silt	Clay	Moist Bulk Density	Permeability (Ksat)	Available Water Capacity	Linear Extensi-bility	Organic Matter	Erosion Factors			Wind Erodi-bility Group	Wind Erodi-bility Index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	In/Hr	In/In	Pct	Pct					
371AD:														
PERSAYO	0-1	---	---	27-35	1.35-1.45	0.2-0.6	0.15-0.17	3.0-5.9	0.5-1.0	.37	.37	2	4L	86
	1-10	---	---	20-35	1.25-1.35	0.2-0.6	0.17-0.19	3.0-5.9	0.0-0.5	.37	.37			
	10-20	---	---	---	---	0.06-0.2	---	---	---	---	---			
372CD:														
WORLAND	0-3	---	---	10-18	1.25-1.35	2-6	0.11-0.13	0.0-2.9	0.5-1.0	.24	.24	3	3	86
	3-32	---	---	10-18	1.35-1.50	2-6	0.11-0.13	0.0-2.9	0.0-0.5	.32	.32			
	32-42	---	---	---	---	---	---	---	---	---	---			
PERSAYO	0-2	---	---	27-35	1.35-1.45	0.2-0.6	0.15-0.17	3.0-5.9	0.5-1.0	.37	.37	2	4L	86
	2-12	---	---	20-35	1.25-1.35	0.2-0.6	0.17-0.19	3.0-5.9	0.0-0.5	.37	.37			
	12-22	---	---	---	---	---	---	---	---	---	---			
409A:														
BAROID, WET	0-2	---	---	5-15	1.25-1.35	2-6	0.05-0.07	0.0-2.9	0.5-1.0	.28	.28	5	3	86
	2-60	---	---	5-15	1.40-1.50	6-20	0.04-0.07	0.0-2.9	0.0-0.5	.28	.28			
GLENTON, WET	0-1	---	---	5-18	1.25-1.35	2-6	0.09-0.11	0.0-2.9	0.4-1.0	.24	.24	5	3	86
	1-60	---	---	5-18	1.30-1.50	2-6	0.09-0.11	0.0-2.9	0.0-0.5	.24	.24			
471CE:														
BRIBUTTE	0-2	---	---	35-60	1.10-1.20	0.06-0.2	0.10-0.14	9.0-12.0	0.5-1.0	.32	.32	2	4	86
	2-12	---	---	35-60	1.20-1.30	0.06-0.2	0.10-0.14	6.0-8.9	0.0-0.5	.37	.37			
	12-16	---	---	---	---	---	---	---	---	---	---			
PERSAYO	0-1	---	---	27-35	1.35-1.45	0.2-0.6	0.15-0.17	3.0-5.9	0.5-1.0	.37	.37	2	4L	86
	1-10	---	---	20-35	1.25-1.35	0.2-0.6	0.17-0.19	3.0-5.9	0.0-0.5	.37	.37			
	10-20	---	---	---	---	0.06-0.2	---	---	---	---	---			
PAVILLION	0-3	---	---	20-30	1.15-1.25	0.6-2	0.14-0.16	3.0-5.9	0.5-1.0	.32	.32	3	5	56
	3-27	---	---	20-35	1.25-1.35	0.6-2	0.14-0.16	3.0-5.9	0.0-0.5	.37	.37			
	27-37	---	---	---	---	---	---	---	---	---	---			

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Table J1b. - Physical Properties of the Soils - Continued

Big Horn County Area, Wyoming

Map Symbol and Soil Name	Depth	Sand	Silt	Clay	Moist Bulk Density	Permeability (Ksat)	Available Water Capacity	Linear Extensi-bility	Organic Matter	Erosion Factors			Wind Erodi-bility Group	Wind Erodi-bility Index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	In/Hr	In/In	Pct	Pct					
471CE:														
493BD:														
EMBLEM	0-3	---	---	5-15	1.25-1.35	2-6	0.10-0.13	0.0-2.9	0.5-1.0	.28	.28	4	3	86
	3-20	---	---	20-27	1.25-1.35	0.6-2	0.16-0.18	0.0-2.9	0.0-0.5	.37	.37			
	20-60	---	---	0-10	1.45-1.55	20	0.03-0.05	0.0-2.9	0.0-0.5	.02	.10			
GRIFFY	0-2	---	---	5-15	1.25-1.35	2-6	0.11-0.13	0.0-2.9	0.5-1.0	.28	.28	5	3	86
	2-11	---	---	25-35	1.25-1.40	0.6-2	0.14-0.16	3.0-5.9	0.0-0.5	.15	.28			
	11-60	---	---	8-15	1.35-1.50	2-6	0.10-0.12	0.0-2.9	0.0-0.5	.15	.32			
PREATORSON	0-11	---	---	5-12	1.25-1.35	2-6	0.07-0.11	0.0-2.9	0.5-1.0	.15	.32	4	4	86
	11-20	---	---	18-35	1.25-1.40	0.6-2	0.04-0.06	3.0-6.0	0.0-0.5	.10	.32			
	20-60	---	---	0-5	1.45-1.60	20	0.02-0.03	0.0-2.9	0.0-0.5	.02	.15			
570AD:														
MUFF	0-3	---	---	5-15	1.25-1.35	0.6-2	0.13-0.15	0.0-2.9	0.5-1.0	.32	.32	3	3	86
	3-24	---	---	20-35	1.20-1.35	0.06-0.2	0.04-0.16	3.0-5.9	0.0-0.5	.37	.37			
	24-37	---	---	20-30	1.25-1.40	0.2-0.6	0.12-0.14	3.0-5.9	0.0-0.5	.32	.32			
	37-47	---	---	---	---	---	---	---	---	---	---			
UFFENS	0-4	---	---	15-20	1.10-1.20	0.2-0.6	0.15-0.17	0.0-2.9	0.5-1.0	.49	.49	5	4L	86
	4-15	---	---	20-30	1.15-1.25	0.2-0.6	0.15-0.17	3.0-5.9	0.0-0.5	.24	.24			
	15-60	---	---	20-30	1.15-1.25	0.2-0.6	0.07-0.11	3.0-5.9	0.0-0.5	.24	.24			
PERSAYO	0-1	---	---	27-35	1.35-1.45	0.2-0.6	0.15-0.17	3.0-5.9	0.5-1.0	.37	.37	2	4L	86
	1-10	---	---	20-35	1.25-1.35	0.2-0.6	0.17-0.19	3.0-5.9	0.0-0.5	.37	.37			
	10-20	---	---	---	---	---	---	---	---	---	---			

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Table J1b. - Physical Properties of the Soils

Washakie County Area, Wyoming

Entries under "Erosion Factors--T" apply to the entire profile. Entries under "Wind Erodibility Group" and "Wind Erodibility Index" apply only to the surface layer. Absence of an entry indicates that data wer estimated.

Map Symbol and Soil Name	Depth	Sand	Silt	Clay	Moist Bulk Density	Permeability (Ksat)	Available Water Capacity	Linear Extensi-bility	Organic Matter	Erosion Factors			Wind Erodi-bility Group	Wind Erodi-bility Index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	In/Hr	In/In	Pct	Pct					
4:														
APRON	0-3	---	---	5-18	1.25-1.35	2-6	0.12-0.14	0.0-2.9	0.5-1.0	.28	.28	5	3	86
	3-60	---	---	5-18	1.35-1.45	2-6	0.12-0.14	0.0-2.9	0.0-0.5	.32	.32			
WORLAND	0-3	---	---	10-18	1.25-1.35	2-6	0.11-0.13	0.0-2.9	0.5-1.0	.24	.24	3	3	86
	3-36	---	---	10-18	1.35-1.50	2-6	0.11-0.13	0.0-2.9	0.0-0.5	.32	.32			
	36-40	---	---	---	---	---	---	---	0.0-0.5	---	---			
14:														
CLIFTERSON	0-5	---	---	20-27	1.15-1.25	2-6	0.09-0.13	0.0-2.9	0.5-1.0	.20	.32	5	6	48
	5-60	---	---	18-28	1.25-1.40	0.6-6	0.04-0.09	3.0-6.0	0.5-1.0	.10	.32			
PERSAYO	0-1	---	---	27-35	1.35-1.45	0.2-0.6	0.15-0.17	3.0-5.9	0.5-1.0	.37	.37	2	4L	86
	1-13	---	---	28-35	1.25-1.35	0.2-0.6	0.17-0.19	3.0-5.9	0.0-0.5	.37	.37			
	13-23	---	---	---	---	---	---	---	---	---	---			
LOSTWELLS	0-3	---	---	20-30	1.15-1.25	0.6-2	0.11-0.16	3.0-5.9	0.5-1.0	.32	.32	5	5	56
	3-60	---	---	20-30	1.25-1.40	0.6-2	0.13-0.16	3.0-5.9	0.0-0.5	.32	.32			
19:														
FLUVAQUENTS	---	---	---	---	---	---	---	---	---	---	---	---	---	---
31:														
GRIFFY	0-3	---	---	5-18	1.25-1.35	2-6	0.11-0.13	0.0-2.9	0.5-1.0	.28	.28	5	3	86
	3-14	---	---	25-35	1.25-1.40	0.6-2	0.14-0.16	3.0-5.9	0.0-0.5	.20	.28			
	14-60	---	---	8-20	1.40-1.60	2-6	0.10-0.12	0.0-2.9	0.0-0.5	.24	.24			
40:														

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Table J1b. - Physical Properties of the Soils - Continued

Washakie County Area, Wyoming

Map Symbol and Soil Name	Depth	Sand	Silt	Clay	Moist Bulk Density	Permeability (Ksat)	Available Water Capacity	Linear Extensi-bility	Organic Matter	Erosion Factors			Wind Erodi-bility Group	Wind Erodi-bility Index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	In/Hr	In/In	Pct	Pct					
40:														
LOSTWELLS	0-8	---	---	27-35	1.15-1.25	0.2-0.6	0.19-0.21	3.0-5.9	0.5-1.0	.32	.32	5	4L	86
	8-60	---	---	20-30	1.25-1.40	0.6-2	0.13-0.16	3.0-5.9	0.0-0.5	.32	.32			
42:														
LOSTWELLS	0-3	---	---	20-30	1.15-1.25	0.6-2	0.11-0.16	3.0-5.9	0.5-1.0	.32	.32	5	5	56
	3-60	---	---	20-30	1.25-1.40	0.6-2	0.13-0.16	3.0-5.9	0.0-0.5	.32	.32			
YOUNGSTON	0-3	---	---	27-35	1.25-1.35	0.2-0.6	0.19-0.21	3.0-5.9	0.5-1.0	.37	.37	5	4L	86
	3-60	---	---	18-35	1.25-1.35	0.2-0.6	0.19-0.21	3.0-5.9	0.5-1.0	.37	.37			
UFFENS	0-1	---	---	15-25	1.20-1.30	0.6-2	0.13-0.16	0.0-2.9	0.5-1.0	.28	.28	5	4L	86
	1-22	---	---	25-35	1.20-1.30	0.2-0.6	0.05-0.10	3.0-5.9	0.5-1.0	.32	.32			
	22-60	---	---	28-35	1.20-1.35	0.2-0.6	0.05-0.10	3.0-5.9	0.0-0.5	.28	.28			
43:														
LOSTWELLS	0-8	---	---	27-35	1.15-1.25	0.6-2	0.19-0.21	3.0-5.9	0.5-1.0	.32	.32	5	4L	86
	8-60	---	---	20-30	1.25-1.35	0.6-2	0.14-0.16	3.0-5.9	0.0-0.5	.37	.37			
YOUNGSTON	0-8	---	---	27-35	1.10-1.20	0.2-0.6	0.19-0.21	3.0-5.9	0.5-1.0	.37	.37	5	4L	86
	8-60	---	---	18-35	1.20-1.30	0.2-0.6	0.19-0.21	3.0-5.9	0.0-0.5	.37	.37			
LOSTWELLS	0-3	---	---	20-30	1.15-1.25	0.6-2	0.11-0.16	3.0-5.9	0.5-1.0	.32	.32	5	5	56
	3-60	---	---	20-30	1.25-1.40	0.6-2	0.13-0.16	3.0-5.9	0.0-0.5	.32	.32			
56:														
PERSAYO	0-1	---	---	27-35	1.35-1.45	0.2-0.6	0.15-0.17	3.0-5.9	0.5-1.0	.37	.37	2	4L	86
	1-13	---	---	28-35	1.25-1.35	0.2-0.6	0.17-0.19	3.0-5.9	0.0-0.5	.37	.37			
	13-23	---	---	---	---	---	---	---	---	---	---			

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Table J1b. - Physical Properties of the Soils - Continued

Washakie County Area, Wyoming

Map Symbol and Soil Name	Depth	Sand	Silt	Clay	Moist Bulk Density	Permeability (Ksat)	Available Water Capacity	Linear Extensi-bility	Organic Matter	Erosion Factors			Wind Erodi-bility Group	Wind Erodi-bility Index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	In/Hr	In/In	Pct	Pct					
56:														
MUFF	0-5	---	---	5-15	1.25-1.35	0.6-2	0.13-0.15	0.0-2.9	0.5-1.0	.24	.24	3	3	86
	5-30	---	---	20-30	1.25-1.40	0.2-0.6	0.14-0.16	3.0-5.9	0.0-0.5	.32	.32			
	30-34	---	---	---	---	---	---	---	---	---	---			
ROCK OUTCROP	---	---	---	---	---	---	---	---	---	---	---	---	---	---
57:														
PERSAYO	0-1	---	---	27-35	1.35-1.45	0.2-0.6	0.15-0.17	3.0-5.9	0.5-1.0	.37	.37	2	4L	86
	1-13	---	---	28-35	1.25-1.35	0.2-0.6	0.17-0.19	3.0-5.9	0.0-0.5	.37	.37			
	13-23	---	---	---	---	---	---	---	---	---	---			
ROCK OUTCROP	---	---	---	---	---	---	---	---	---	---	---	---	---	---
71:														
UFFENS	0-1	---	---	15-25	1.20-1.30	0.6-2	0.13-0.16	0.0-2.9	0.5-1.0	.28	.28	5	4L	86
	1-5	---	---	25-35	1.20-1.30	0.2-0.6	0.05-0.10	3.0-5.9	0.5-1.0	.32	.32			
	5-60	---	---	20-30	1.20-1.35	0.2-0.6	0.05-0.10	3.0-5.9	0.0-0.5	.28	.28			
RAIRDENT	0-2	---	---	10-18	1.25-1.35	2-6	0.13-0.15	0.0-2.9	0.5-1.0	.24	.24	4	3	86
	2-17	---	---	30-40	1.25-1.35	0.6-2	0.10-0.15	3.0-5.9	0.5-1.0	.20	.37			
	17-55	---	---	8-15	1.35-1.45	2-6	0.07-0.11	0.0-2.9	0.0-0.5	.15	.24			
	55-60	---	---	2-7	1.45-1.55	6-20	0.02-0.04	0.0-2.9	0.0-0.5	.05	.20			
GRIFFY	0-3	---	---	5-18	1.25-1.35	2-6	0.11-0.13	0.0-2.9	0.5-1.0	.28	.28	5	3	86
	3-14	---	---	25-35	1.25-1.40	0.6-2	0.14-0.16	3.0-5.9	0.0-0.5	.20	.28			
	14-60	---	---	8-20	1.40-1.60	2-6	0.07-0.12	0.0-2.9	0.0-0.5	.24	.24			
82:														
YOUNGSTON	0-9	---	---	27-35	1.25-1.35	0.2-0.6	0.19-0.21	3.0-5.9	0.5-1.0	.37	.37	5	4L	86
	9-60	---	---	18-35	1.25-1.35	0.2-0.6	0.19-0.21	3.0-5.9	0.5-1.0	.37	.37			

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Table J1b. - Physical Properties of the Soils - Continued

Washakie County Area, Wyoming

Map Symbol and Soil Name	Depth	Sand	Silt	Clay	Moist Bulk Density	Permeability (Ksat)	Available Water Capacity	Linear Extensi-bility	Organic Matter	Erosion Factors			Wind Erodi-bility Group	Wind Erodi-bility Index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	In/Hr	In/In	Pct	Pct					
82:														
84:														
YOUNGSTON	0-4	---	---	27-35	1.25-1.35	0.2-0.6	0.19-0.21	3.0-5.9	0.5-1.0	.37	.37	5	4L	86
	4-60	---	---	18-30	1.25-1.35	0.2-0.6	0.19-0.21	0.0-3.0	0.5-1.0	.37	.37			
UFFENS	0-1	---	---	15-25	1.20-1.30	0.6-2	0.13-0.16	0.0-2.9	0.5-1.0	.28	.28	5	4L	86
	1-5	---	---	28-35	1.20-1.30	0.2-0.6	0.05-0.10	3.0-5.9	0.5-1.0	.32	.32			
	5-60	---	---	20-30	1.20-1.35	0.2-0.6	0.05-0.10	3.0-5.9	0.0-0.5	.28	.28			
LOSTWELLS	0-3	---	---	20-30	1.15-1.25	0.6-2	0.11-0.16	3.0-5.9	0.5-1.0	.32	.32	5	5	56
	3-60	---	---	20-30	1.25-1.40	0.6-2	0.13-0.16	3.0-5.9	0.0-0.5	.32	.32			

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Table J2. - Chemical Properties of the Soils

Big Horn County Area, Wyoming

Absence of an entry indicates that data were not estimated.

Map Symbol and Soil Name	Depth	Cation Exchange Capacity	Effective Cation Exchange Capacity	Soil Reaction	Calcium Carbon-ate	Gypsum	Salinity	Sodium Adsorp-tion Ratio
	In	meq/100 g	meq/100 g	pH	Pct	Pct	mmhos/cm	
43A:								
LOSTWELLS	0-8	10-15	---	7.4 - 8.4	0-5	0	0.0	0-5
	8-60	5.0-20	---	7.9 - 9.0	5-10	0	0.0-4.0	5-13
45AB:								
LOSTWELLS, wet	0-8	10-15	---	8.5 - 9.6	0-5	0	8.0-16.0	13-25
	8-60	5.0-20	---	8.5 - 9.0	5-10	0	2.0-8.0	13-20
YOUNGSTON, wet	0-9	15-20	---	8.5 - 9.6	0-5	0	8.0-16.0	13-25
	9-60	15-20	---	8.5 - 9.0	5-10	0	0.0-8.0	13-20
67AC:								
UFFENS	0-4	6.0-12	---	8.4 - 9.0	15-35	0-2	8.0-16.0	0-10
	4-15	8.0-18	---	8.4 - 9.6	15-35	0-2	8.0-32.0	13-25
	15-60	8.0-18	---	7.8 - 9.0	20-40	0-2	16.0-32.0	0-10
102:								
BADLAND	0-60	---	---	---	---	---	---	---
315BD:								
PREATORSON	0-2	3.0-6.0	---	7.4 - 8.4	0	0	0.0	0
	2-11	10-15	---	7.4 - 8.4	0	0	0.0	0
	11-60	10-15	---	7.4 - 8.4	0	0	0.0-4.0	0
WORLAND	0-3	5.0-10	---	7.4 - 9.0	1-2	0-1	0.0-2.0	0-5
	3-32	5.0-10	---	7.9 - 9.0	2-5	0-1	0.0-4.0	0-5
	32-42	---	---	---	---	---	---	---
WILLWOOD	0-8	1.0-5.0	---	7.4 - 8.4	1-2	0	0.0-4.0	0
	8-60	0.0	---	7.4 - 8.4	1-2	0	0.0-4.0	0
317:								
MUDRAY VARIANT	0-2	0.0-3.0	---	7.9 - 9.0	1-5	0	8.0-32.0	13-45
	2-15	21-28	---	8.5 - 9.0	5-10	0	8.0-32.0	13-45
	15-19	---	---	---	---	---	---	---
MUFF	0-3	5.0-15	---	7.4 - 8.4	0-5	0-4	2.0-4.0	0-5
	3-24	10-20	---	8.5 - 9.0	4-15	0-4	4.0-8.0	13-30
	24-37	10-15	---	8.5 - 9.0	4-15	0-4	4.0-8.0	5-20
	37-47	---	---	---	---	---	---	---
BRIBUTTE	0-3	20-40	---	8.5 - 9.0	5-15	3-10	2.0-16.0	15-35
	3-12	20-40	---	8.5 - 9.0	5-15	3-10	2.0-16.0	15-35
	12-22	---	---	---	---	---	---	---

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Table J2. - Chemical Properties of the Soils - Continued

Big Horn County Area, Wyoming

Map Symbol and Soil Name	Depth	Cation Exchange Capacity	Effective Cation Exchange Capacity	Soil Reaction	Calcium Carbon-ate	Gypsum	Salinity	Sodium Adsorp-tion Ratio
	In	meq/100 g	meq/100 g	pH	Pct	Pct	mmhos/cm	
351AC:								
LOSTWELLS, ALKALI	0-3	15-20	---	8.4 - 9.6	2-15	2-6	2.0-8.0	13-25
	3-60	5.0-20	---	8.4 - 9.6	2-15	2-6	2.0-8.0	13-25
367AC:								
RAIRDENT	0-2	10-15	---	7.4 - 8.4	2-5	0	2.0-4.0	0
	2-60	10-15	---	7.4 - 8.4	10-15	5-10	2.0-8.0	3-13
UFFENS	0-4	6.0-12	---	8.4 - 9.6	15-35	0-2	8.0-32.0	20-40
	4-15	8.0-18	---	8.4 - 9.6	15-35	0-2	8.0-32.0	45-80
	15-60	8.0-18	---	8.4 - 9.6	20-40	0-2	16.0-32.0	40-60
368A:								
KINNEAR	0-10	10-15	---	7.9 - 9.0	0-5	0	0.0-4.0	0-10
	10-60	5.0-20	---	7.9 - 9.0	5-10	0	0.0-4.0	0-10
LOSTWELLS	0-8	10-15	---	7.4 - 8.4	0-5	0	0.0	0-5
	8-60	5.0-20	---	7.9 - 9.0	5-10	0	0.0-4.0	5-13
368AC:								
KINNEAR	0-10	10-15	---	7.9 - 9.0	---	---	0.0-4.0	---
	10-60	5.0-20	---	7.9 - 9.0	---	---	0.0-4.0	---
LOSTWELLS	0-8	10-15	---	7.4 - 8.4	0-5	0	0.0	0-5
	8-60	5.0-20	---	7.9 - 9.0	5-10	0	0.0-4.0	5-13
368B:								
KINNEAR	0-10	10-15	---	7.9 - 9.0	---	---	0.0-4.0	---
	10-60	5.0-20	---	7.9 - 9.0	---	---	0.0-4.0	---
LOSTWELLS	0-8	10-15	---	7.4 - 8.4	0-5	0	0.0	0-5
	8-60	5.0-20	---	7.9 - 9.0	5-10	0	0.0-4.0	5-13
371A:								
GREYBULL	0-10	10-20	---	7.9 - 8.4	0-10	0	2.0-4.0	0
	10-21	15-25	---	7.9 - 9.0	5-15	0-5	2.0-4.0	0-10
	21-31	---	---	---	---	---	---	---
PERSAYO	0-1	5.0-15	---	7.9 - 9.0	5-10	0-5	0.0-8.0	0-10
	1-10	5.0-15	---	7.4 - 9.0	5-10	0-5	0.0-8.0	0-10
	10-20	---	---	---	---	---	---	---
371AD:								
GREYBULL	0-10	10-20	---	7.9 - 8.4	0-10	0	2.0-4.0	0
	10-21	15-25	---	7.9 - 9.0	5-15	0-5	2.0-4.0	0-10
	21-31	---	---	---	---	---	---	---

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Table J2. - Chemical Properties of the Soils - Continued

Big Horn County Area, Wyoming

Map Symbol and Soil Name	Depth	Cation Exchange Capacity	Effective Cation Exchange Capacity	Soil Reaction	Calcium Carbon-ate	Gypsum	Salinity	Sodium Adsorp-tion Ratio
	In	meq/100 g	meq/100 g	pH	Pct	Pct	mmhos/cm	
371AD:								
PERSAYO	0-1	5.0-15	---	7.9 - 9.0	5-10	0-5	0.0-8.0	0-10
	1-10	5.0-15	---	7.4 - 9.0	5-10	0-5	0.0-8.0	0-10
	10-20	---	---	---	---	---	---	---
372CD:								
WORLAND	0-3	5.0-10	---	7.4 - 9.0	1-2	0-1	0.0-2.0	0
	3-32	5.0-10	---	7.9 - 9.0	2-5	0-1	0.0-4.0	0-5
	32-42	---	---	---	---	---	---	---
PERSAYO	0-2	5.0-15	---	7.9 - 9.0	5-10	0-5	0.0-8.0	0-10
	2-12	5.0-15	---	7.4 - 9.0	5-10	0-5	0.0-8.0	0-10
	12-22	---	---	---	---	---	---	---
409A:								
BAROID, WET	0-2	5.0-10	---	8.5 - 9.0	5-10	0-4	8.0-16.0	13-20
	2-60	3.0-10	---	7.9 - 9.0	5-10	0-4	8.0-16.0	0-10
GLENTON, WET	0-1	5.0-10	---	8.5 - 9.6	5-10	0-4	8.0-16.0	13-20
	1-60	5.0-10	---	8.5 - 9.6	5-10	0-4	4.0-8.0	13-20
471CE:								
BRIBUTTE	0-2	20-40	---	8.4 - 9.6	5-15	3-10	2.0-16.0	15-35
	2-12	20-40	---	8.4 - 9.6	5-15	3-10	2.0-16.0	15-35
	12-16	---	---	---	---	---	---	---
PERSAYO	0-1	5.0-15	---	7.9 - 9.0	5-10	0-5	0.0-8.0	0-10
	1-10	5.0-15	---	7.4 - 9.0	5-10	0-5	0.0-8.0	0-10
	10-20	---	---	---	---	---	---	---
PAVILLION	0-3	10-20	---	7.4 - 9.0	5-10	0-5	0.0-4.0	0-10
	3-27	10-20	---	7.4 - 9.0	5-15	0-5	0.0-4.0	0-10
	27-37	---	---	---	---	---	---	---
493BD:								
EMBLEM	0-3	5.0-10	---	7.4 - 8.4	0-5	0	0.0	0
	3-20	10-20	---	7.4 - 9.0	4-15	0	0.0-4.0	0-5
	20-60	1.0-5.0	---	7.9 - 9.0	0	0	0.0-4.0	0-10
GRIFFY	0-2	5.0-10	---	7.4 - 8.4	0-5	0	0.0	0
	2-11	10-20	---	7.4 - 8.4	0-5	0	0.0-2.0	0
	11-60	5.0-10	---	7.9 - 9.0	4-15	0	0.0-4.0	0-5
PREATORSON	0-11	3.0-6.0	---	7.4 - 8.4	0	0	0.0	0
	11-20	10-15	---	7.4 - 8.4	0	0	0.0	0
	20-60	1.0-5.0	---	7.9 - 8.4	0	0	0.0-4.0	0-5

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Table J2. - Chemical Properties of the Soils - Continued

Big Horn County Area, Wyoming

Map Symbol and Soil Name	Depth	Cation Exchange Capacity	Effective Cation Exchange Capacity	Soil Reaction	Calcium Carbon-ate	Gypsum	Salinity	Sodium Adsorp-tion Ratio
	In	meq/100 g	meq/100 g	pH	Pct	Pct	mmhos/cm	
570AD:								
MUFF	0-3	5.0-15	---	7.4 - 8.4	0-5	0-4	2.0-4.0	0-5
	3-24	10-20	---	8.4 - 9.6	4-15	0-4	4.0-8.0	13-30
	24-37	10-15	---	8.4 - 9.6	4-15	0-4	4.0-8.0	5-20
	37-47	---	---	---	---	---	---	---
UFFENS	0-4	6.0-12	---	8.4 - 9.6	15-35	0-2	8.0-16.0	20-40
	4-15	8.0-18	---	8.4 - 9.6	15-35	0-2	8.0-16.0	45-80
	15-60	8.0-18	---	8.4 - 9.6	20-40	0-2	16.0-32.0	40-60
PERSAYO	0-1	5.0-15	---	7.9 - 9.0	5-10	0-5	0.0-8.0	0-10
	1-10	5.0-15	---	7.4 - 9.0	5-10	0-5	0.0-8.0	0-5
	10-20	---	---	---	---	---	---	---

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Table J2. - Chemical Properties of the Soils

Washakie County Area, Wyoming

Absence of an entry indicates that data were not estimated.

Map Symbol and Soil Name	Depth	Cation Exchange Capacity	Effective Cation Exchange Capacity	Soil Reaction	Calcium Carbon-ate	Gypsum	Salinity	Sodium Adsorp-tion Ratio
	In	meq/100 g	meq/100 g	pH	Pct	Pct	mmhos/cm	
4:								
APRON	0-3	5.0-10	---	7.4 - 8.4	2-10	0	0.0-2.0	0
	3-60	5.0-10	---	7.9 - 9.0	2-10	0	0.0-2.0	0
WORLAND	0-3	5.0-10	---	7.4 - 9.0	1-2	0-1	0.0-2.0	0
	3-36	5.0-10	---	7.9 - 9.0	2-5	0-1	0.0-4.0	0-5
	36-40	---	---	---	---	---	---	---
14:								
CLIFTERSON	0-5	10-15	---	7.9 - 9.0	1-10	0	0.0-2.0	0
	5-60	15-20	---	7.9 - 9.0	4-12	0	0.0-2.0	0
PERSAYO	0-1	15-20	---	7.9 - 9.0	1-10	0	0.0-8.0	0-3
	1-13	10-20	---	7.4 - 9.0	5-14	0	0.0-8.0	0-3
	13-23	---	---	---	---	---	---	---
LOSTWELLS	0-3	10-15	---	7.4 - 8.4	0-5	0	0.0	0-5
	3-60	5.0-20	---	7.9 - 9.0	5-10	0	0.0-4.0	5-13
19:								
FLUVAQUENTS	---	---	---	---	---	---	---	---
31:								
GRIFFY	0-3	5.0-10	---	7.4 - 7.8	0-5	0	0.0	0
	3-14	10-20	---	7.4 - 8.4	0-5	0	0.0-2.0	0
	14-60	5.0-10	---	7.9 - 9.0	0-5	0	0.0-4.0	0
40:								
LOSTWELLS	0-8	15-20	---	7.4 - 8.4	0-5	0	0.0	0-5
	8-60	5.0-20	---	7.9 - 9.0	5-10	0	0.0-4.0	5-13
42:								
LOSTWELLS	0-3	10-15	---	7.4 - 8.4	0-5	0	0.0	0-5
	3-60	5.0-20	---	7.9 - 9.0	5-10	0	0.0-4.0	5-13
YOUNGSTON	0-3	10-20	---	7.4 - 8.4	4-15	0-4	0.0-2.0	0-12
	3-60	5.0-20	---	7.9 - 9.0	4-15	0-4	2.0-8.0	0-12
UFFENS	0-1	8.0-15	---	7.4 - 9.0	0-1	0-4	4.0-8.0	5-13
	1-22	15-20	---	8.5 - 9.0	3-10	0-4	16.0-32.0	13-30
	22-60	10-15	---	7.9 - 9.0	5-15	0-4	16.0-32.0	13-30
43:								
LOSTWELLS	0-8	15-20	---	9.1 - 11.0	5-10	0	8.0-16.0	3-13
	8-60	10-15	---	8.5 - 9.0	5-10	0	2.0-8.0	0-5

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Table J2. - Chemical Properties of the Soils - Continued

Washakie County Area, Wyoming

Map Symbol and Soil Name	Depth	Cation Exchange Capacity	Effective Cation Exchange Capacity	Soil Reaction	Calcium Carbon-ate	Gypsum	Salinity	Sodium Adsorp-tion Ratio
	In	meq/100 g	meq/100 g	pH	Pct	Pct	mmhos/cm	
43:								
YOUNGSTON	0-8	15-20	---	8.5 - 9.0	4-15	0-4	8.0-16.0	3-13
	8-60	10-20	---	8.5 - 9.0	4-15	0-4	0.0-8.0	0-13
LOSTWELLS	0-3	10-15	---	7.4 - 8.4	0-5	0	0.0	0-5
	3-60	5.0-20	---	7.9 - 9.0	5-10	0	0.0-4.0	5-13
56:								
PERSAYO	0-1	15-20	---	7.9 - 9.0	5-14	0-4	0.0-8.0	0-3
	1-13	10-20	---	7.9 - 9.0	5-14	0-4	0.0-8.0	3-13
	13-23	---	---	---	---	---	---	---
MUFF	0-5	5.0-15	---	7.4 - 8.4	0-5	0-4	2.0-4.0	0-5
	5-30	10-15	---	8.5 - 9.0	4-15	0-4	4.0-8.0	5-20
	30-34	---	---	---	---	---	---	---
ROCK OUTCROP	---	---	---	---	---	---	---	---
57:								
PERSAYO	0-1	15-20	---	7.9 - 9.0	5-14	0-4	0.0-8.0	0-3
	1-13	10-20	---	7.4 - 9.0	5-14	0-4	0.0-8.0	3-13
	13-23	---	---	---	---	---	---	---
ROCK OUTCROP	---	---	---	---	---	---	---	---
71:								
UFFENS	0-1	10-15	---	7.4 - 9.0	0-1	0-5	4.0-8.0	3-13
	1-5	15-20	---	8.5 - 9.0	3-10	0-5	16.0-32.0	13-30
	5-60	10-15	---	8.5 - 9.0	5-14	0-5	16.0-32.0	13-30
RAIRDENT	0-2	5.0-10	---	7.4 - 8.4	5-10	0-5	2.0-4.0	1-10
	2-17	15-20	---	7.4 - 8.4	5-10	5-10	2.0-8.0	3-13
	17-55	4.0-8.0	---	7.4 - 8.4	5-10	5-10	2.0-8.0	3-13
	55-60	1.0-5.0	---	7.4 - 8.4	5-10	0-5	2.0-8.0	3-13
GRIFFY	0-3	5.0-10	---	7.4 - 8.4	0-5	0	0.0	0
	3-14	10-20	---	7.4 - 8.4	0-5	0	0.0-2.0	0
	14-60	5.0-10	---	7.9 - 9.0	0-5	0	0.0-4.0	0
82:								
YOUNGSTON	0-9	10-20	---	7.4 - 8.4	4-15	0-4	0.0-2.0	0-12
	9-60	5.0-20	---	7.9 - 9.0	4-15	0-4	2.0-8.0	0-12
84:								
YOUNGSTON	0-4	10-20	---	7.4 - 8.4	4-15	0-4	0.0-2.0	0-12
	4-60	5.0-20	---	7.9 - 9.0	4-15	0-4	2.0-8.0	0-12

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Table J2. - Chemical Properties of the Soils - Continued

Washakie County Area, Wyoming

Map Symbol and Soil Name	Depth	Cation Exchange Capacity	Effective Cation Exchange Capacity	Soil Reaction	Calcium Carbon-ate	Gypsum	Salinity	Sodium Adsorp-tion Ratio
	In	meq/100 g	meq/100 g	pH	Pct	Pct	mmhos/cm	
84:								
UFFENS	0-1	8.0-15	---	7.4 - 9.0	0-1	0-4	4.0-8.0	3-13
	1-5	13-20	---	8.5 - 9.0	3-10	0-4	16.0-32.0	13-30
	5-60	10-15	---	7.9 - 9.0	5-14	0-4	16.0-32.0	13-30
LOSTWELLS	0-3	10-15	---	7.4 - 8.4	0-5	0	0.0	0-5
	3-60	5.0-20	---	7.9 - 9.0	5-10	0	0.0-4.0	5-13

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Table WMS-1. - Water Management

Big Horn County Area, Wyoming

The information in this table indicates the dominant soil condition, but does not eliminate the need for onsite investigation. The numbers in the value colu range from 0.01 to 1.00. The larger the value, the greater the potential limitation. Limiting features in this report are limited to the top 5 limitations. Addit limitations may exist.

Map Symbol and Soil Name	Pct of Map Unit	Pond Reservoir Areas		Embankments, Dikes, and Levees		Aquifer-Fed Excavated Ponds	
		Rating Class and Limiting Features	Value	Rating Class and Limiting Features	Value	Rating Class and Limiting Features	Value
43A:							
LOSTWELLS	85	Somewhat limited		Somewhat limited		Very limited	
		Seepage	0.70	Piping	0.61	Depth to water	1.00
45AB:							
LOSTWELLS, wet	35	Somewhat limited		Very limited		Somewhat limited	
		Seepage	0.70	Piping	1.00	Slow refill	0.30
				Depth to saturated zone	0.84	Cutbanks cave	0.10
						Depth to water	0.07
				Salinity	0.50		
YOUNGSTON, wet	35	Somewhat limited		Very limited		Somewhat limited	
		Seepage	0.03	Piping	1.00	Slow refill	0.97
				Depth to saturated zone	0.84	Cutbanks cave	0.10
						Depth to water	0.07
				Salinity	0.50		
67AC:							
UFFENS	85	Somewhat limited		Very limited		Very limited	
		Seepage	0.03	Salinity	1.00	Depth to water	1.00
				Piping	1.00		
102:							
BADLAND	90	Very limited		Not Rated		Not Rated	
		Depth to bedrock	1.00				
		Slope	1.00				
315BD:							
PREATORSON	30	Somewhat limited		Somewhat limited		Very limited	
		Seepage	0.70	Seepage	0.50	Depth to water	1.00
		Slope	0.05				
WORLAND	25	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Thin layer	0.81	Depth to water	1.00
		Depth to bedrock	0.08	Seepage	0.03		
		Slope	0.06				
WILLWOOD	20	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Seepage	0.38	Depth to water	1.00
317:							
MUDRAY VARIANT	40	Very limited		Very limited		Very limited	
		Depth to bedrock	1.00	Thin layer	1.00	Depth to water	1.00
				Hard to pack	1.00		
				Salinity	1.00		

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Table WMS-1. - Water Management - Continued

Big Horn County Area, Wyoming

Map Symbol and Soil Name	Pct of Map Unit	Pond Reservoir Areas		Embankments, Dikes, and Levees		Aquifer-Fed Excavated Ponds	
		Rating Class and Limiting Features	Value	Rating Class and Limiting Features	Value	Rating Class and Limiting Features	Value
317:							
MUFF	25	Somewhat limited		Very limited		Very limited	
		Seepage	0.03	Piping	1.00	Depth to water	1.00
		Depth to bedrock	0.02	Thin layer	0.61		
BRIBUTTE	15	Somewhat limited		Very limited		Very limited	
		Depth to bedrock	0.78	Thin layer	1.00	Depth to water	1.00
				Hard to pack	1.00		
				Salinity	0.03		
351AC:							
LOSTWELLS, ALKALI	85	Somewhat limited		Very limited		Very limited	
		Seepage	0.70	Piping	1.00	Depth to water	1.00
367AC:							
RAIRDENT	60	Somewhat limited		Very limited		Very limited	
		Seepage	0.70	Piping	1.00	Depth to water	1.00
UFFENS	35	Somewhat limited		Very limited		Very limited	
		Seepage	0.03	Salinity	1.00	Depth to water	1.00
				Piping	1.00		
368A:							
KINNEAR	40	Somewhat limited		Somewhat limited		Very limited	
		Seepage	0.70	Piping	0.02	Depth to water	1.00
LOSTWELLS	40	Somewhat limited		Somewhat limited		Very limited	
		Seepage	0.70	Piping	0.61	Depth to water	1.00
368AC:							
KINNEAR	40	Somewhat limited		Not limited		Very limited	
		Seepage	0.70			Depth to water	1.00
LOSTWELLS	40	Somewhat limited		Somewhat limited		Very limited	
		Seepage	0.70	Piping	0.61	Depth to water	1.00
368B:							
KINNEAR	40	Somewhat limited		Not limited		Very limited	
		Seepage	0.70			Depth to water	1.00
LOSTWELLS	40	Somewhat limited		Somewhat limited		Very limited	
		Seepage	0.70	Piping	0.61	Depth to water	1.00
371A:							
GREYBULL	50	Somewhat limited		Very limited		Very limited	
		Depth to bedrock	0.42	Thin layer	1.00	Depth to water	1.00
		Seepage	0.03	Piping	0.15		

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Table WMS-1. - Water Management - Continued

Big Horn County Area, Wyoming

Map Symbol and Soil Name	Pct of Map Unit	Pond Reservoir Areas		Embankments, Dikes, and Levees		Aquifer-Fed Excavated Ponds	
		Rating Class and Limiting Features	Value	Rating Class and Limiting Features	Value	Rating Class and Limiting Features	Value
371A:							
PERSAYO	25	Somewhat limited		Very limited		Very limited	
		Depth to bedrock	0.84	Thin layer	1.00	Depth to water	1.00
				Piping	0.87		
371AD:							
GREYBULL	50	Somewhat limited		Very limited		Very limited	
		Depth to bedrock	0.42	Thin layer	1.00	Depth to water	1.00
		Seepage	0.03	Piping	0.15		
		Slope	0.03				
PERSAYO	30	Somewhat limited		Very limited		Very limited	
		Depth to bedrock	0.84	Thin layer	1.00	Depth to water	1.00
		Slope	0.05	Piping	0.87		
372CD:							
WORLAND	45	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Thin layer	0.81	Depth to water	1.00
		Slope	0.08	Seepage	0.03		
		Depth to bedrock	0.08				
PERSAYO	30	Somewhat limited		Very limited		Very limited	
		Depth to bedrock	0.78	Thin layer	1.00	Depth to water	1.00
		Slope	0.32	Piping	0.86		
409A:							
BAROID, WET	30	Very limited		Very limited		Very limited	
		Seepage	1.00	Piping	1.00	Cutbanks cave	1.00
				Depth to saturated zone	0.84	Salty water	0.78
						Depth to water	0.07
				Salinity	0.50		
GLENTON, WET	30	Very limited		Very limited		Very limited	
		Seepage	1.00	Piping	1.00	Cutbanks cave	1.00
				Depth to saturated zone	0.84	Depth to water	0.07
						Salty water	0.06
				Salinity	0.50		
471CE:							
BRIBUTTE	30	Somewhat limited		Very limited		Very limited	
		Depth to bedrock	0.78	Thin layer	1.00	Depth to water	1.00
		Slope	0.64	Hard to pack	1.00		
				Salinity	0.03		
PERSAYO	30	Somewhat limited		Very limited		Very limited	
		Depth to bedrock	0.84	Thin layer	1.00	Depth to water	1.00
		Slope	0.32	Piping	0.87		

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Table WMS-1. - Water Management - Continued

Big Horn County Area, Wyoming

Map Symbol and Soil Name	Pct of Map Unit	Pond Reservoir Areas		Embankments, Dikes, and Levees		Aquifer-Fed Excavated Ponds	
		Rating Class and Limiting Features	Value	Rating Class and Limiting Features	Value	Rating Class and Limiting Features	Value
471CE:							
PAVILLION	15	Somewhat limited		Somewhat limited		Very limited	
		Seepage	0.70	Thin layer	0.93	Depth to water	1.00
		Depth to bedrock	0.19	Piping	0.02		
		Slope	0.01				
493BD:							
EMBLEM	40	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Seepage	0.65	Depth to water	1.00
				Piping	0.02		
GRIFFY	25	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Seepage	0.03	Depth to water	1.00
PREATORSON	20	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Seepage	0.82	Depth to water	1.00
		Slope	0.06				
570AD:							
MUFF	35	Somewhat limited		Very limited		Very limited	
		Seepage	0.03	Piping	1.00	Depth to water	1.00
		Depth to bedrock	0.02	Thin layer	0.61		
UFFENS	25	Somewhat limited		Very limited		Very limited	
		Seepage	0.03	Salinity	1.00	Depth to water	1.00
				Piping	1.00		
PERSAYO	20	Somewhat limited		Very limited		Very limited	
		Depth to bedrock	0.84	Thin layer	1.00	Depth to water	1.00
		Slope	0.13	Piping	0.87		

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Table WMS-1. - Water Management

Washakie County Area, Wyoming

The information in this table indicates the dominant soil condition, but does not eliminate the need for onsite investigation. The numbers in the value colu range from 0.01 to 1.00. The larger the value, the greater the potential limitation. Limiting features in this report are limited to the top 5 limitations. Addit limitations may exist.

Map Symbol and Soil Name	Pct of Map Unit	Pond Reservoir Areas		Embankments, Dikes, and Levees		Aquifer-Fed Excavated Ponds	
		Rating Class and Limiting Features	Value	Rating Class and Limiting Features	Value	Rating Class and Limiting Features	Value
4:							
APRON	45	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Seepage	0.02	Depth to water	1.00
WORLAND	30	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Thin layer	0.66	Depth to water	1.00
		Depth to bedrock	0.03	Seepage	0.03		
14:							
CLIFTERSON	45	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Seepage	0.31	Depth to water	1.00
		Slope	0.05				
PERSAYO	25	Somewhat limited		Very limited		Very limited	
		Depth to bedrock	0.74	Thin layer	1.00	Depth to water	1.00
		Slope	0.25	Piping	0.85		
LOSTWELLS	10	Somewhat limited		Somewhat limited		Very limited	
		Seepage	0.70	Piping	0.61	Depth to water	1.00
19:							
FLUVAQUENTS	85	Not limited		Not Rated		Not Rated	
31:							
GRIFFY	85	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Seepage	0.03	Depth to water	1.00
40:							
LOSTWELLS	85	Somewhat limited		Somewhat limited		Very limited	
		Seepage	0.70	Piping	0.61	Depth to water	1.00
42:							
LOSTWELLS	40	Somewhat limited		Somewhat limited		Very limited	
		Seepage	0.70	Piping	0.61	Depth to water	1.00
YOUNGSTON	25	Somewhat limited		Somewhat limited		Very limited	
		Seepage	0.03	Piping	0.60	Depth to water	1.00
UFFENS	10	Somewhat limited		Very limited		Very limited	
		Seepage	0.03	Salinity	1.00	Depth to water	1.00
				Piping	1.00		
43:							

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Table WMS-1. - Water Management - Continued

Washakie County Area, Wyoming

Map Symbol and Soil Name	Pct of Map Unit	Pond Reservoir Areas		Embankments, Dikes, and Levees		Aquifer-Fed Excavated Ponds	
		Rating Class and Limiting Features	Value	Rating Class and Limiting Features	Value	Rating Class and Limiting Features	Value
43:							
LOSTWELLS	30	Somewhat limited		Somewhat limited		Somewhat limited	
		Seepage	0.70	Depth to saturated zone	0.84	Slow refill	0.30
						Cutbanks cave	0.10
				Salinity	0.50	Depth to water	0.07
				Piping	0.40		
YOUNGSTON	30	Somewhat limited		Somewhat limited		Somewhat limited	
		Seepage	0.03	Depth to saturated zone	0.84	Slow refill	0.97
						Cutbanks cave	0.10
				Piping	0.52	Depth to water	0.07
				Salinity	0.50		
LOSTWELLS	25	Somewhat limited		Somewhat limited		Very limited	
		Seepage	0.70	Piping	0.61	Depth to water	1.00
56:							
PERSAYO	50	Somewhat limited		Very limited		Very limited	
		Depth to bedrock	0.74	Thin layer	1.00	Depth to water	1.00
				Piping	1.00		
MUFF	15	Somewhat limited		Very limited		Very limited	
		Depth to bedrock	0.12	Piping	1.00	Depth to water	1.00
		Seepage	0.03	Thin layer	0.87		
ROCK OUTCROP	10	Not Rated		Not Rated		Not Rated	
57:							
PERSAYO	40	Somewhat limited		Very limited		Very limited	
		Depth to bedrock	0.74	Thin layer	1.00	Depth to water	1.00
		Slope	0.41	Piping	1.00		
ROCK OUTCROP	40	Not Rated		Not Rated		Not Rated	
71:							
UFFENS	40	Somewhat limited		Very limited		Very limited	
		Seepage	0.03	Salinity	1.00	Depth to water	1.00
				Piping	1.00		
RAIRDENT	30	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Piping	0.40	Depth to water	1.00
				Seepage	0.19		
GRIFFY	10	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Seepage	0.03	Depth to water	1.00
82:							
YOUNGSTON	85	Somewhat limited		Somewhat limited		Very limited	
		Seepage	0.03	Piping	0.60	Depth to water	1.00

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Table WMS-1. - Water Management - Continued

Washakie County Area, Wyoming

Map Symbol and Soil Name	Pct of Map Unit	Pond Reservoir Areas		Embankments, Dikes, and Levees		Aquifer-Fed Excavated Ponds	
		Rating Class and Limiting Features	Value	Rating Class and Limiting Features	Value	Rating Class and Limiting Features	Value
84:							
YOUNGSTON	40	Somewhat limited		Somewhat limited		Very limited	
		Seepage	0.03	Piping	0.96	Depth to water	1.00
UFFENS	25	Somewhat limited		Very limited		Very limited	
		Seepage	0.03	Salinity	1.00	Depth to water	1.00
				Piping	1.00		
LOSTWELLS	15	Somewhat limited		Somewhat limited		Very limited	
		Seepage	0.70	Piping	0.61	Depth to water	1.00

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RUSLE Related Attributes

Big Horn County Area, Wyoming

Map Unit Symbol and Map Unit Name	% Comp-osition	Component	Hydrologic Group	Kw	T Factor	Representative Value		
						% Sand	% Silt	% Clay
43A: LOSTWELLS CLAY LOAM, 0 TO 3 PERCENT SLOPES	85	LOSTWELLS	B	.32	5	57.0	18.0	25.0
45AB: LOSTWELLS-YOUNGSTON SOILS, WET, 0 TO 6 PERCENT SLOPES	35	LOSTWELLS, wet	C	.32	5	35.4	33.6	31.0
	35	YOUNGSTON, wet	C	.37	5	35.4	33.6	31.0
67AC: UFFENS SILTY CLAY LOAM, 0 TO 10 PERCENT SLOPES	85	UFFENS	B	.49	5	43.0	39.5	17.5
102: BADLAND	90	BADLAND	D	---	---	---	---	---
315BD: PREATORSON-WORLAND-WILLWOOD ASSOCIATION, STEEP	30	PREATORSON	B	.15	5	69.7	21.8	8.5
	25	WORLAND	C	.24	3	66.8	19.2	14.0
	20	WILLWOOD	A	.10	5	66.9	23.1	10.0
317: MUDRAY VARIANT-MUFF-BRIBUTTE COMPLEX, 0 TO 10 PERCENT SLOPES	40	MUDRAY VARIANT	D	.28	1	67.7	22.3	10.0
	25	MUFF	C	.32	3	68.5	21.5	10.0
	15	BRIBUTTE	D	.32	2	32.2	28.8	39.0
351AC: LOSTWELLS CLAY LOAM, ALKALI, 0 TO 10 PERCENT SLOPES	85	LOSTWELLS, ALKALI	C	.32	5	35.4	33.6	31.0
367AC: RAIRDENT-UFFENS LOAMS, 0 TO 10 PERCENT SLOPES	60	RAIRDENT	B	.32	5	43.0	39.5	17.5

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RUSLE Related Attributes - Continued

Big Horn County Area, Wyoming

Map Unit Symbol and Map Unit Name	% Comp-osition	Component	Hydrologic Group	Kw	T Factor	Representative Value		
						% Sand	% Silt	% Clay
367AC: RAIRDENT-UFFENS LOAMS, 0 TO 10 PERCENT SLOPES	35	UFFENS	C	.49	5	43.0	39.5	17.5
368A: LOSTWELLS-KINNEAR SANDY CLAY LOAMS, 0 TO 3 PERCENT SLOPES	40	KINNEAR	B	.32	5	55.1	17.4	27.5
	40	LOSTWELLS	B	.32	5	57.0	18.0	25.0
368AC: LOSTWELLS-KINNEAR SANDY CLAY LOAMS, 0 TO 10 PERCENT SLOPES	40	KINNEAR	B	.32	5	55.1	17.4	27.5
	40	LOSTWELLS	B	.32	5	57.0	18.0	25.0
368B: LOSTWELLS-KINNEAR SANDY CLAY LOAMS, 3 TO 6 PERCENT SLOPES	40	KINNEAR	B	.32	5	55.1	17.4	27.5
	40	LOSTWELLS	B	.32	5	57.0	18.0	25.0
371A: GREYBULL-PERSAYO CLAY LOAMS, 0 TO 3 PERCENT SLOPES	50	GREYBULL	C	.37	3	35.4	33.6	31.0
	25	PERSAYO	D	.37	2	35.4	33.6	31.0
371AD: GREYBULL-PERSAYO ASSOCIATION, ROLLING	50	GREYBULL	C	.37	3	35.4	33.6	31.0
	30	PERSAYO	D	.37	2	35.4	33.6	31.0
372CD: WORLAND-PERSAYO COMPLEX, 2 TO 45 PERCENT SLOPES	45	WORLAND	C	.24	3	66.8	19.2	14.0
	30	PERSAYO	D	.37	2	35.4	33.6	31.0

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RUSLE Related Attributes - Continued

Big Horn County Area, Wyoming

Map Unit Symbol and Map Unit Name	% Comp-osition	Component	Hydrologic Group	Kw	T Factor	Representative Value		
						% Sand	% Silt	% Clay
409A: GLENTON-BAROID SANDY LOAMS, WET, 0 TO 3 PERCENT SLOPES	30	BAROID, WET	C	.28	5	66.9	23.1	10.0
	30	GLENTON, WET	C	.24	5	65.7	22.8	11.5
471CE: BRIBUTTE-PERSAYO-PAVILLION COMPLEX, 3 TO 60 PERCENT SLOPES	30	BRIBUTTE	D	.32	2	23.3	29.2	47.5
	30	PERSAYO	D	.37	2	35.4	33.6	31.0
	15	PAVILLION	C	.32	3	57.0	18.0	25.0
493BD: EMBLEM-GRIFFY-PREATORSON COMPLEX, 1 TO 30 PERCENT SLOPES	40	EMBLEM	B	.28	4	66.9	23.1	10.0
	25	GRIFFY	B	.28	5	66.9	23.1	10.0
	20	PREATORSON	C	.15	4	69.7	21.8	8.5
570AD: MUFF-UFFENS-PERSAYO COMPLEX, 0 TO 30 PERCENT SLOPES	35	MUFF	C	.32	3	68.5	21.5	10.0
	25	UFFENS	C	.49	5	43.0	39.5	17.5
	20	PERSAYO	D	.37	2	35.4	33.6	31.0

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RUSLE Related Attributes

Washakie County Area, Wyoming

Map Unit Symbol and Map Unit Name	% Comp-osition	Component	Hydrologic Group	Kw	T Factor	Representative Value		
						% Sand	% Silt	% Clay
4: APRON-WORLAND SANDY LOAMS, 1 TO 12 PERCENT SLOPES	45	APRON	B	.28	5	65.3	23.2	11.5
	30	WORLAND	C	.24	3	66.8	19.2	14.0
14: CLIFTERSON-PERSAYO ASSOCIATION	45	CLIFTERSON	B	.20	5	59.6	17.9	22.5
	25	PERSAYO	D	.37	2	35.4	33.6	31.0
	10	LOSTWELLS	B	.32	5	57.0	18.0	25.0
19: FLUVAQUENTS	85	FLUVAQUENTS	D	---	---	---	---	---
31: GRIFFY SANDY LOAM, 1 TO 10 PERCENT SLOPES	85	GRIFFY	B	.28	5	65.3	23.2	11.5
40: LOSTWELLS CLAY LOAM, 0 TO 3 PERCENT SLOPES	85	LOSTWELLS	B	.32	5	35.4	33.6	31.0
42: LOSTWELLS-YOUNGSTON COMPLEX, 1 TO 10 PERCENT SLOPES	40	LOSTWELLS	B	.32	5	57.0	18.0	25.0
	25	YOUNGSTON	B	.37	5	20.0	49.0	31.0
	10	UFFENS	B	.28	5	42.1	37.9	20.0
43: LOSTWELLS-YOUNGSTON COMPLEX, WET, 0 TO 6 PERCENT SLOPES	30	LOSTWELLS	C	.32	5	35.4	33.6	31.0
	30	YOUNGSTON	C	.37	5	20.0	49.0	31.0

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RUSLE Related Attributes - Continued

Washakie County Area, Wyoming

Map Unit Symbol and Map Unit Name	% Comp-osition	Component	Hydrologic Group	Kw	T Factor	Representative Value		
						% Sand	% Silt	% Clay
43: LOSTWELLS-YOUNGSTON COMPLEX, WET, 0 TO 6 PERCENT SLOPES	25	LOSTWELLS	B	.32	5	57.0	18.0	25.0
56: PERSAYO-MUFF-ROCK OUTCROP ASSOCIATION	50	PERSAYO	D	.37	2	35.4	33.6	31.0
	15	MUFF	C	.24	3	63.5	26.5	10.0
	10	ROCK OUTCROP	D	---	---	---	---	---
57: PERSAYO-ROCK OUTCROP ASSOCIATION	40	PERSAYO	D	.37	2	35.4	33.6	31.0
	40	ROCK OUTCROP	D	---	---	---	---	---
71: UFFENS-RAIRDENT COMPLEX, 1 TO 10 PERCENT SLOPES	40	UFFENS	C	.28	5	42.1	37.9	20.0
	30	RAIRDENT	B	.24	4	66.1	19.9	14.0
	10	GRIFFY	B	.28	5	65.3	23.2	11.5
82: YOUNGSTON SILTY CLAY LOAM, 0 TO 3 PERCENT SLOPES	85	YOUNGSTON	C	.37	5	20.0	49.0	31.0
84: YOUNGSTON-UFFENS-LOSTWELLS COMPLEX, 1 TO 10 PERCENT SLOPES	40	YOUNGSTON	C	.37	5	20.0	49.0	31.0
	25	UFFENS	C	.28	5	42.1	37.9	20.0
	15	LOSTWELLS	B	.32	5	57.0	18.0	25.0

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Table Y. - Prime Farmland

Washakie County Area, Wyoming

Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmla only under certain conditions, the conditions are specified in parenthesis after the soil name.

Map Symbol	Soil Name
40	LOSTWELLS CLAY LOAM, 0 TO 3 PERCENT SLOPES (Prime farmland if irrigated)
82	YOUNGSTON SILTY CLAY LOAM, 0 TO 3 PERCENT SLOPES (Prime farmland if irrigated)

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APPENDIX D

SCIENTIFIC NAMES FOR WILDLIFE DISCUSSED IN TEXT

COMMON NAME	SCIENTIFIC NAME
Big Game	
Pronghorn antelope	*Antilocapra americana*
White-tailed deer	*Odocoileus virginianus*
Mule deer	*Odocoileus hemionus*
Birds	
Osprey	*Pandion haliaetus*
Bald eagle	*Haliaeetus leucocephalus*
Northern harrier	*Circus cyaneus*
Sharp-shinned hawk	*Accipiter striatus*
Cooper's hawk	*Accipiter cooperii*
Northern goshawk	*Accipiter gentilis*
Swainson's hawk	*Buteo swainsoni*
Red-tailed hawk	*Buteo jamaicensis*
Ferruginous hawk	*Buteo regalis*
Rough-legged hawk	*Buteo lagopus*
Golden eagle	*Aquila chrysaetos*
American kestrel	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine falcon	*Falco peregrinus*
Prairie falcon	*Falco mexicanus*
Broad-winged hawk	*Buteo platypterus*
Gyrfalcon	*Falco rusticolus*
Greater sage-grouse	*Centrocerrcus urophasianus*
Mountain plover	*Charadrius montanus*
Mammals	
White-tailed prairie dog	*Cynomys leucurus*
Desert cottontail	*Sylvilagus audubonii*
Coyote	*Canis latrans*
White-tailed jackrabbit	*Lepus townsendii*
Northern pocket gopher	*Thomomys talpoides*
Ord's kangaroo rat	*Dipodomys ordii*
Deer mouse	*Peromyscus maniculatus*
Prairie vole	*Microtus ochrogaster*
Porcupine	*Erethizon dorsatum*
Red fox	*Vulpes vulpes*
Raccoon	*Procyon lotor*
Bobcat	*Lynx rufus*
Badger	*Taxidea taxus*
Black-footed ferret	*Mustela nigripes*

Reptiles

Northern sagebrush lizard	*Sceloporus graciosus graciosus*
Eastern short-horned lizard	*Phrynosoma hernandesi*
Eastern yellow belly racer	*Coluber constrictor flaviventris*
Pale milk snake	*Lampropeltis triangulum multistrata*
Bull snake	*Pituophis caternifer sayi*
Wandering garter snake	*Thamnophis elegans vagrans*
Prairie rattlesnake	*Crotalus viridis concolor*

Amphibians

Tiger salamander	*Ambystoma tigrinum*
Plains spadefoot	*Spea bombifrons*
Woodhouse's toad	*Bufo woodhousii*
Northern leopard frog	*Rana pipiens*
Boreal chorus frog	*Pseudacris maculata*

Fish

Shovelnose sturgeon	*Scaphirhynchus platorynchus*
Sturgeon chub	*Macrohybopsis gelida*
Western silvery minnow	*Hybognathus argyritis*
Plains minnow	*Hybognathus placitus*
Sauger	*Stizostedion canadense*
River carp sucker	*Carpiodes carpio*
Fathead minnow	*Pimephales promelas*
Sand shiner	*Notropis stramineus*
Channel catfish	*Ictalurus punctatus*
Yellow perch	*Perca flavescens*
White sucker	*Catostomus commersoni*
Longnose dace	*Rhinichthys cararactae*
Flathead chub	*Platygobio gracilis*
Common shiner	*Notropis cornuta*
Shorthead redhorse	*Moxostoma macrolepidotum*
Common carp	*Carassius carassius*
Burbot	*Lota lota*

Invertebrates

Caddisfly spp.	Hydropsychids
Mayfly spp.	Baetids
Dragonfly spp.	Libellulids

APPENDIX E

FISH SURVEY REPORT

FINAL REPORT

SENSITIVE STATUS FISH SPECIES SURVEYS IN THE BIGHORN RIVER, WYOMING: WORLAND – MANDERSON RIVER SEGMENT

31 January 2006

Prepared for:

Westside Irrigation District preparation of EIS

Prepared by:

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Appendices

Appendix A. Physical characteristics of sample sites.
Appendix B. Diagrams and photos of sample sites.

1.0 INTRODUCTION

In comments dated 27 Aug 2004 regarding the transfer of BLM land to the Westside Irrigation District (WID), Wyoming Game and Fish (WGFD) requested that sensitive species surveys be conducted for sturgeon chub (*Macrohybopsis gelida*), plains minnow (*Hybognathus placitus*), and western silvery minnow (*Hybognathus argyritis*) in the vicinity of the project area.

The sturgeon chub and western silvery minnow are classified by WGFD as Status 1 species that are physically isolated and/or exist at extremely low densities. The plains minnow is a Status 3 species that is widely distributed, but habitat conditions are declining or vulnerable. If these species are found, a detailed impacts assessment will be included in the EIS and consideration for the species will be included in a Mitigation and Monitoring Plan for the project, if needed.

To address concerns about effects of the WID project on aquatic resources, we sampled the Bighorn River for the presence of sturgeon chub, plains minnow, and western silvery minnow in the portion of the Bighorn River considered likely to be impacted by flow modification resulting from the project. The goals of this survey were to:

1) Identify presence and/or absence of the target species along the river's project area,
2) Qualitatively characterize macrohabitat of survey reaches of each study site,
3) Provide baseline data for use in the environmental impact analysis for the Westside project,
4) Provide baseline data for a before-after-comparison-investigation (BACI design) if needed and if target species or other sensitive species are documented, and
5) Provide insight and recommendations for mitigation and monitoring efforts in terms of water quality and quantitative measurement of micro- and macrohabitats, if needed, based on the overall impact analysis and permitting requirements.

2.0 METHODS

2.1 Study Period

Sampling took place between 28-31 August 2005, after the peak summer flow period (Wiley et al. 1995; based on post-dam construction hydrographs at Boysen Dam; also based on the suggestion by Mark Smith, Regional Fisheries Biologist, WGFD, Cody, pers. comm. 14 Feb 05). Suitable habitat for the target species is generally turbid, shallow water (<3ft [91cm]), with swift flows (~ 0.3-3 ft/sec [9-91 cm/sec]) over sand, gravel, or rock substrates, or shallow protected areas adjacent to such habitats. Late summer conditions were expected to create the maximum amount of suitable habitat in the study area. However, total discharge from Boysen Reservoir in August 2005 was 81367 cfs, and was much higher than the previous 5 years (August 2000-2004 ranged from 53576-65651 cfs; USBR Hydromet data for Boysen Reservoir, http://www.usbr.gov/gp/hydromet/).

2.2 Study Area

We defined this study area to start about 3.6 miles north of Worland and end at the bridge over the river at Manderson (Figure 1). The project study area was broken into three reaches, each approximately six river miles in length (Figure 1). These include (1) the upstream site (upstream of diversion-1, approximately half mile upstream of gravel pit), (2) impact-1 site (between diversion-1 and diversion-2), and (3) impact-2 site (diversion-2 to Manderson). Each site was surveyed for target fish species at 5 different river reaches. Sampling locations were chosen based on the availability of suitable habitat. We targeted reaches where swift, shallow flows occurred adjacent to slightly deeper side channel and/or pool habitats. Due to relatively high flow conditions compared to previous years, we did not find an abundance of suitable habitat, and our sampling locations represent the majority of ideal available habitat for the target species. River reaches surveyed that contained suitable habitat were all at least 100 meters long. However, distances seined were constrained by available habitat. Riffle habitats ranged from 5-25 meters, and pool and side channel habitat ranged from 15-100 meters in length.

2.3 Sampling Methods

Fish Communities. **–** Methods for sampling fishes followed those of Plafkin et al. (1989), and Barbour (1999). Fish were captured using a seine, and all seinable habitat was covered. Our large bag seine was 25 ft (7.6m) long and 6 ft (1.8m) deep. Mesh size was 3/16-in (7.5mm), and incorporated a 6 ft by 6 ft bag. We used a smaller 15-foot (4.6m) straight seine for sampling smaller areas of habitat, or areas with obstructions, and for kick-seining riffles. Fish were identified, counted, checked for anomalies, and returned to the water. Young-of-the-year fish were identified when possible and all unidentified fishes too small for correct identification (typically fish < 20 millimeters total length) were categorized to the nearest taxon possible (e.g., unidentified Cyprinid, Centrarchid, Ictalurid, or *Notropis sp*., *Pimephales sp*., etc.). No reach was sampled more than once in order to keep effort standard in terms of linear river coverage.

A seine haul was initiated from the downstream end of the reach and progressed upstream. In some cases, multiple haul-outs were necessary to cover the sample area, but no backtracking downstream occurred. All fishes were transferred to 5-gallon buckets filled with river water (at least four buckets were available along shoreline). Fishes were processed and returned to water after 50 meters of river was seined; however, all fish were returned to the river below the sampled reach before seining the upper reach so that no individuals would be recaptured. All fish were returned to the river via aquarium net or wet hand immediately after identification. Biologists were trained in species identification using comparative collections at the University of Wyoming and field guides such as Pflieger (1975), Eddy and Underhill (1978), and Baxter and Stone (1995). One biologist has extensive previous experience sampling lotic systems for non-game and game fishes.

Physical Macrohabitat Characterization. **–** Two to 4 transects per site were used to measure mean depth, velocity, and width for later use in the cross-sectional/incremental method if needed (Platts et al. 1983). Current velocity (m/s), depth (m), and substrate type, were measured at 20, 40, 50, 60, and 80% of the stream width at each transect (Platts et al. 1983). At

depths less than 0.75 m, one measurement of the velocity was taken at 60% of the water depth (Buchanan and Somers 1969; McMahon et al. 1996). At depths greater than 0.75 m, velocity was measured at 20% and 80% of the water depth (Buchanan and Somers 1969). Current velocity was measured using a Global Flow Probe Model FP101 flowmeter during the first two days, but the flowmeter broke, and we then estimated flow at the surface based on the time it took a floating object to travel a known distance. These same transects were used to visually estimate substrata coverage (%) using the modified Wentworth scale (Cummins 1962; bedrock or boulder = > 256 mm, cobble = 65 - 256 mm, pebble = 32 - 64 mm, gravel = 2 - 32 mm, sand = 0.0625 - 2 mm, silt = 0.0039 - 0.0625 mm, clay = < 0.0039 mm). Percent coverage of riffle, pool, and run was also visually estimated. Water temperature was measured in the sample area. GPS coordinates (UTM NAD27) were collected at the head of each survey reach and a unique label was given to the reach. A diagram of each sample site (except U-1) was drawn to show river morphology, hydrology, and relative location of sample areas.

3.0 RESULTS

We sampled 15 areas of suitable habitat, 5 in each river reach of the study area (Figure 2; coordinates in Table 1). We also conducted seine hauls in 2 smaller areas of potential habitat: one pool at the mouth of an inlet, and one pool associated with an oxbow. Seine hauls were conducted in riffles, pools, and in side channels adjacent to runs. Overall availability of riffle, run, and side channel/pool habitats varied among sample sites (see Appendix B for diagrams of sample sites).

Fish. -- No sturgeon chub, plains minnow, or western silvery minnow were found. A total of 1088 fish representing 13 species were captured, identified, and released (Table 2). We found both adults and juveniles for all but 4 of the species encountered (Tables 3-5). However, one of these species was young-of-the-year minnows less than 20 mm in length and were coded as unidentified minnow. These were most often, if not always, either sand shiners or flathead chubs, but close scrutiny was refrained in order to get these small, fragile individuals back in the river as soon as possible. Therefore, the actual total number of species is 12. Eleven species were observed in the upper reach where the most numerous fishes were fathead minnow (173), unidentified minnow (139), sand shiner (88), and river carpsucker (67), and to a lesser degree the remaining 8 species. Ten species were observed in the middle reach where the most numerous fishes were longnose dace (111), unidentified minnow (59), sand shiner (54), flathead chub (26), and to a lesser degree the remaining 7 species. Nine species were observed in the lower reach where the most numerous fishes were unidentified minnow (93), sand shiner (34), longnose dace (30), flathead chub (28), and to a lesser degree the remaining 6 species. Four sauger were observed, one adult (middle reach) and three juveniles all about 6 inches in length (one upper reach, two lower reach). Given the length of the juvenile saugers, it is likely that they are of the 2004 year-class (Figure 3).

Physical Measurements. – In the sampled areas, total river width ranged from 10 to 62 m. In some cases, total river width is the sum of more than one river channel where sampled areas were within braided river channels. Sampled river depths ranged from 0.15 to >1.5 m (too deep

to measure with a hand-held staff in swift current). Water temperatures at sampled sites were 65-70°F. Current velocities ranged from 0 to >3.5 m/sec. Substrate types ranged from deep unconsolidated silt to gravel and pebble/cobble with some boulder sized materials (Figure 4). In general, courser substrate types were found in areas with higher current velocities, while silt/sand sites generally had lower current velocities. Sample site physical characteristics are included in Appendix A.

4.0 DISCUSSION

No plains minnows, sturgeon chubs, or western silvery minnows were found in this study. Fish species encountered were generally representative of turbid, warm water rivers in northern Wyoming. We did not detect any shovelnose sturgeon, stonecats, or longnose suckers. Sturgeon are unlikely to be caught in a seine, so their absence does not mean they are absent from the Bighorn River. Adult longnose suckers may also be less vulnerable to seining gear, although we would have expected juveniles. However, at sites in all 3 reaches we were successful in catching 1 adult sauger and 3 juvenile sauger. We expected that we would catch stonecats if a somewhat abundant and reproducing population was present. The riffle areas surveyed throughout the study area varied in depth, substrate, and current speed. Longnose dace were common to all these areas, as was a prolific macroinvertebrate larvae-load including, but not restricted to, Hydropsychids (caddisfly sp.), Baetids (mayfly sp.), and Libellulids (dragonfly sp.). Therefore, if this area is known to harbor stonecats, then they were surprisingly absent. Strong currents due to the above-average river discharge for this time of year may have inhibited the efficiency of seining and kick-seining for this species.

Seining surveys conducted by WGFD between 2000 and 2002 did not detect sauger (M. Smith, pers. comm..). The results of our 2005 survey indicate that the Bighorn River segment between Worland and Manderson is used by both adult and juvenile sauger. While it is unknown as to the general population level of adult sauger in this river segment, it would appear that it is an important rearing area for juvenile sauger. It is also unknown if adult sauger spawn in this river segment or whether they use shoals or other suitable spawning habitat upstream or downstream.

Common shiners were not previously documented in the Bighorn River. Our identification of this species was based on big eyes and mouth, laterally compressed bodies, large diamond or crescent-shaped lateral line scales, strongly dipping lateral line, and lack of notable mid-line stripes. The adult size was indicative of medium-sized common shiners, which would be similar to very large adult emerald shiners (*Notropis atherinoides*). It is possible that these fish were emerald shiners; however they did not seem as slender and they lacked pigmentation indicative of emerald shiners (though chin pigmentation was not inspected). Loss of pigmentation is not uncommon during seining and handling, especially while being retained in a holding bucket.

The number of sites surveyed was lower than our original study plan, 15 instead of 30. Due to the atypical high river discharge, it would have been difficult to come up with more than 5 sites per reach that contained suitable habitat, especially having both riffle and pool and/or side channel. However, we feel that we did sample the majority of suitable habitat that was seinable, such as side channels and pools in proximity to riffles and strong runs. Attempts were also made

to incorporate any stream morphologic feature that provided backwater-type habitat, either via small tributary or old river channel (see photographic examples of survey sites, Appendix C). Overall, survey results are representative of fish species using those habitats in the Bighorn River between Worland and Manderson, though no target species were detected.

If high flows precluded detection of stonecats, they may have also affected seining efficiency for sturgeon chubs, a species found in swift riffle currents with tight affinity to the stream substrate. Efforts were made upstream of the seine to disrupt upstream pebble and cobble while kick-seining, and macroinvertebrates and longnose dace were successfully captured even though currents were at times very swift. The sturgeon chub has not been collected in the Bighorn River drainage since the late 1960's.

The plains minnow prefers slower water and side pools of turbid streams (Baxter and Stone 1995). Baxter and Stone (1995) cite habitat preferences for the western silvery minnow in Wyoming based upon seminal works on fishes in Kansas (Cross 1967) and Canada (Scott and Crossman 1973), simply stating a preference for sluggish flow and silted bottoms of large rivers. Pflieger (1975) states that the plains and western silvery minnows occur at the same localities but tend to be segregated ecologically; the plains minnow predominates in the river channel where there is a sandy bottom and some current, whereas the western silvery minnow is more abundant in protected areas with little current and a silt bottom, including quiet lower reaches of tributaries. Sluggish flow and silted bottom habitats of the Bighorn River during August 2005 were likely deeper than normal, we noted several backwater areas with soft substrate during reconnaissance with canoe that were too deep to seine. We did survey several other backwater silty areas where we were successful seining all sauger. Habitats of tributaries far away from the main river could possibly have provided suitable habitat for *Hybognathus* species during high discharge of the main river as well. It is believed that the western silvery minnow may have been extirpated since the time of the construction of the Big Horn Reservoir (Baxter and Stone 1995).

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Table 1. UTM coordinates (UTM zone 13, NAD 27) of sampling locations on the Bighorn River, Wyoming, 28-31 August 2005.

REACH	SITE	DATE SAMPLED	EASTING	NORTHING
Upper	U-1	28 Aug	265341	4883590
Upper	U-2	28 Aug	265214	4884412
Upper	U-3	31 Aug	265496	4885226
Upper	U-4	31 Aug	265248	4886942
Upper	U-5	31 Aug	265862	4888922
Middle	M-1	29 Aug	265784	4890457
Middle	M-2	29 Aug	265850	4891943
Middle	M-3	29 Aug	266232	4893767
Middle	M-4	29 Aug	266793	4895994
Middle	M-5	29 Aug	267143	4897151
Lower	L-1	30 Aug	267231	4898434
Lower	L-2	30 Aug	266311	4899727
Lower	L-3	30 Aug	265198	4902093
Lower	L-4	30 Aug	264431	4903633
Lower	L-5	30 Aug	264682	4904614
Middle	Inlet 1	29 Aug	265859	4892949
Middle	Oxbow	29 Aug	265964	4893304

Table 2. List of fish species caught by seining in the Bighorn River, Wyoming, 28-31 August 2005.

Code	Common Name	Scientific Name
RICA	River carp sucker	*Carpiodes carpio*
FAMI	Fathead minnow	*Pimephales promelas*
SASH	Sand shiner	*Notropis stramineus*
CHCA	Channel catfish	*Ictalurus punctatus*
YEPE	Yellow perch	*Perca flavescens*
WHSU	White sucker	*Catostomus commersoni*
LODA	Longnose dace	*Rhinichthys cararactae*
FLCH	Flathead chub	*Platygobio gracilis*
COSH*	Common shiner	*Notropis cornuta*
SHRE	Shorthead redhorse	*Moxostoma macrolepidotum*
SAUG	Sauger	*Stizostedion canadense*
COCA	Common carp	*Carassius carassius*
UNMI	Unidentified minnow	

* Possibly emerald shiners that were mis-identified.

Table 3. Summary of fish captures by age and location in the UPPER REACH.

		U1		U2		U3		U4		U5			
		pool / side channel	riffle	pool / side channel	riffle	pool / side channel	riffle	pool / side channel	riffle	pool / side channel	riffle	TOTAL by species/ age	TOTAL by species
RICA	adult	2										2	67
	yoy	65										65	
FAMI	adult	170		3								173	173
	yoy											0	
UNMI	adult											0	139
	yoy	90		16		11		18		4		139	
SASH	adult	52		7		14		1				74	88
	yoy	9		1		3		1				14	
CHCA	adult											0	1
	yoy	1										1	
YEPE	adult	2										2	2
	yoy											0	
WHSU	adult											0	40
	yoy	16		23		1						40	
LODA	adult		6		8							14	52
	yoy		13		25							38	
FLCH	adult			4		1		13		2		20	20
	yoy											0	
COSH*	adult			4								4	5
	yoy			1								1	
SHRE	adult							2				2	5
	yoy					3						3	
SAUG	adult							1				1	1
	yoy											0	
COCA	adult											0	0
	yoy											0	
TOTALS by site		407	19	59	33	33	0	36	0	6	0		

* Possibly emerald shiners that were mis-identified.

Table 4. Summary of fish captures by age and location in the MIDDLE REACH.

		U1		U2		U3		U4		U5			
		pool / side channel	riffle	pool / side channel	riffle	pool / side channel	riffle	pool / side channel	riffle	pool / side channel	riffle	TOTAL by species/ age	TOTAL by species
RICA	adult											0	0
	yoy											0	
FAMI	adult			1								1	1
	yoy											0	
UNMI	adult											0	59
	yoy	12		1		21	2	20		1	2	59	
SASH	adult	2		7		13		28		3		53	54
	yoy					1						1	
CHCA	adult											0	3
	yoy	1	1	1								3	
YEPE	adult											0	0
	yoy											0	
WHSU	adult											0	2
	yoy							2				2	
LODA	adult	1	5		3		8	1	1			19	111
	yoy		22		9	1	39		10		11	92	
FLCH	adult	3		3		13		3		2		24	26
	yoy	1						1				2	
COSH*	adult	6	1					1				8	12
	yoy	4										4	
SHRE	adult			1						1		2	8
	yoy					2		4				6	
SAUG	adult			1								1	1
	yoy											0	
COCA	adult							4				4	6
	yoy							2				2	
TOTALS by site		30	29	15	12	51	49	66	11	7			

* Possibly emerald shiners that were mis-identified.

Table 5. Summary of fish captures by age and location in the LOWER REACH and two ADDITIONAL SITES.

		L1		L2		L3		L4		L5		Addl. Site - Inlet 1	Add.. Site - Oxbow		
		pool / side channel	riffle	pool / side channel	riffle	pool / side channel	riffle	pool / side channel	riffle	pool / side channel	riffle	pool / side channel	Stream outlet	TOTAL by species /age	TOTAL by species
RICA	adult													0	0
	yoy													0	
FAMI	adult							1				1		2	8
	yoy											6		6	
UNMI	adult													0	93
	yoy	3	8	29	17	13	2	5		15	1			93	
SASH	adult			3	3	4		1		5		2		18	34
	yoy		1	4	6	4				1				16	
CHCA	adult													0	1
	yoy									1				1	
YEPE	adult													0	0
	yoy													0	
WHSU	adult					2								2	8
	yoy					5	1							6	
LODA	adult		1				1							2	30
	yoy		3	1	9		10				4	1		28	
FLCH	adult		1	7	1	5		3						17	28
	yoy		1										10	11	
COSH*	adult													0	0
	yoy													0	
SHRE	adult													0	7
	yoy			3	1	1		1				1		7	
SAUG	adult	2												2	2
	yoy													0	
COCA	adult												1	1	1
	yoy													0	
TOTALS by site		5	15	47	37	34	14	11	0	22	5	11	11		

* Possibly emerald shiners that were mis-identified.

Figure 1. General sampling area on the Bighorn River in Washakie and Big Horn Counties for the Westside Irrigation District (WID) EIS.

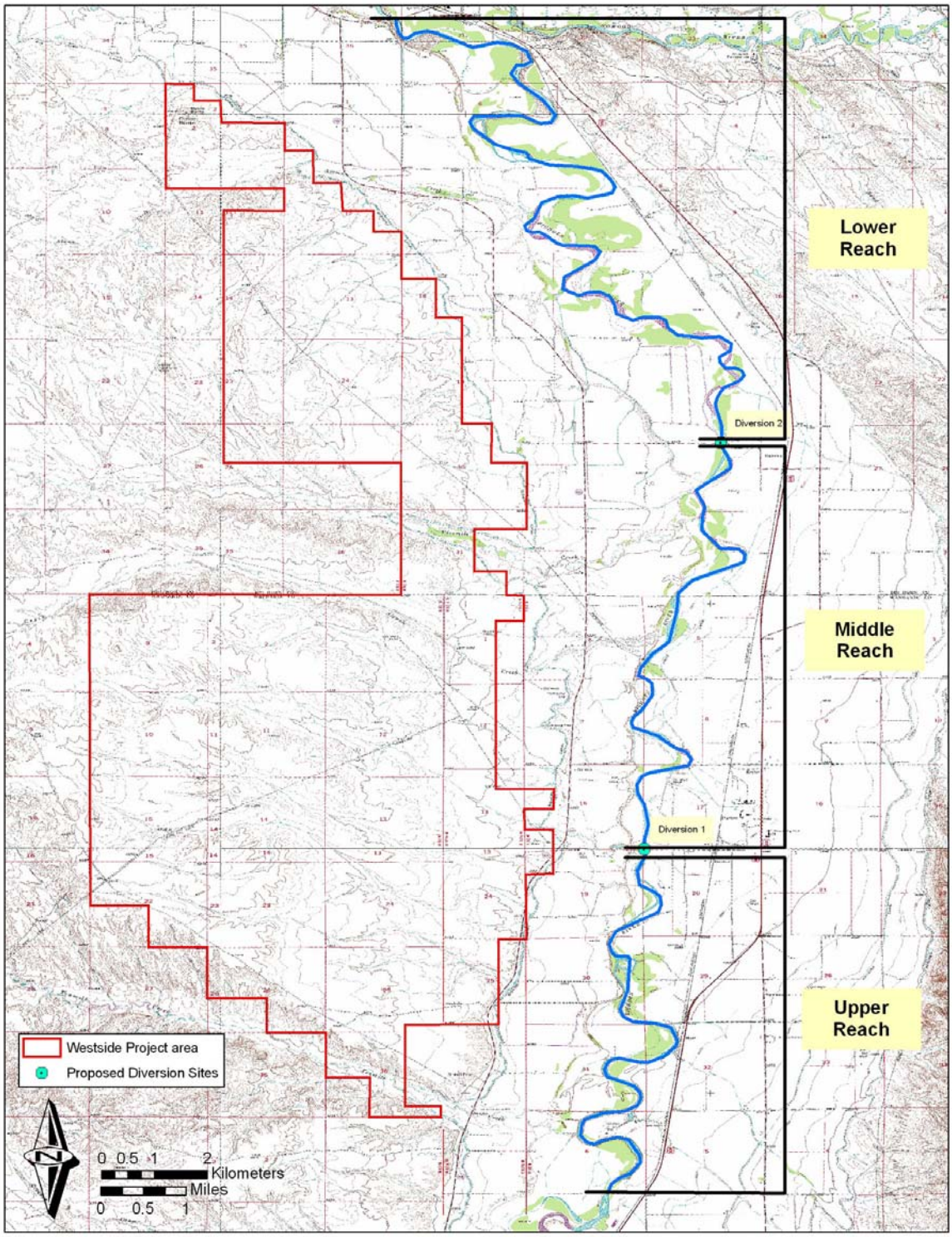


Figure 2. Seining locations on the Bighorn River, 28-31 August 2005.

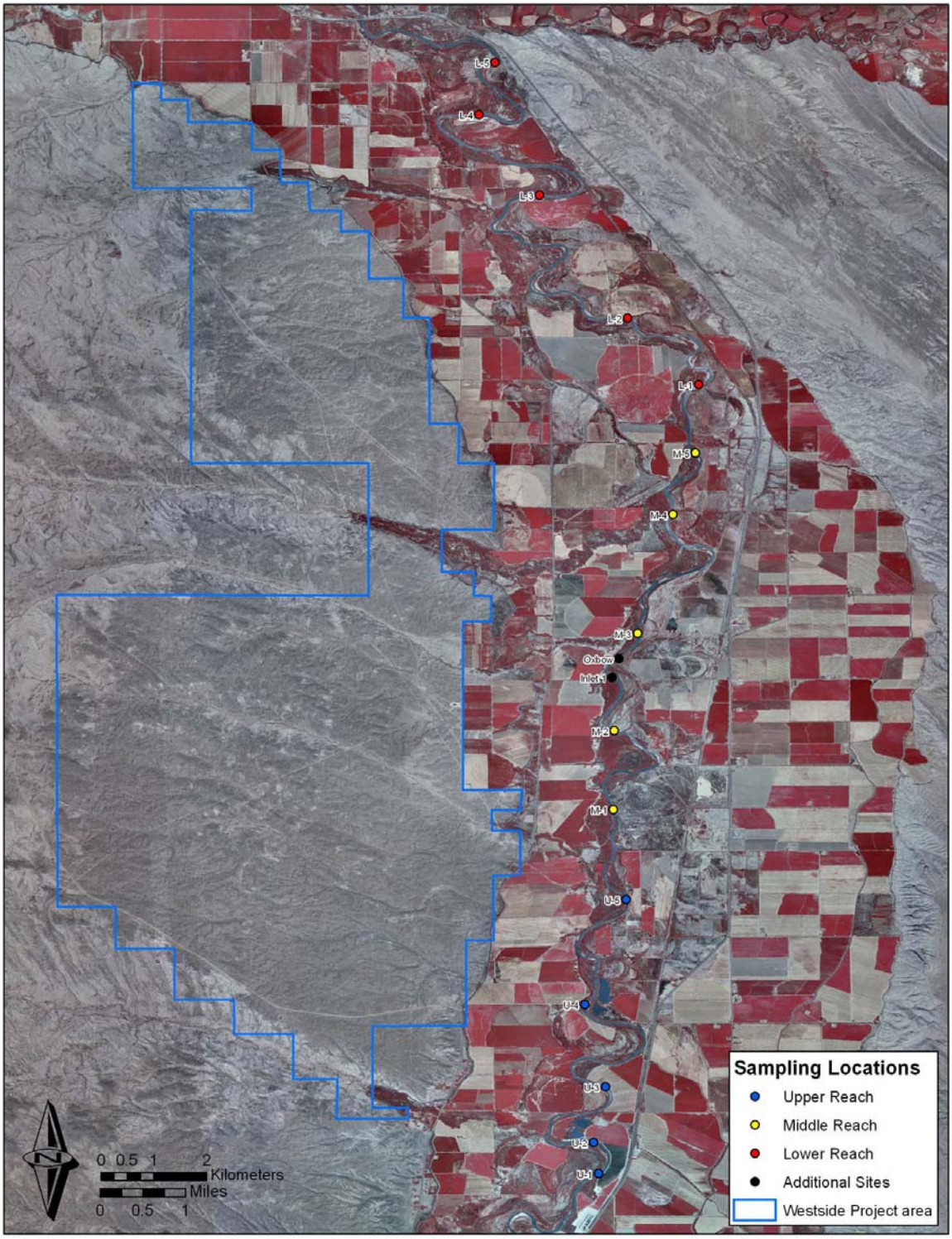


Figure 3. Juvenile sauger captured and released on the Bighorn River, 28-31 August 2005.

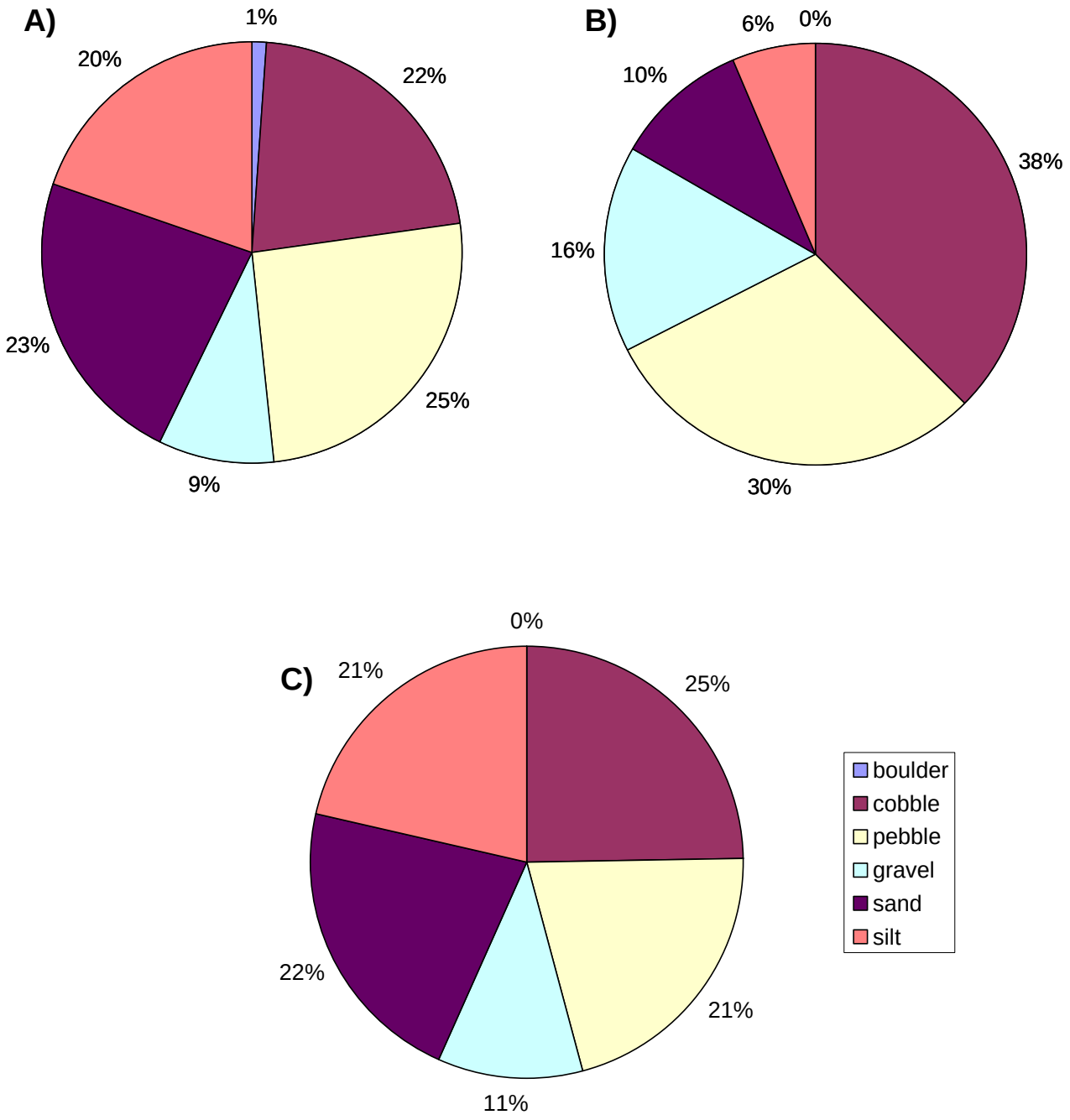


Figure 4. Average substrate composition at the A) upper reach sites, B) middle reach sites, and C) lower reach sites. Site-by-site substrate descriptions are in Appendix A.

APPENDIX A. Physical characteristics of sample sites.

Physical Characteristics at sampling sites in the UPPER REACH, Bighorn River, 28-31 Aug 2005.

				20% Stream Width								40% Stream Width								60% Stream Width								80% Stream Width								100% Stream Width							
						substrate								substrate								substrate								substrate								substrate						
Site	Date	tran.	wid (m)	dep (m)	curr. (m/s)	BO	CO	PE	GR	SA	SI	dep (m)	curr. (m/s)	BO	CO	PE	GR	SA	SI	dep (m)	curr. (m/s)	BO	CO	PE	GR	SA	SI	dep (m)	curr. (m/s)	BO	CO	PE	GR	SA	SI	dep (m)	curr. (m/s)	BO	CO	PE	GR	SA	SI
U-1	28-Aug	1	44.6	0.15	3.1cfs		15	70	15			0.25	2.8cfs		40	45		15		0.35	3.4cfs		50	40	10			0.45	4.6cfs		50	40	10			0.4	2.9cfs		60	10	30		
U-1	28-Aug	2	24	0.9	4.4cfs		20	60	10	10		0.9	2.2cfs		20	60	10	10		0.95	2.9cfs		30	60	10			0.8	1.8cfs		15	50	20	15		0.6	0						100
U-1	28-Aug	3	27	1.3	2.7cfs		30	60	10			1.2	2.7cfs		20	50	30			1.05	1.9cfs				20	80		0.8	0					50	50	0.7	0					20	80
U-1	28-Aug	4	26	1.4	1.7cfs		60	40				1.25	1.5cfs		70	20	10			1.05	1.3cfs		40	40	20			1	1.2cfs					100		0.9	0.6cfs			10		20	70
U-2	28-Aug	1	42	0.65	3.3cfs		10	50	40			0.6	3.3cfs		20	60	20			0.55	0.67			70	30			0.45	0.8		10	50		40		0.3	0.8		40	35	10	15	
U-2	28-Aug	2	43	0.5	1		25	75				0.4	3.3cfs			50	30	20		0.5	3.3cfs		50	40	10			0.55	3.3cfs		60	25		15		0.45	3.3cfs		15	60	15	10	
U-2	28-Aug	3	35.5	0.45	0.8			90	10			0.5	0.91		20	60	10	10		0.7	1		30	50		20		0.7	1		20	60	10	10		0.4	1		10	50		40	
U-2	28-Aug	4	40	1.3	0.33			30	20	10	40	1.2	0.5						100	0.8	0.67		10	60	20	10		1	0.67		15	55	15	15		0.9	0.57		10	20		70	
U-3	31-Aug	1	26	0.6	0.48		20			40	40	0.75	0.5		60	10	20	10		0.8	0.63		50			50		0.9	0.71		30			70		1	0.67					100	
U-3	31-Aug	2	28	0.7	0.67				10		90	0.9	0.67		10			90		1.1	0.67		50			50		1.3	0.67		15		10	75		1.3	0.6		70	20	10		
U-4	31-Aug	1	25	0.45	0.44		20			40	40	0.5	0.5		50			50		0.65	0.49					100		1.3	0.67		20			80		>1.5	too swift and deep to measure						
U-4	31-Aug	2	23	0.45	0						100	0.5	0						100	0.75	0.53				10		90	1.15	0.71		50	40	10			1.3	too swift and deep to measure						
U-5	31-Aug	1	10	0.9	0.43		100					1.1	0.67				10	90		1	0.45						100	0.9	0.44						100									
U-5	31-Aug	2	10	0.7	0.43						100	0.9	0.48				20		80	1.1	0.5				50	50		0.8	0.42	80	20												

Physical Characteristics at sampling sites in the MIDDLE REACH, Bighorn River, 28-31 Aug 2005.

				20% Stream Width								40% Stream Width								60% Stream Width								80% Stream Width								100% Stream Width							
						substrate								substrate								substrate								substrate								substrate						
Site	Date	tran.	wid (m)	dep (m)	curr. (m/s)	BO	CO	PE	GR	SA	SI	dep (m)	curr. (m/s)	BO	CO	PE	GR	SA	SI	dep (m)	curr. (m/s)	BO	CO	PE	GR	SA	SI	dep (m)	curr. (m/s)	BO	CO	PE	GR	SA	SI	dep (m)	curr. (m/s)	BO	CO	PE	GR	SA	SI
M-1	29-Aug	1	37	0.95	1		20	60	20			0.7	0.95		40	40	20			0.55	0.8		30	30	40			0.25	0.91		40	45	15			0.45	0		60	25	15		
M-1	29-Aug	2	49.5	0.75	1.43		50	30	20			0.65	1.18		20	65	15			0.3	0.87		50	25	15	10		0.35	0.67			55	25	20		0.75	0.4		30	50	10	10	
M-1	29-Aug	3	47	0.7	1.11			50	50			0.35	0.91			25	75			0.2	0.5			25	10	15	50	0.55	0.48			20		40	40	1	0.57		50	15	20	15	
M-2	29-Aug	1	50	0.4	1.25		40	40	20			0.5	1.33		30	40	30			0.6	1.67		45	45	10			0.4	0.95		70	20		10		0.45	1		90		10		
M-2	29-Aug	2	31	1	1		40	50	10			0.9	0.91		20	50	30			0.8	0.71		60	20	10	10		0.6	0.5					100		0.6	0.4		20			40	40
M-2	29-Aug	3	31	0.9	1		60	20	20			0.7	0.83		60	20	20			0.6	0.67		40	20	20	20		0.65	0.59		50			50		0.45	0.5		20	55	15	10	
M-3	29-Aug	1	56.5	0.6	1.33		20	70	10			0.65	0.56		60	20	20			0.3	0.91		50	20		30		0.3	0.95			80	20			0.45	0.67			60	40		
M-3	29-Aug	2	36	0.6	0.95		50	25	25			0.7	0.91		50	40	10			0.9	1		60	30	10			0.6	0.95		30	55	15			0.45	0.5		50	25		25	
M-3	29-Aug	3	36	0.8	0.91		50	35	15			1	1		30	40	30			0.9	0.91		30	30	30	10		0.9	0.65		50	30	10	10		0.7	0.4		10			45	45
M-4	29-Aug	1	52	0.25	0		40				60	0.4	0			30	70			0.85	0.8		70	30				0.5	0.91		80	20				0.5	0.8		50	20		30	
M-4	29-Aug	2	62	0.3	0.2						100	0.35	0.25					20	80	0.65	0.95		65	20		15		0.5	1		60	20		20		0.35	0.95		20	60	20		
M-5	29-Aug	1	45	0.9	0.74		60	20	20			1	1		70	30				1	0.91		65	20	15			0.5	0.77		60		20	20		0.35	0.67		10	70	20		
M-5	29-Aug	2	45	0.3	0.61			20		80		0.45	0.91		30	45	25			0.65	0.95		65	10	15	10		0.7	0.67		65	15	10	10		0.65	0.67		60	20	20		

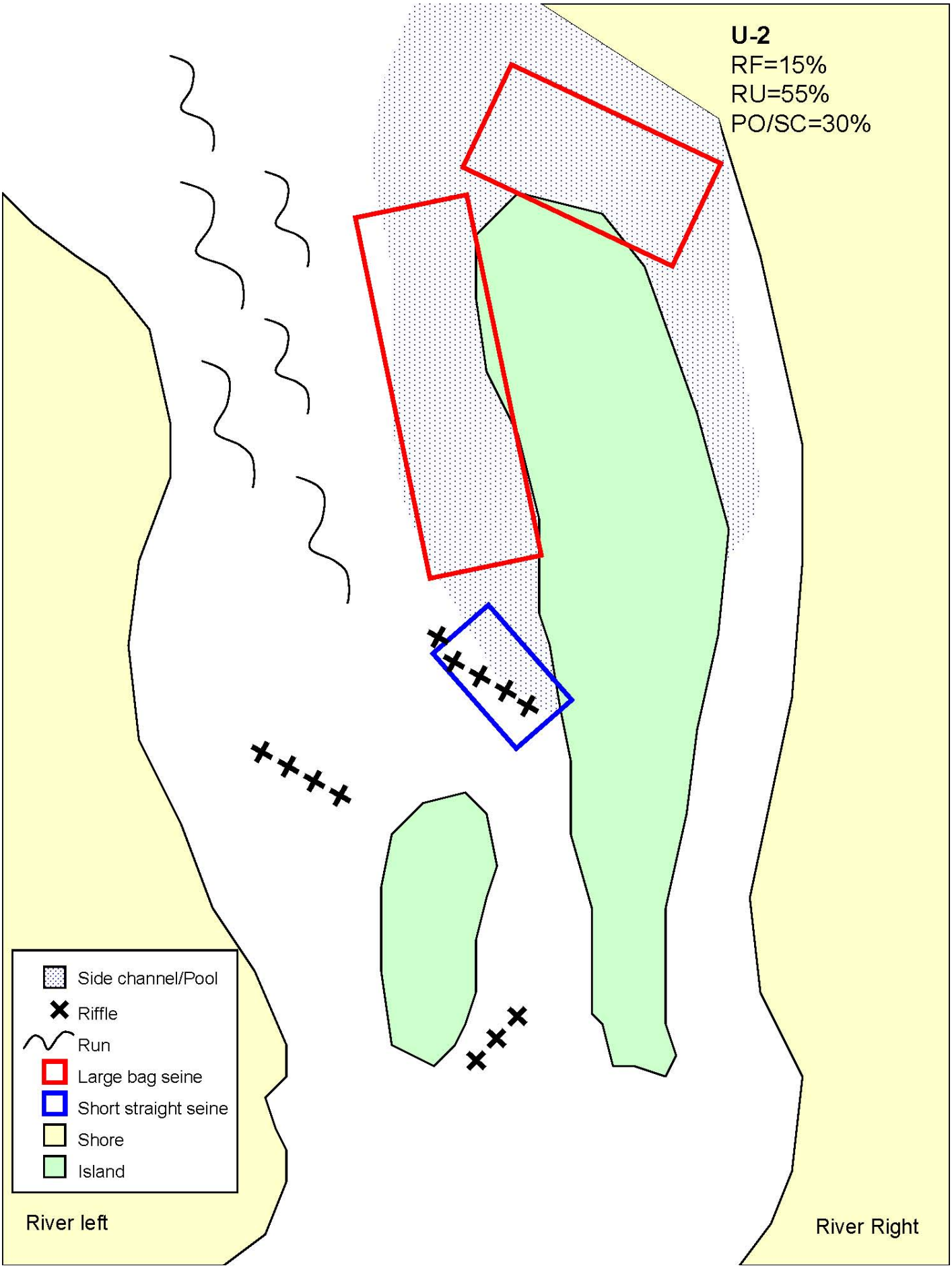
Physical Characteristics at sampling sites in the LOWER REACH, Bighorn River, 28-31 Aug 2005.

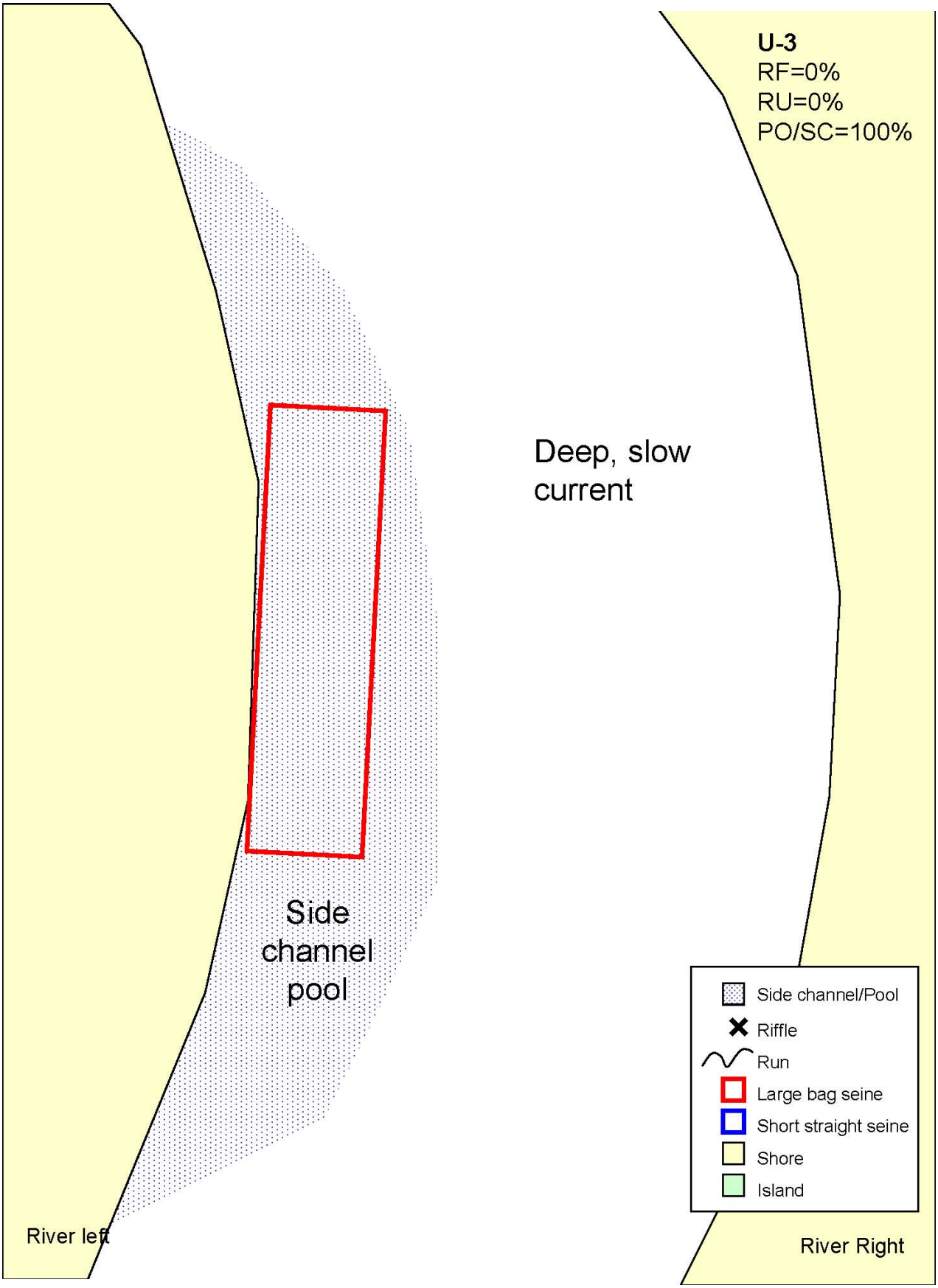
				20% Stream Width								40% Stream Width								60% Stream Width								80% Stream Width								100% Stream Width							
						substrate								substrate								substrate								substrate								substrate						
Site	Date	tran.	wid (m)	dep (m)	curr. (m/s)	BO	CO	PE	GR	SA	SI	dep (m)	curr. (m/s)	BO	CO	PE	GR	SA	SI	dep (m)	curr. (m/s)	BO	CO	PE	GR	SA	SI	dep (m)	curr. (m/s)	BO	CO	PE	GR	SA	SI	dep (m)	curr. (m/s)	BO	CO	PE	GR	SA	SI
L-1	30-Aug	1	30	1.25	1		15	85				1.2	fast		100					1	0.91		30	50	20			0.8	0.91		50	50				0.55	0						100
L-1	30-Aug	2	35	>1.5	fast		100					1.2	0.59		10	50	40			0.65	0						100	0.4	0						100	0.3	0						100
L-1	30-Aug	3	30	1.3	fast		100					1.2	fast		50	50				1.15	0.71			40	60			0.7	0						100	0.3	0						100
L-2	30-Aug	1	26	0.4	0.67			20		80		0.75	0.67		10	40		50		0.9	0.87		10	40		50		1.05	0.83		10	45	30	15		1.45	0.77		70	30			
L-2	30-Aug	2	23	0.45	0.4					50	50	0.85	0.61					100		1.15	0.45		30	20		50		1.3	0.67		30	50	20			>1.5	0.77		70	30			
L-2	30-Aug	3	30	0.25	1		70	30				0.4	1		60	25	15			0.55	0.87			50	40	10		0.8	0.91		30	50	20			0.9	1		10	55	20	15	
L-3	30-Aug	1	18	0.35	0						100	0.6	0.5					50	50	0.8	0.91		10	60		30		1	1		20	60	20			1.2	1		80	10	10		
L-3	30-Aug	2	20	0.7	0.48						100	1	0.67					80	20	1.1	0.67		60	30	10			1.1	0.63		80	20				1.1	0.91		70	10	20		
L-3	30-Aug	3	25	0.35	0.87		70	15	15			0.2	0.95			50	50			0.2	1.11			50	50			0.35	1.11		50	20	30			0.4	1.05		50	50			
L-4	30-Aug	1	28	0.65	0.61					30	70	0.75	0.59			20		80		1.1	0.95			30	50	20		0.45	0.67				30		70	0.2	0.48						100
L-4	30-Aug	2	34	0.65	0.87			30	30	40		0.7	0			30	30	40		0.8	1			60	40			0.8	1		70	20	10			0.5	0.57					30	70
L-5	30-Aug	1	35	0.4	0		20				80	0.55	0.5		40	40	20			0.9	0.91		50	20	30			1.2	1					100										
L-5	30-Aug	2	40									0.7	0.33					80	20	0.85	0.67					100		1.1	0.77					100		1	1.11		70		20	10	
L-5	30-Aug	3	40	0.65	0.33					20	80	0.7	0.5					100		0.7	0.59					100		0.8	0.67		80	10	10			0.95	0.67					80	20

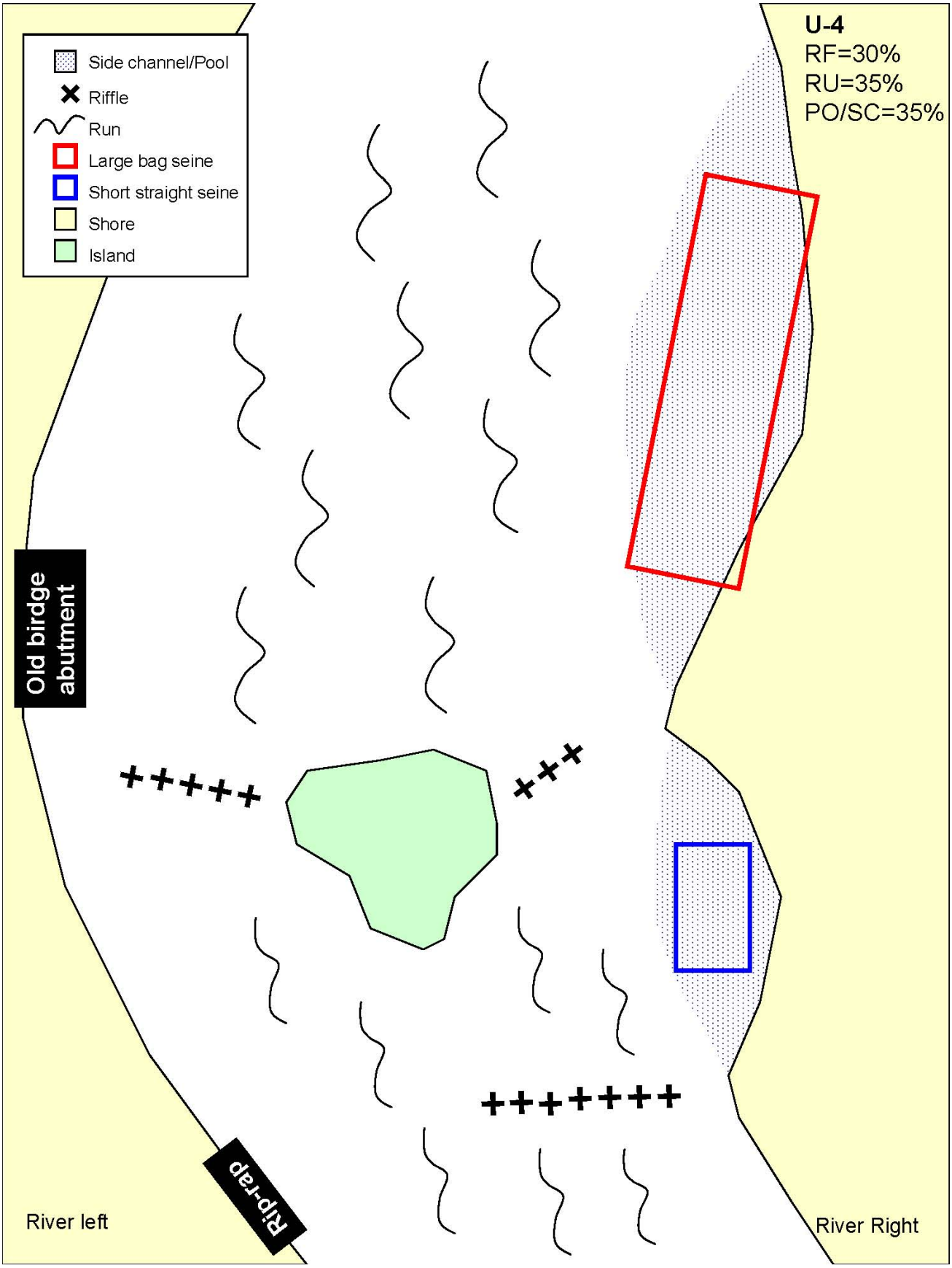
U-1

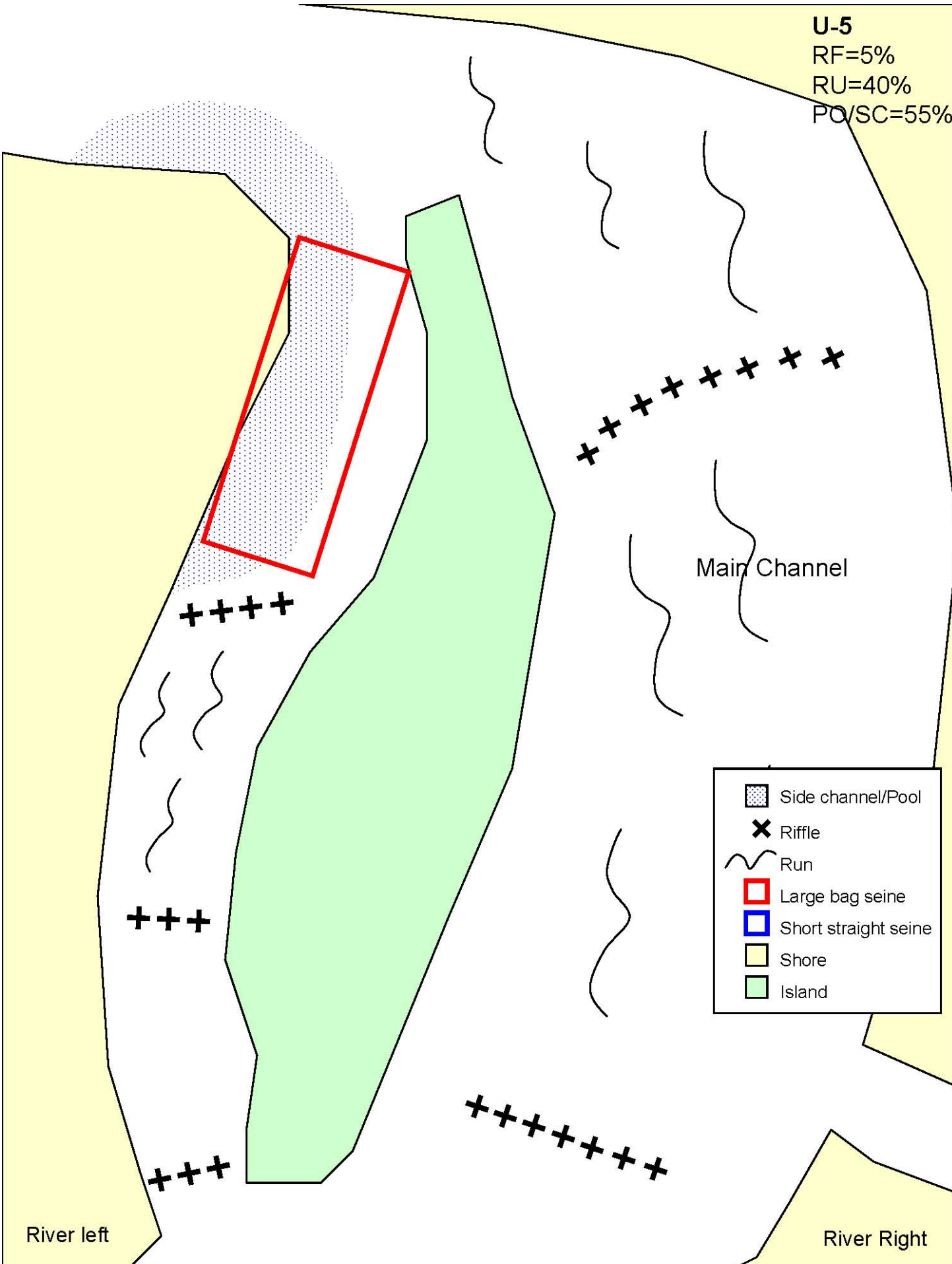
No site diagram or pictures available.

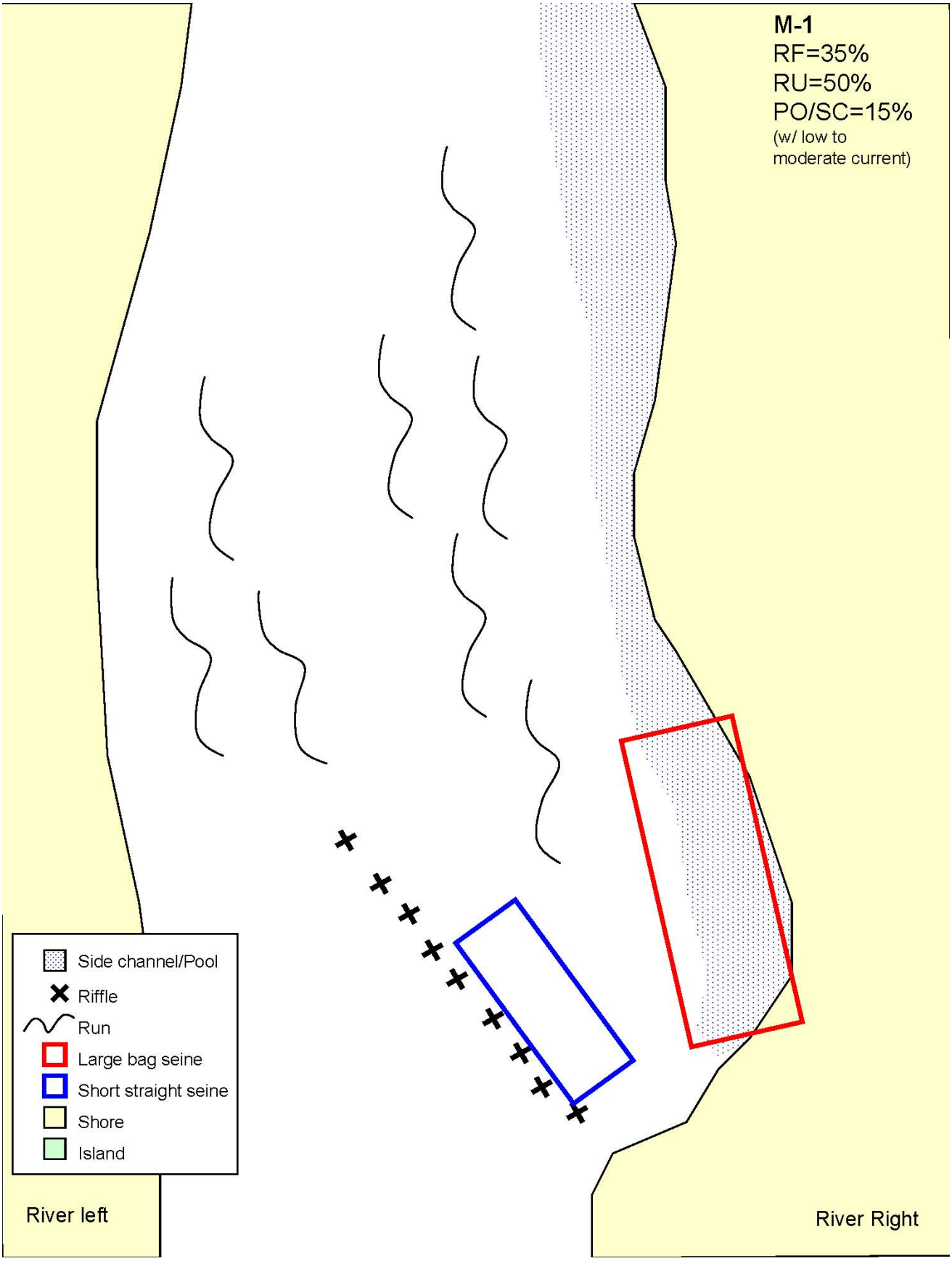
This sampling site was located on the inside of a gently curving river bend. The large bag seine was used along 100m of side channel habitat. The short straight seine was used along 20 meters of riffle habitat just upstream of the side channel.

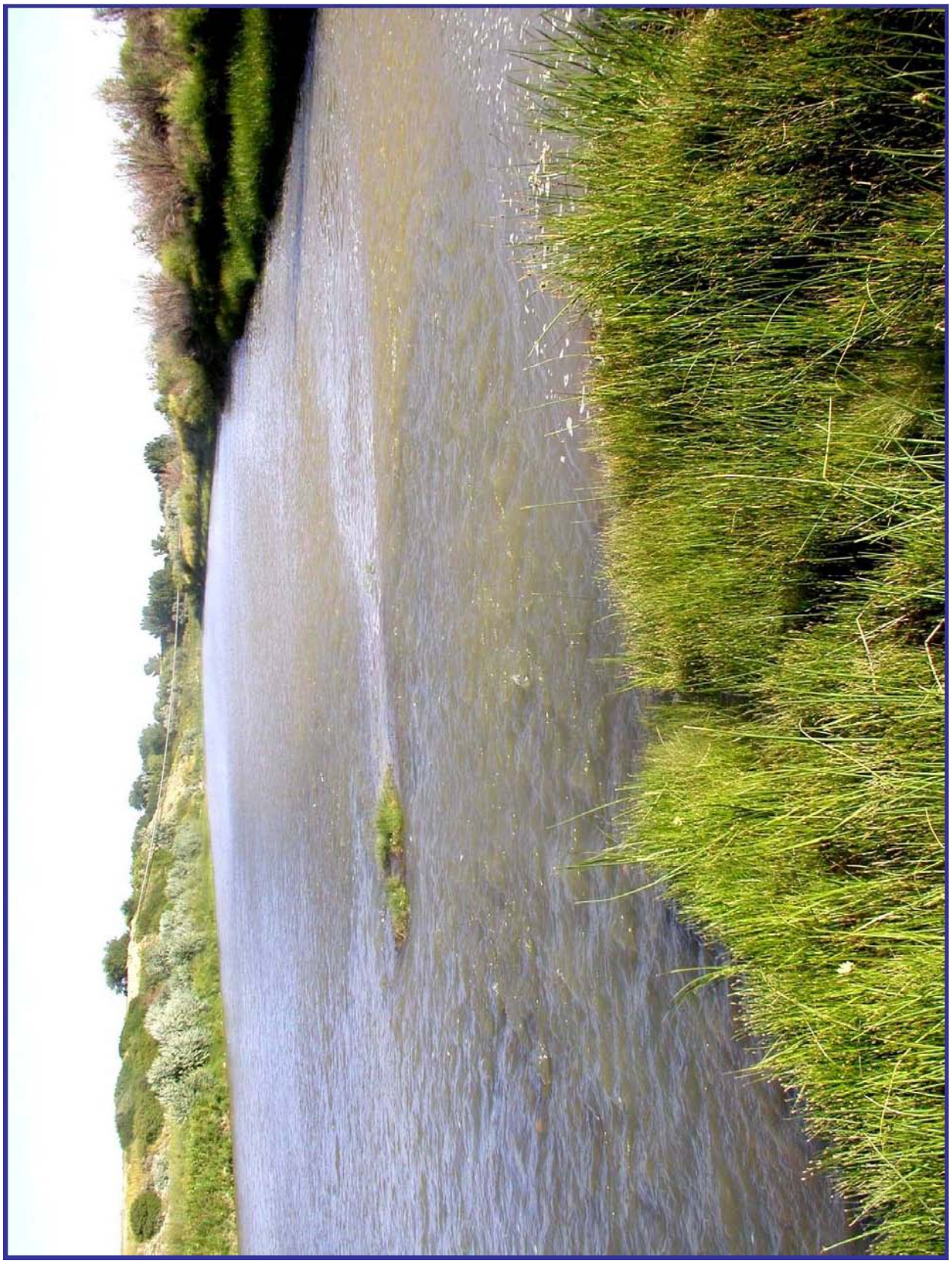

U-2
RF=15%
RU=55%
PO/SC=30%
Side channel/Pool
Riffle
Run
Large bag seine
Short straight seine
Shore
Island
River left
River Right

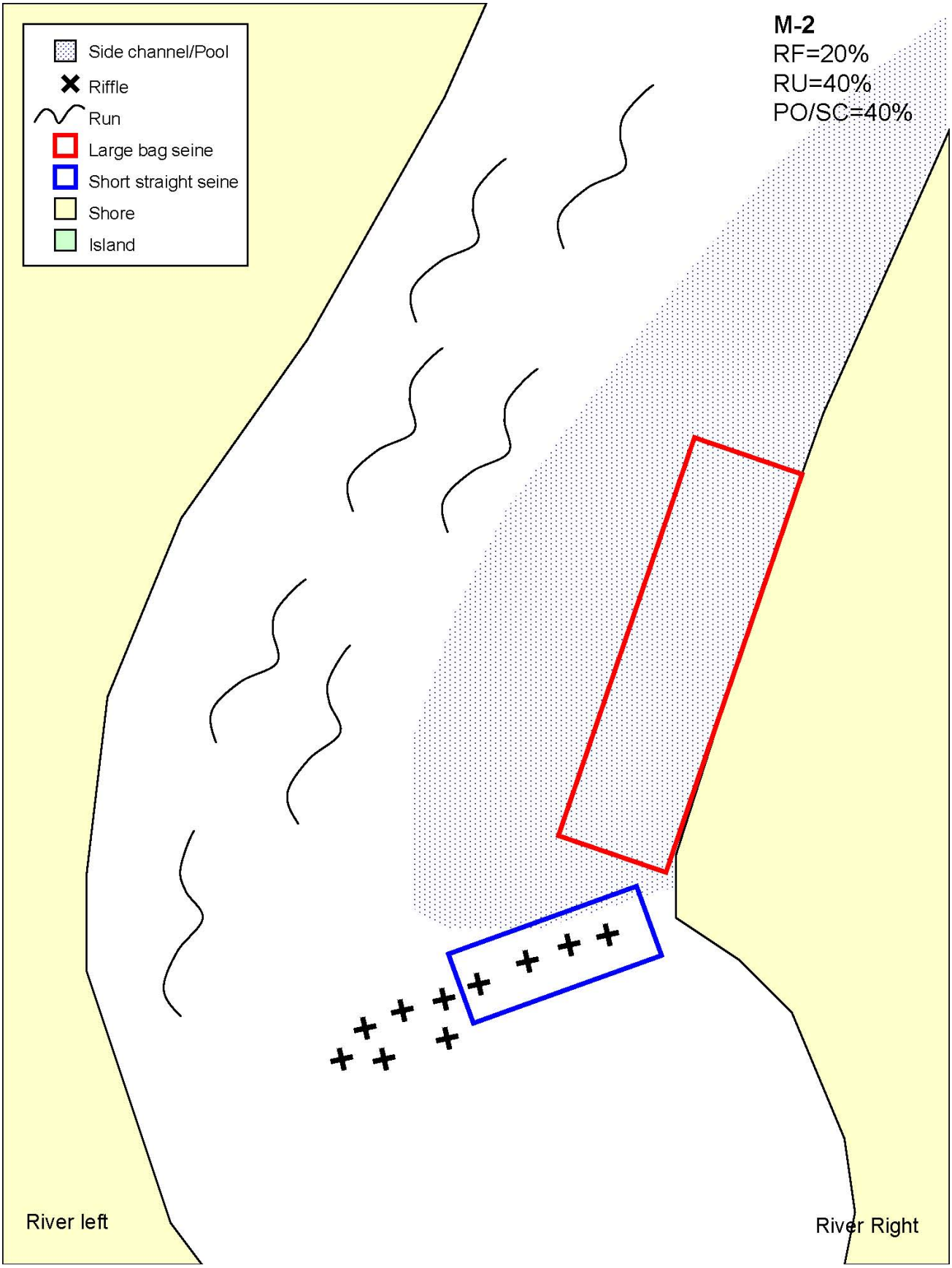

U-3
RF=0%
RU=0%
PO/SC=100%
Deep, slow current
Side channel pool
River left
River Right
Side channel/Pool
Riffle
Run
Large bag seine
Short straight seine
Shore
Island

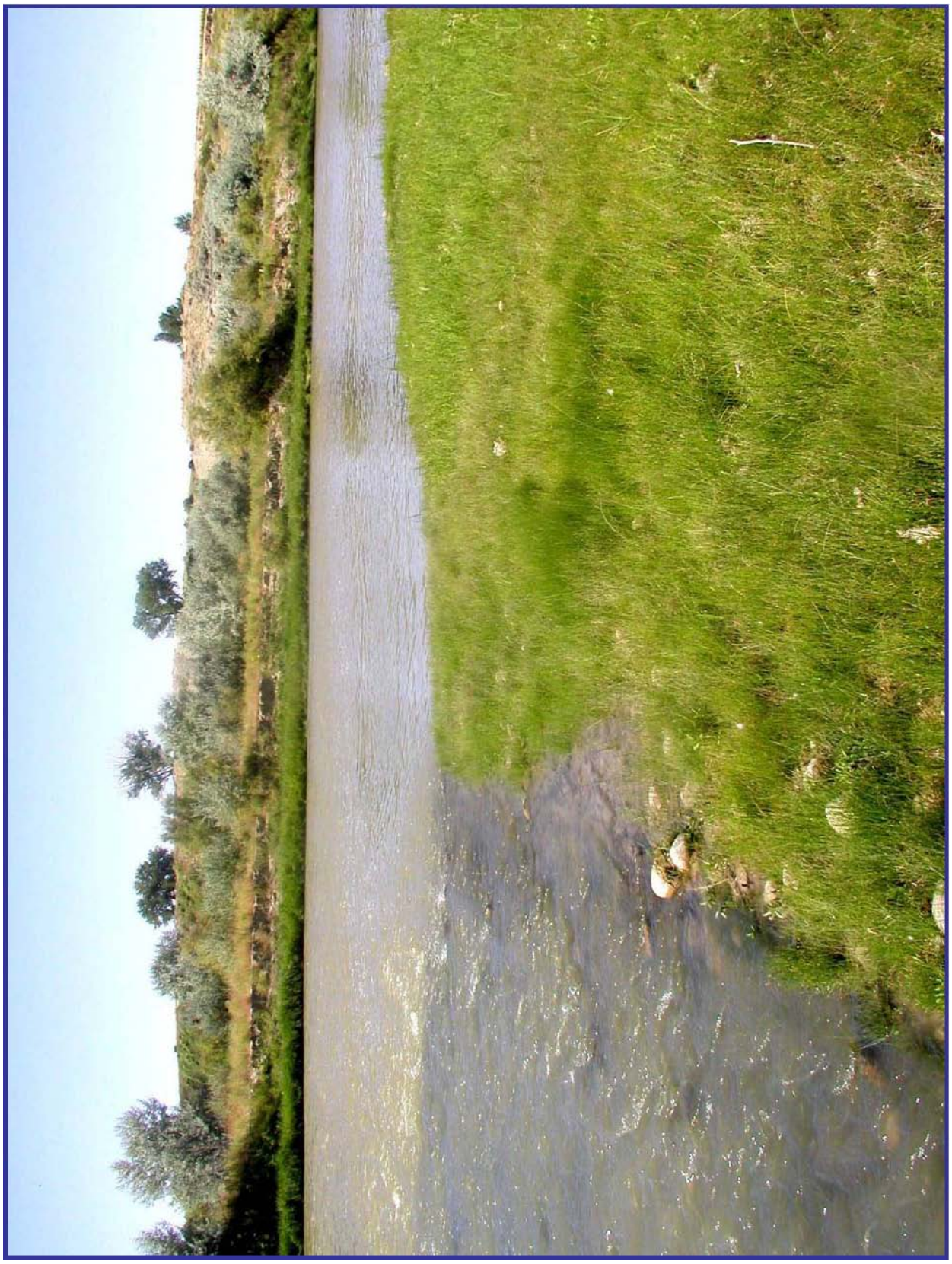

Side channel/Pool
Riffle
Run
Large bag seine
Short straight seine
Shore
Island
U-4
RF=30%
RU=35%
PO/SC=35%
Old birdge abutment
Rip-rap
River left
River Right

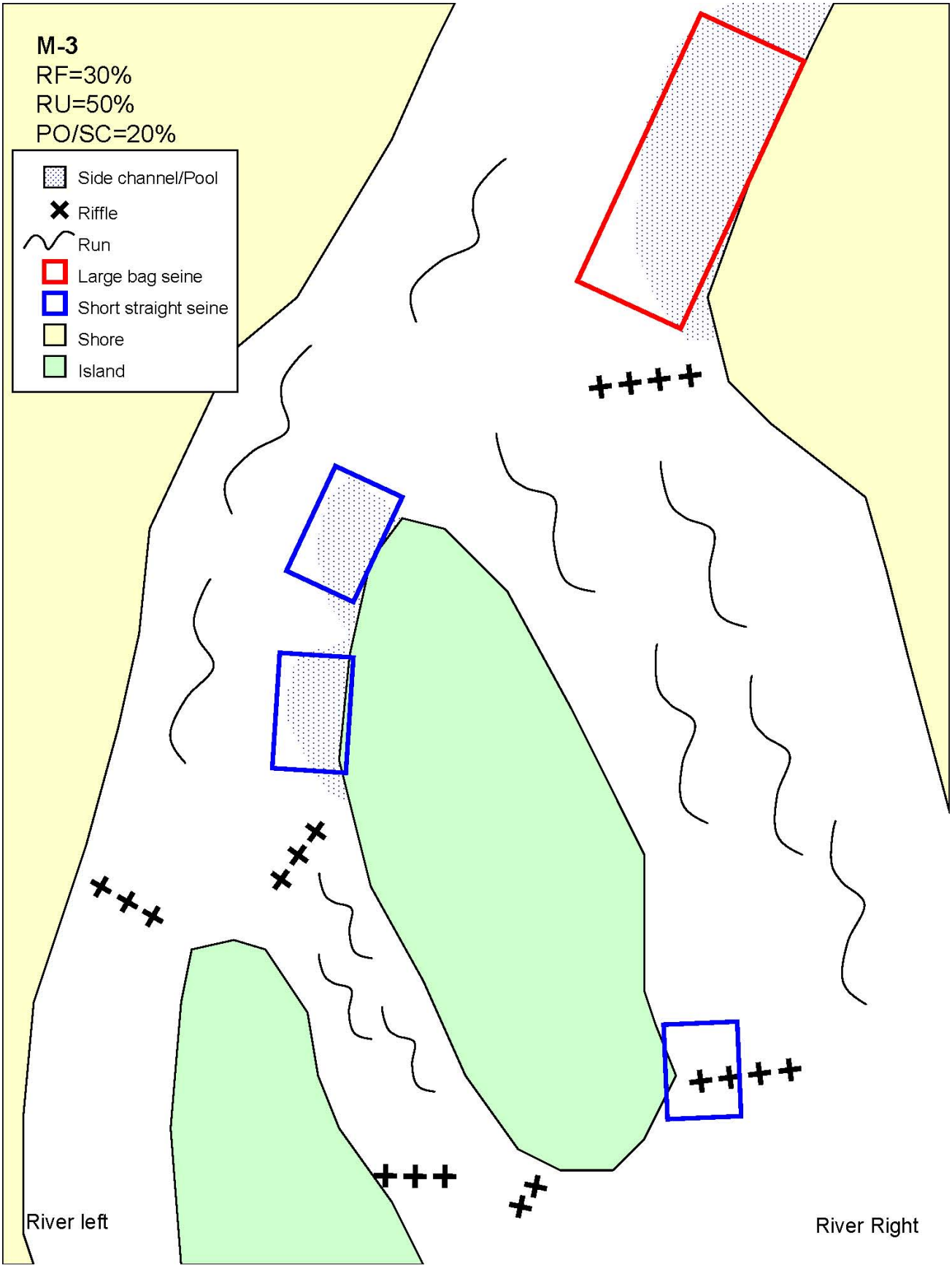

U-5
RF=5%
RU=40%
PO/SC=55%
Main Channel
Side channel/Pool
Riffle
Run
Large bag seine
Short straight seine
Shore
Island
River left
River Right

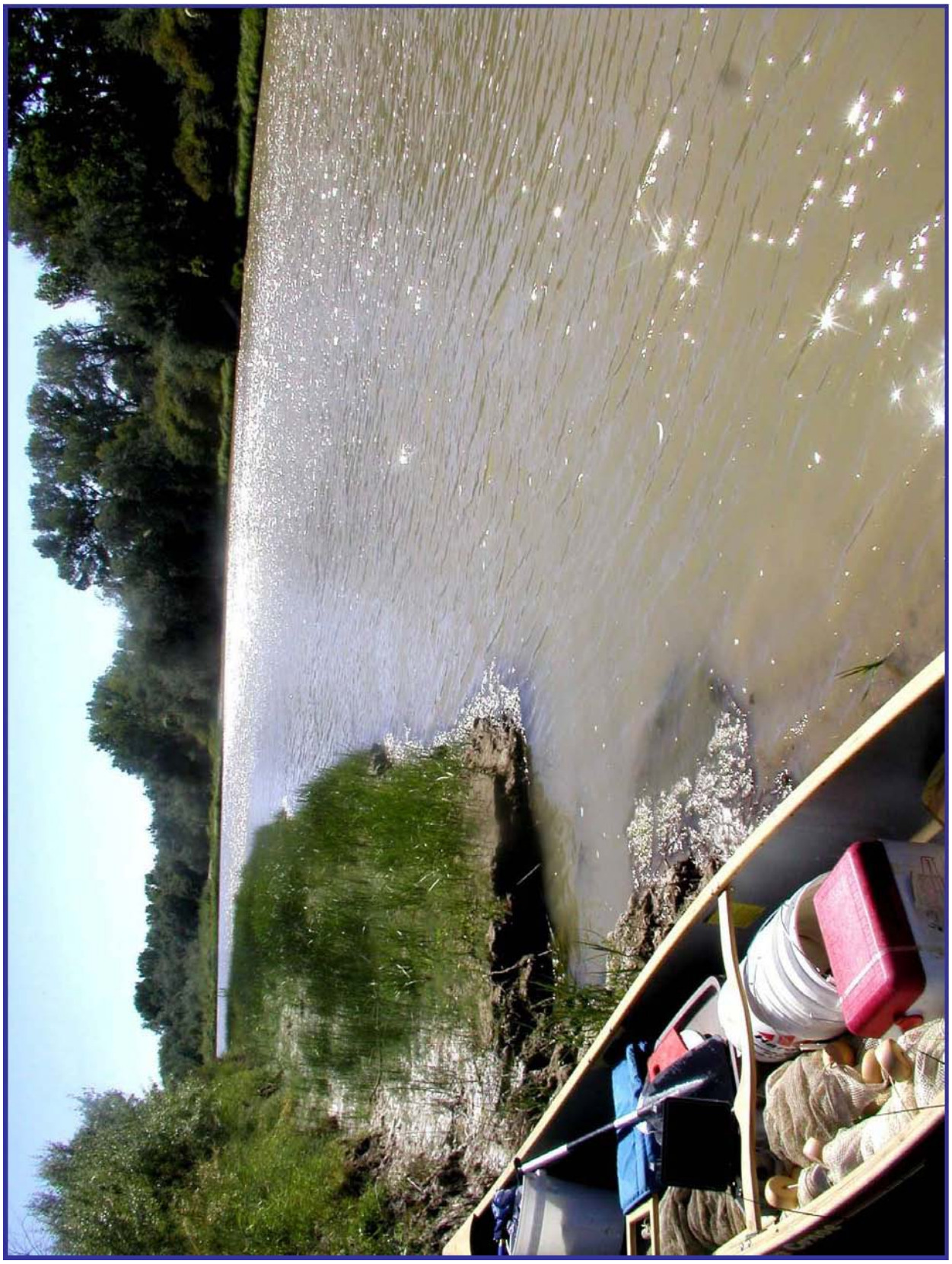

M-1
RF=35%
RU=50%
PO/SC=15%
(w/ low to moderate current)
Side channel/Pool
Riffle
Run
Large bag seine
Short straight seine
Shore
Island
River left
River Right

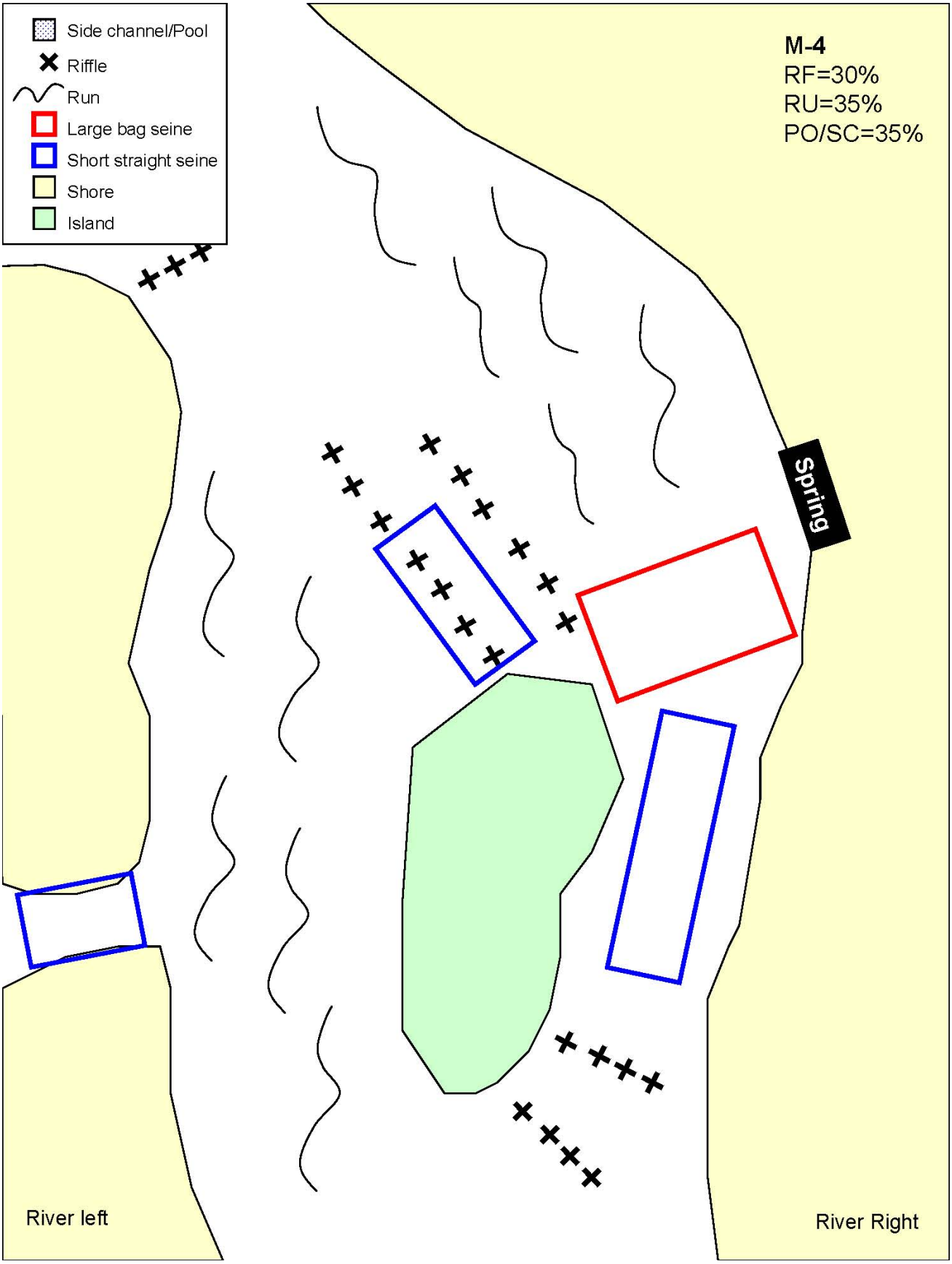


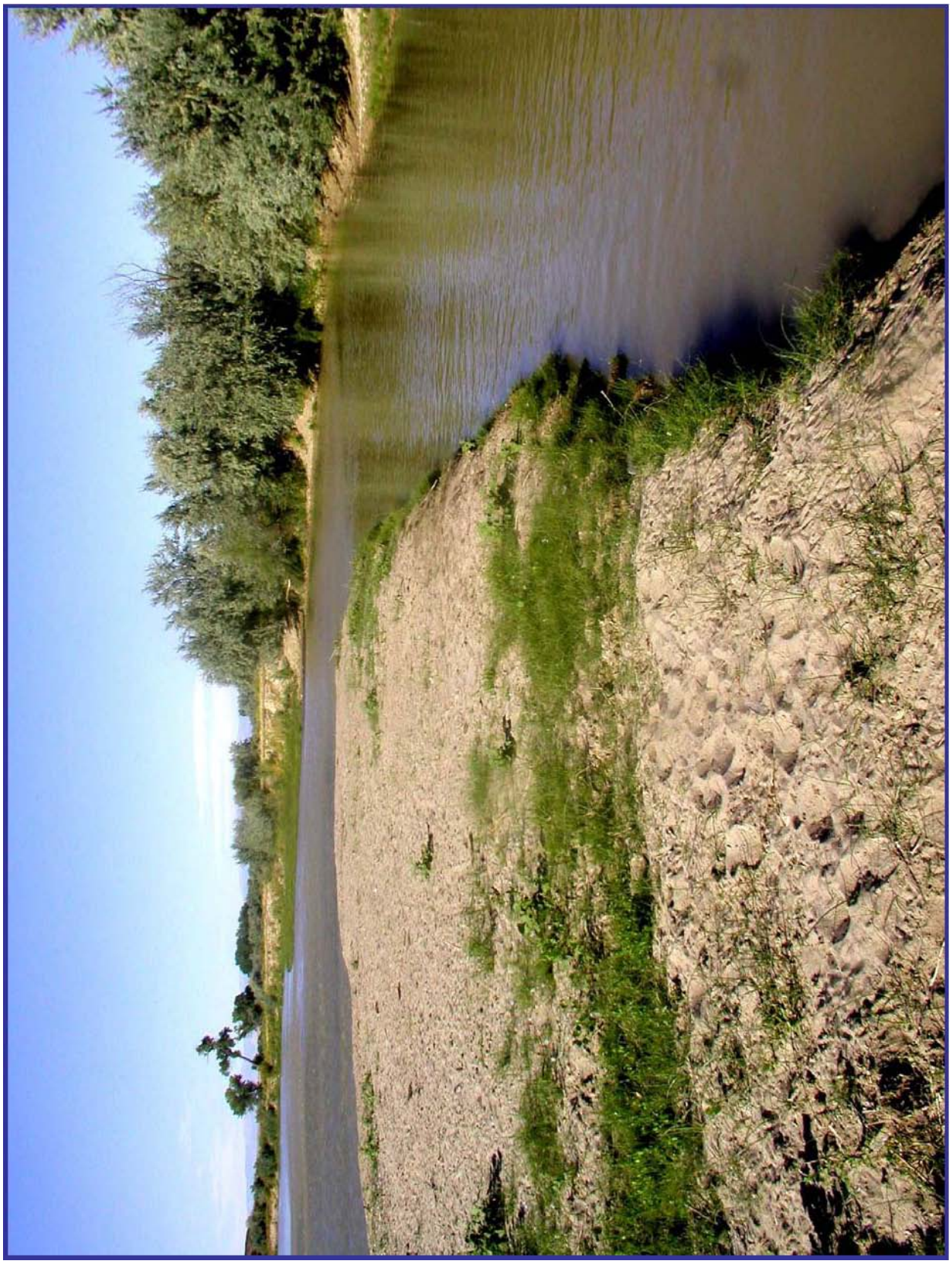

Side channel/Pool
Riffle
Run
Large bag seine
Short straight seine
Shore
Island
M-2
RF=20%
RU=40%
PO/SC=40%
River left
River Right

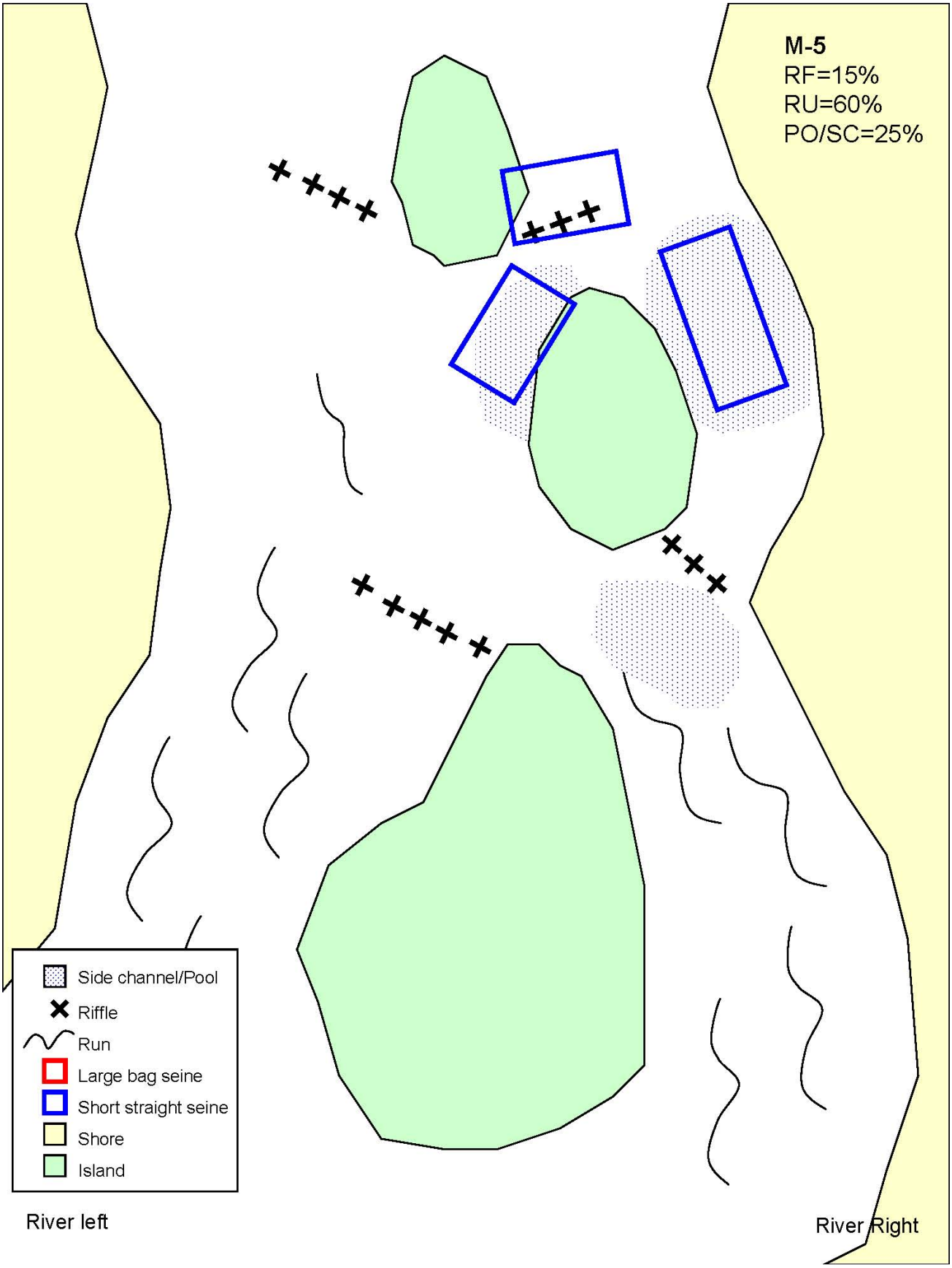


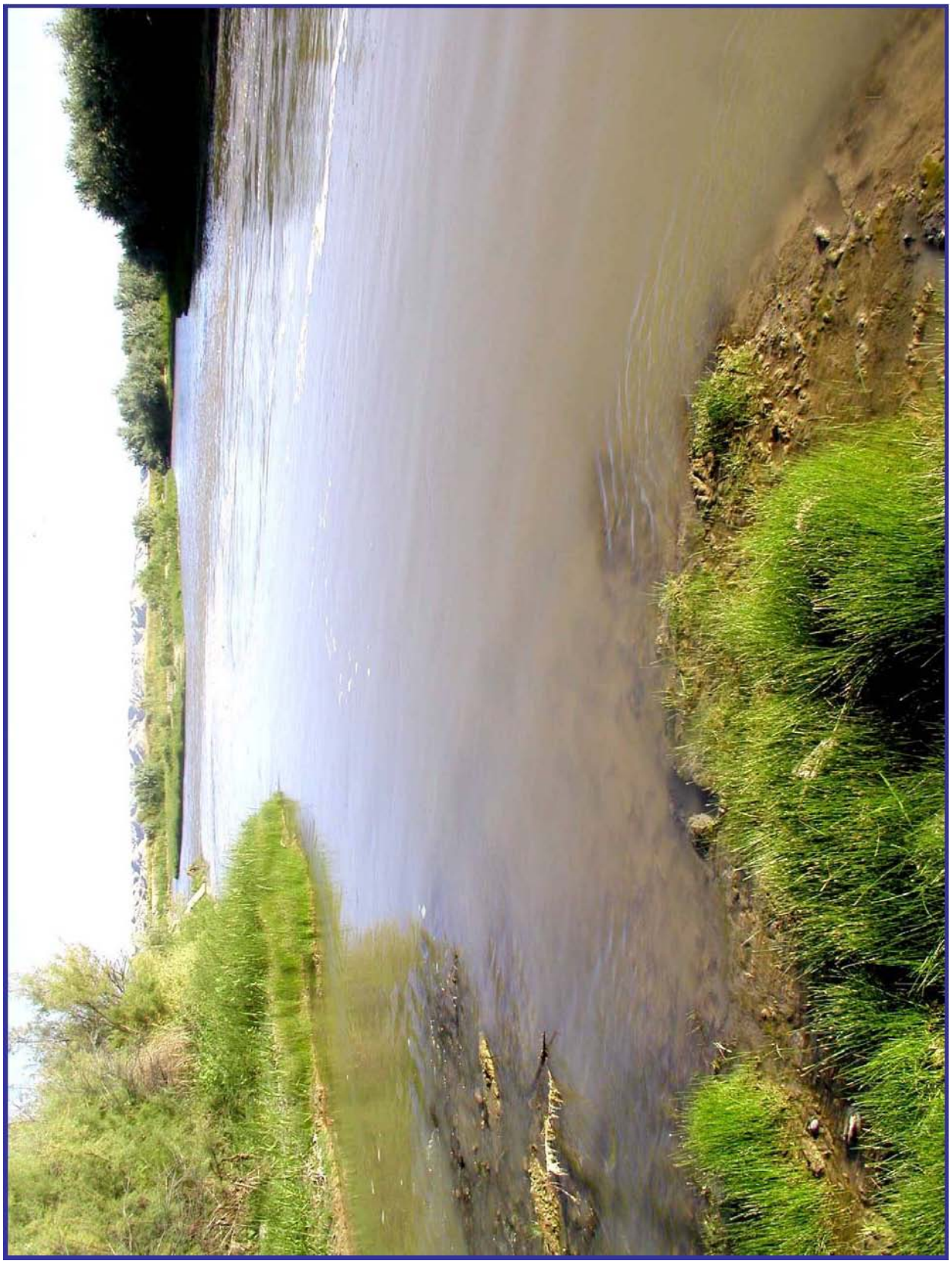

M-3
RF=30%
RU=50%
PO/SC=20%
Side channel/Pool
Riffle
Run
Large bag seine
Short straight seine
Shore
Island
River left
River Right

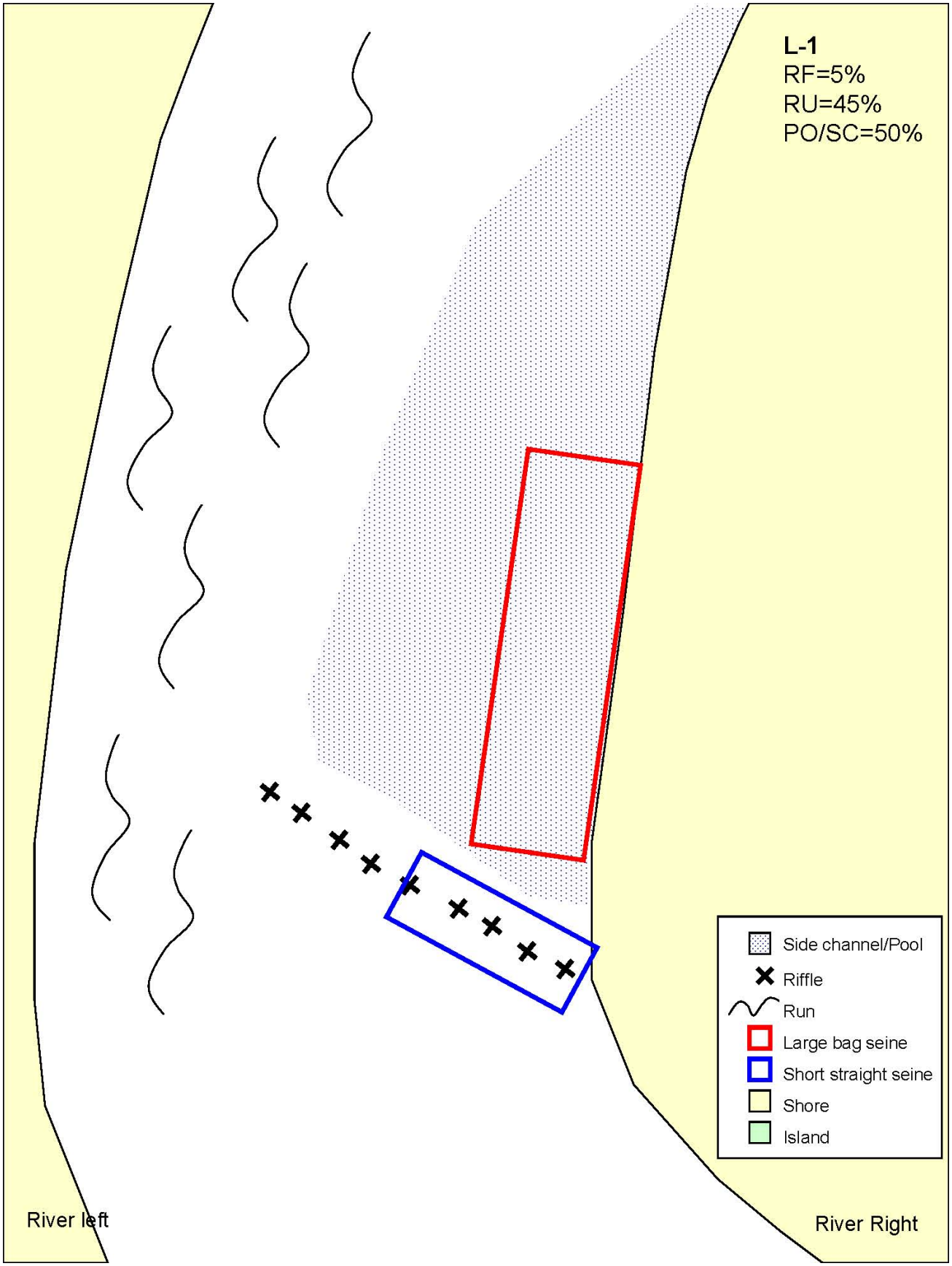


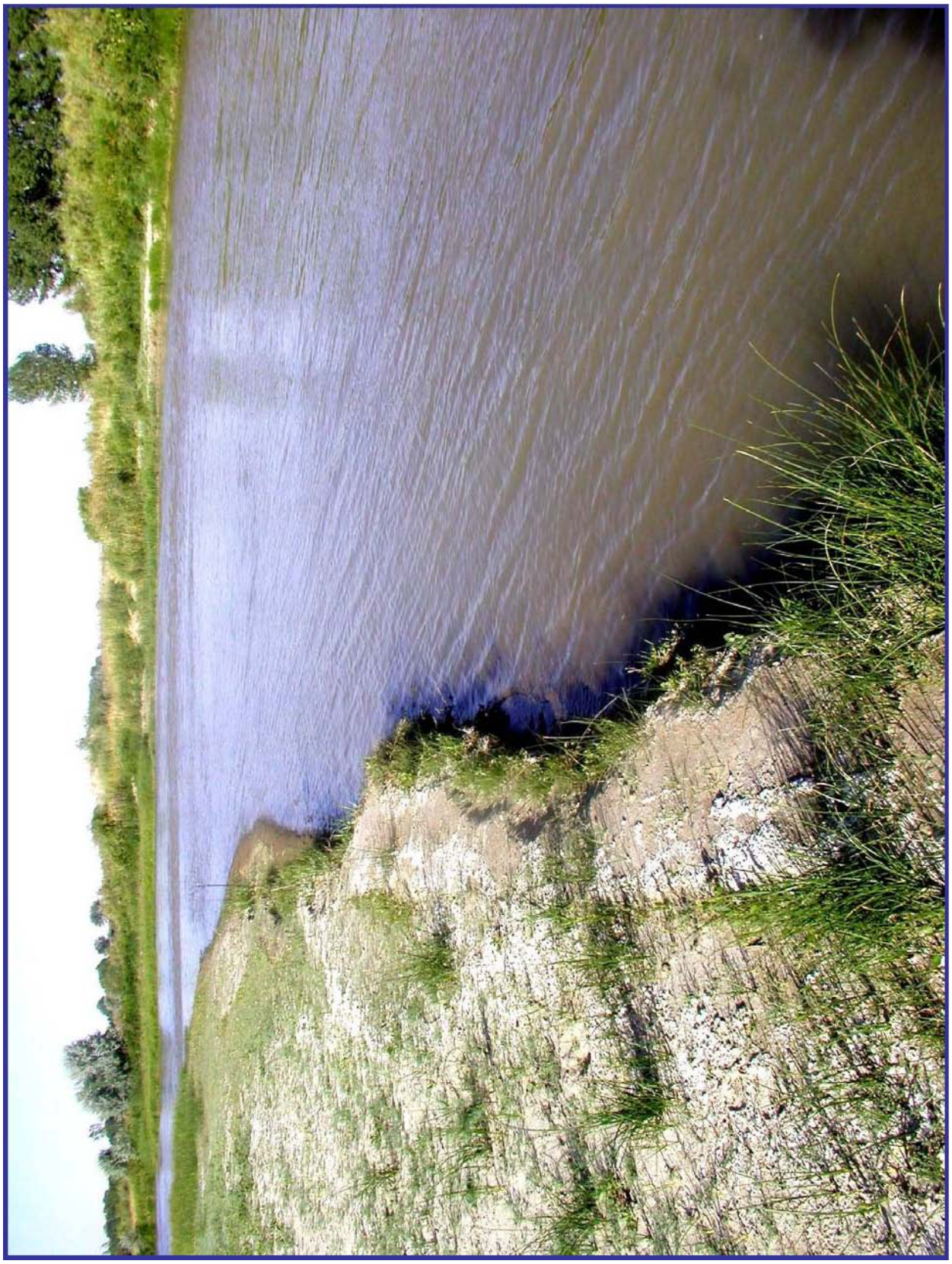

Side channel/Pool
Riffle
Run
Large bag seine
Short straight seine
Shore
Island
M-4
RF=30%
RU=35%
PO/SC=35%
Spring
River left
River Right

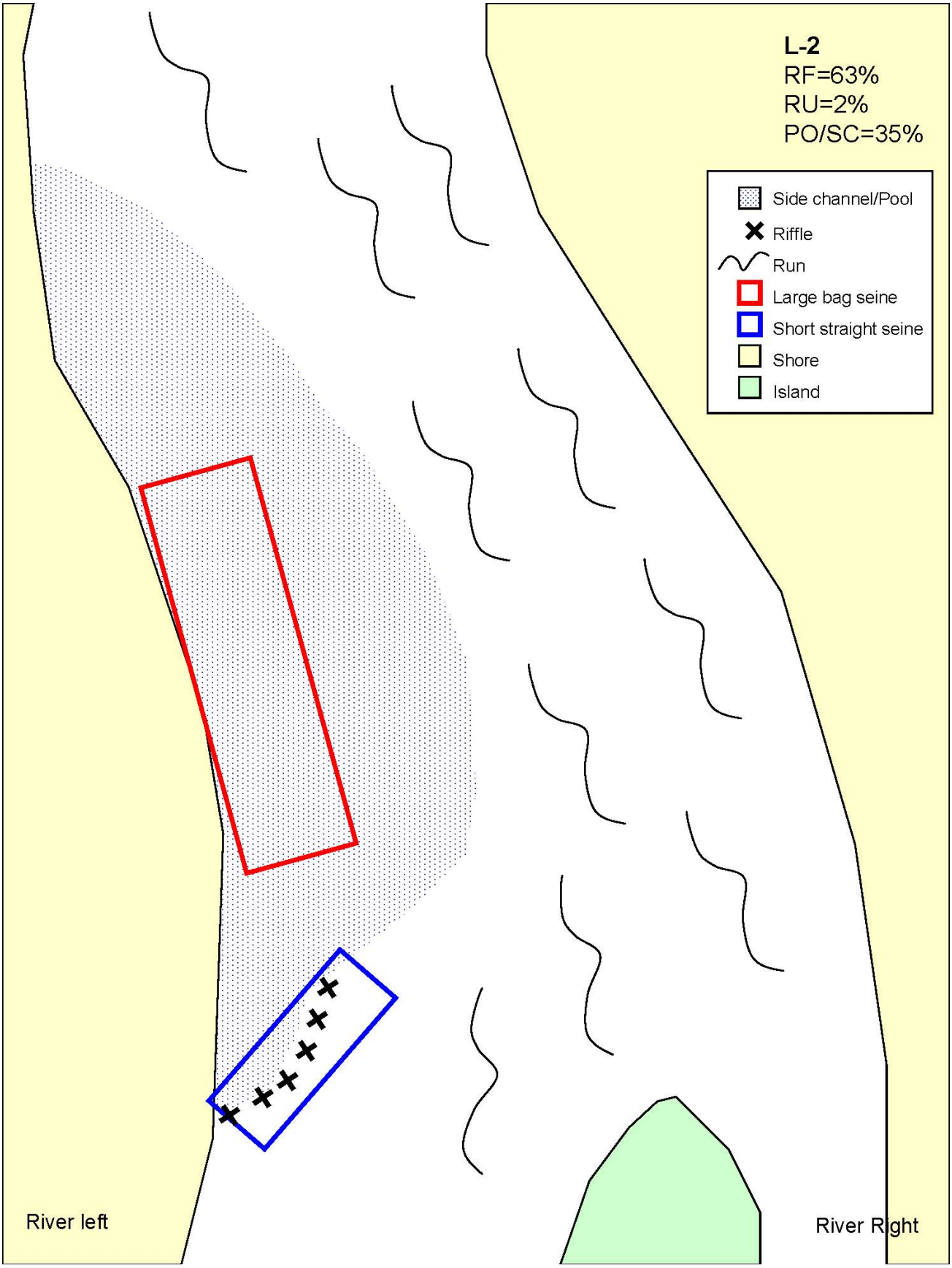


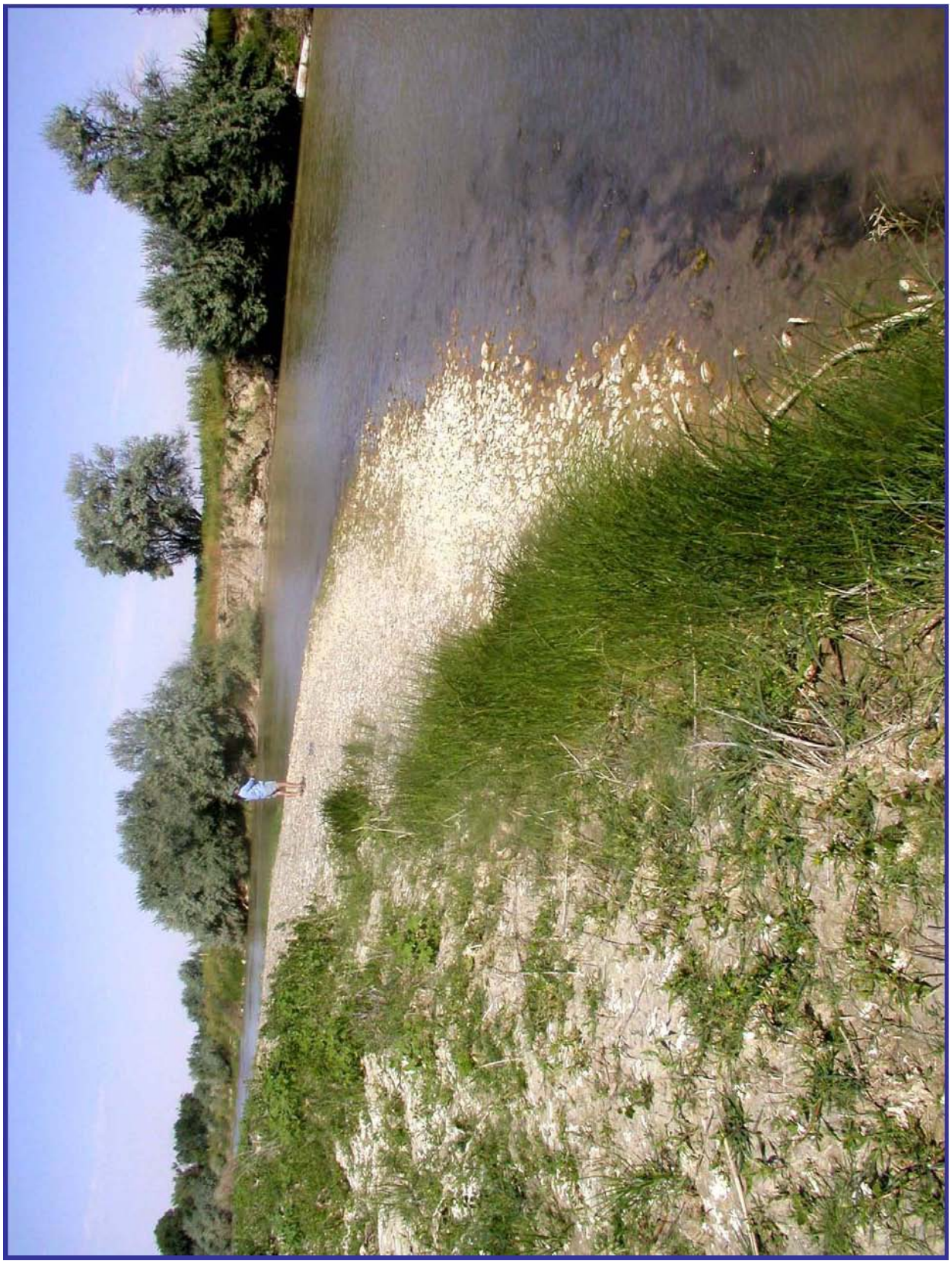

M-5
RF=15%
RU=60%
PO/SC=25%
Side channel/Pool
Riffle
Run
Large bag seine
Short straight seine
Shore
Island
River left
River Right

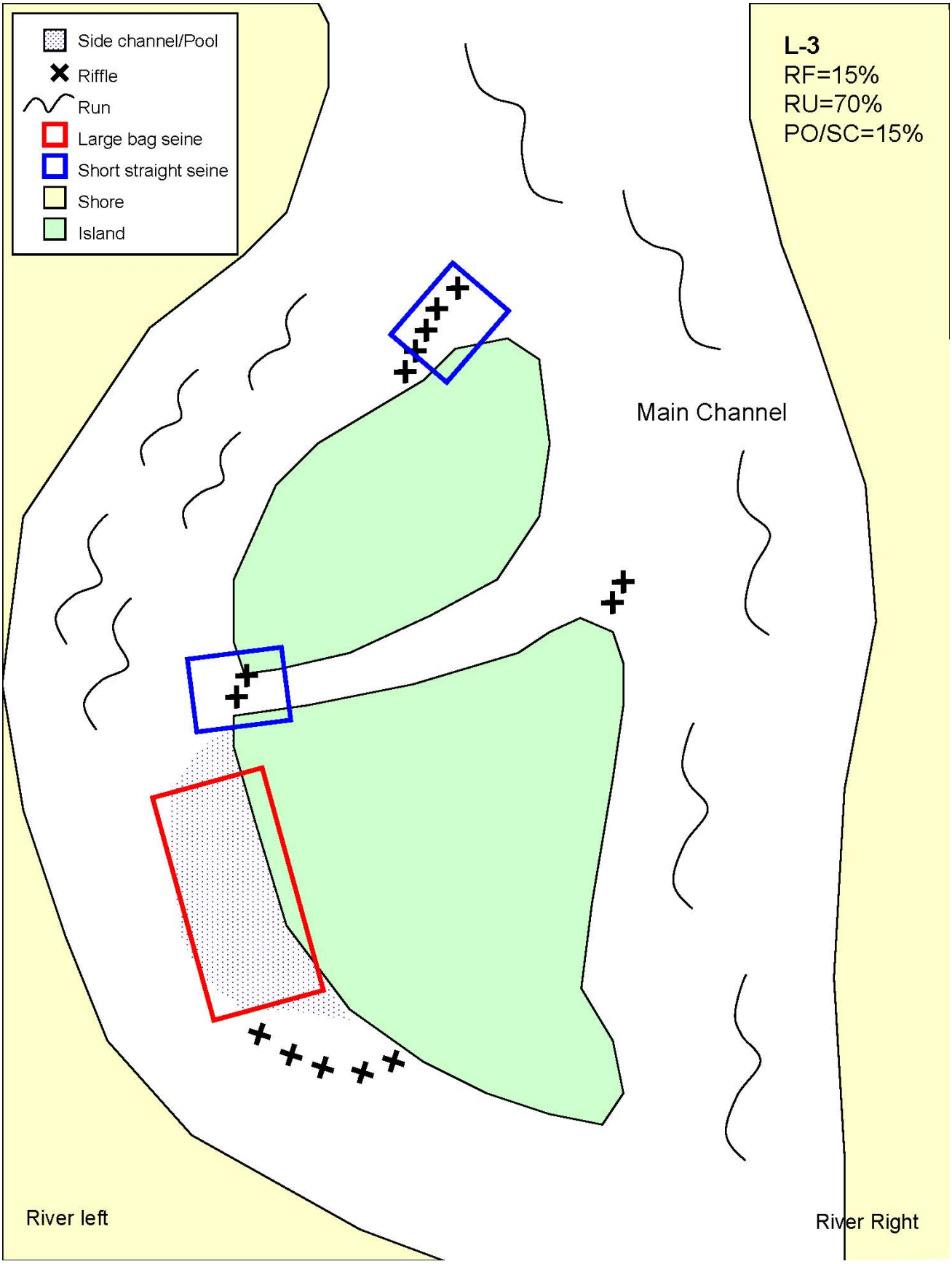


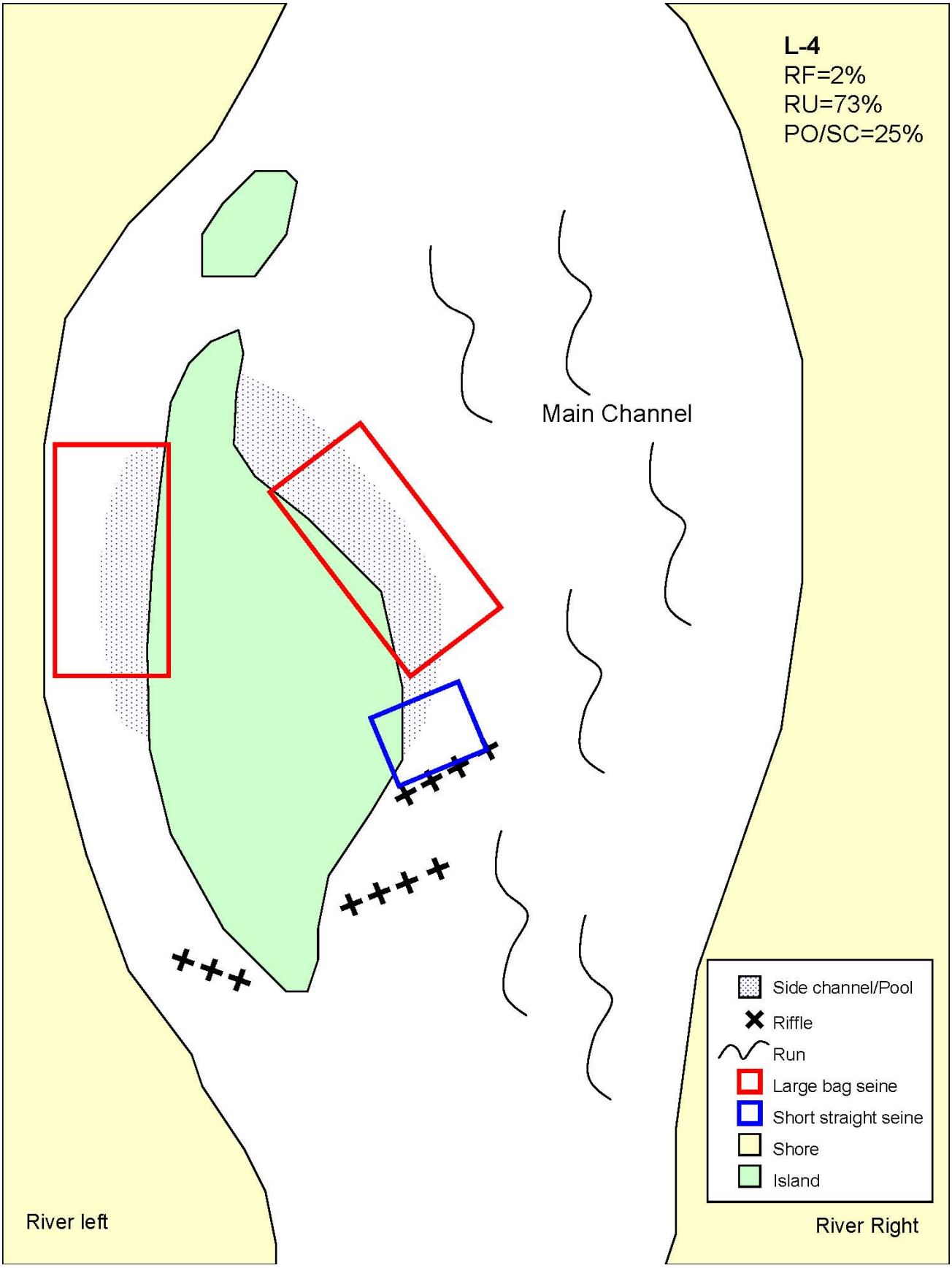

L-1
RF=5%
RU=45%
PO/SC=50%
Side channel/Pool
Riffle
Run
Large bag seine
Short straight seine
Shore
Island
River left
River Right

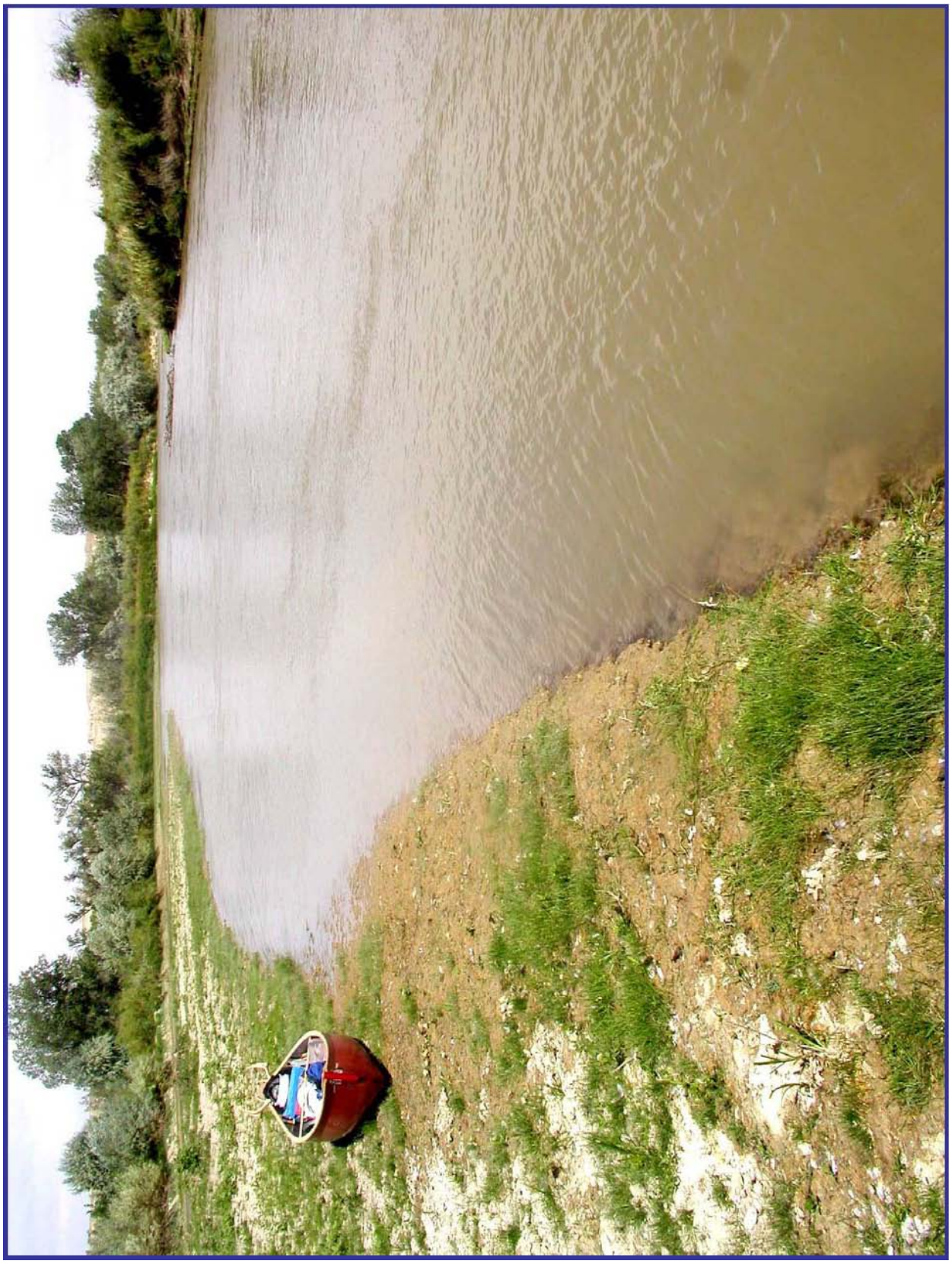


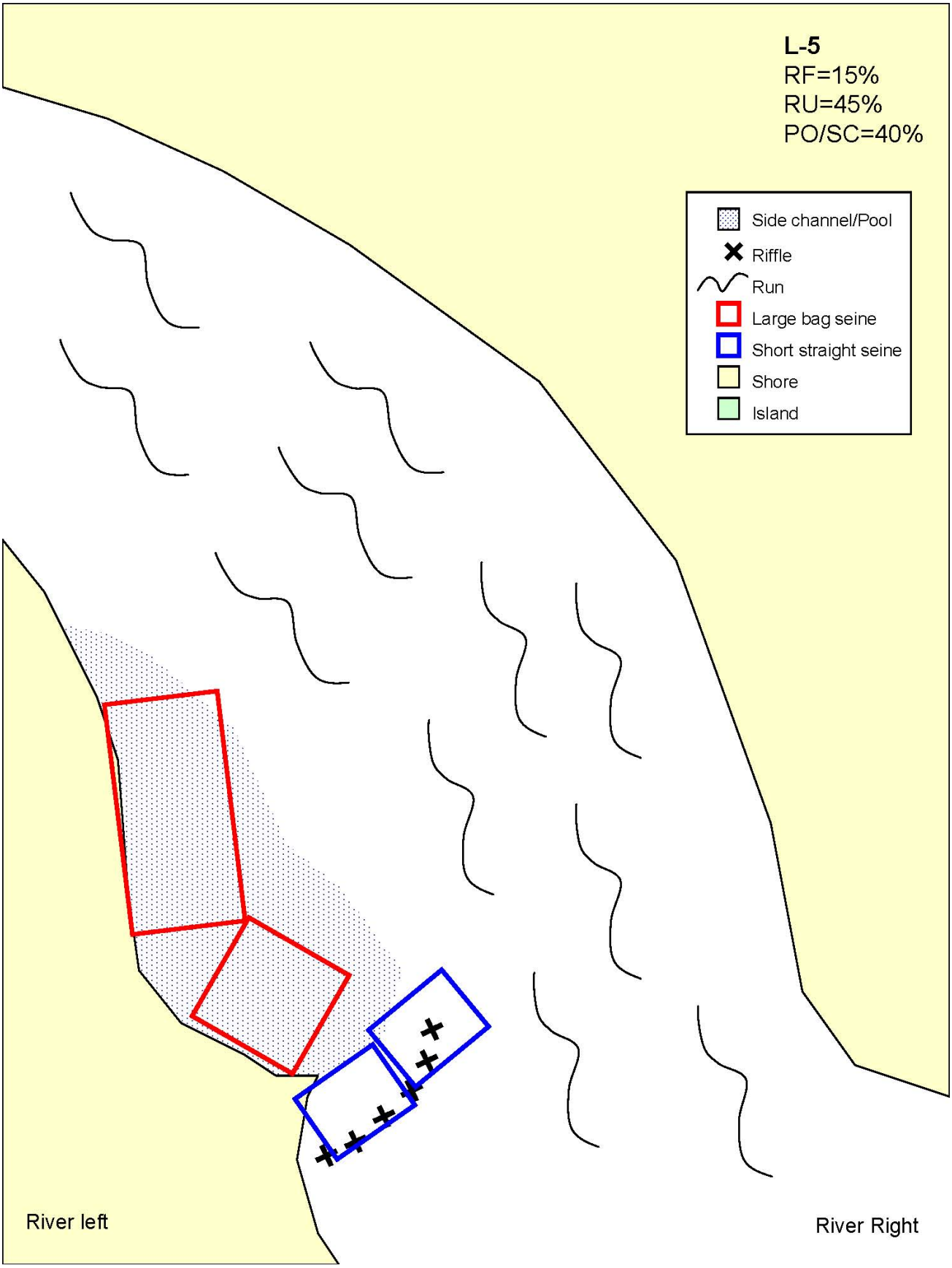

L-2
RF=63%
RU=2%
PO/SC=35%
Side channel/Pool
Riffle
Run
Large bag seine
Short straight seine
Shore
Island
River left
River Right




Side channel/Pool
Riffle
Run
Large bag seine
Short straight seine
Shore
Island
L-3
RF=15%
RU=70%
PO/SC=15%
Main Channel
River left
River Right


L-4
RF=2%
RU=73%
PO/SC=25%
Main Channel
Side channel/Pool
Riffle
Run
Large bag seine
Short straight seine
Shore
Island
River left
River Right




L-5
RF=15%
RU=45%
PO/SC=40%
Side channel/Pool
Riffle
Run
Large bag seine
Short straight seine
Shore
Island
River left
River Right

APPENDIX F

WETLANDS AND OTHER SURFACE WATERS REPORT

PRELIMINARY

WETLANDS AND OTHER SURFACE WATERS REPORT

Project Number 328-02-14
Big Horn County and Washakie County, Wyoming

Prepared for:

Westside Irrigation District
Whorland, WY

Prepared by:

Kurt Flaig

Western **E**co**S**ystems **T**echnology, Inc.
2003 Central Avenue
Cheyenne, WY 82001

October 18, 2005

I. INTRODUCTION

The proposed project involves the conveyance of a parcel of land, comprising approximately 16,500 acres, from the Bureau of Land Management (BLM) to the Westside Irrigation District (WID). The parcel is located in southern Big Horn County and northern Washakie County, immediately west of Whorland, Wyoming. The site is bound to the east by the Bighorn Canal, of which some sections occur within the project boundary (Figure 1). WID proposes to use those portions of the parcel that are irrigable and that avoid impacts to wildlife, recreation, sensitive environmental areas, and other land uses. The majority of the project area is potentially suitable for irrigation by center pivot sprinkler systems. Irrigation water would be obtained by pumping water from the Bighorn River at three locations. Each site would contain two pumps together capable of pumping 80 cfs, a pump station and fore bay.

The majority of the 16,500-acre parcel is dominated by sagebrush steppe. Although extensive tracts of salt desert shrub occur immediately adjacent the site to the west, only small, scattered inclusions of this habitat were observed within the parcel. Four intermittent drainages convey water across the site in an easterly direction into the Bighorn River. The four tributaries, listed from north to south, include Alamo, Fivemile, Sixmile, and Tenmile Creeks. All of these drainages are culverted beneath the Bighorn Canal and presumably receive additional water inputs from the canal via seepage or diversions. Three impoundments (stockponds) were observed on site, one of which was inundated and supported hydrophytic vegetation (Figure1).

This report has been prepared to document a survey that was conducted for waters of the United States within the 16,500-acre project area. The term "waters of the United States" has been defined to include essentially all surface waters, including both those connected to a surface tributary system and isolated waters that are not part of a tributary system. The term also includes wetlands. A summary of the wetland delineation methodology and results is provided below.

II. METHODS

WEST biologists surveyed all portions of the project site for waters of the U.S. Development in such areas is subject to the permit requirements of the U.S. Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act (1972). Field surveys were conducted from September 12 through September 16, 2005.

Prior to conducting the survey, WEST biologists reviewed U.S. Geological Survey (USGS) topographic maps, soil survey information from the Natural Resource Conservation Service (NRCS), and U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) maps for the survey area. Preparation of this report complies with guidelines issued by the Regulatory Branch of the Sacramento District, USACE, titled *Minimum Standards for Acceptance of Preliminary Wetland Delineations* and a guidance letter issued by the Wyoming Regulatory Office, USACE, dated 1996.

Wetlands were delineated in accordance with the 1987 *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987). This manual emphasizes a three-parameter approach to identify wetlands that may be federally regulated, including the presence of hydrophytic vegetation, hydric soils, and wetland hydrology. These criteria were applied to establish the presence and extent of wetlands. The delineated wetlands were classified according to methodologies set forth in *Wetlands and Deepwater Habitats of the United States* (Cowardin *et al*., 1979).

Vegetation. Plants observed at a given survey location were identified to species using a standard flora appropriate for Wyoming, *Vascular Plants of Wyoming* (Dorn 2001). Plant species nomenclature and indicator status were assigned according to the *National List of Plant Species that Occur in Wetlands: National Summary* (Reed 1988) and the *National List of Plant Species that Occur in Wetlands: Northwest Supplement (Region 9)* (Reed 1993). A list of species was then compiled for the survey area and an assessment of the dominant species was made. It was then determined if the survey area supported wetland vegetation. The 1987 manual frequently uses the term "dominant vegetation" but provides no definition. The term is defined by the 1989 Federal Manual for Identifying and Delineating Wetlands, which is no longer in use, as those species the dominance measures of which, when added together, immediately exceed 50% of the total dominance measure, plus those individual species which contribute 20% or more of the total dominance measure. This definition was used for this project.

Wetland indicator species are so designated according to their frequency of occurrence in wetlands. For instance, a species with a presumed frequency of occurrence of 67 percent to 99 percent in wetlands is designated a facultative wetland indicator species. The wetland indicator groups, indicator symbol, and the frequency of occurrence of species within wetlands are found in table 1.

Table 1. Plant Wetland Indicator Status Categories*

Indicator Category	Symbol	Frequency of Occurrence
OBLIGATE	OBL	Greater than 99%
FACULTATIVE WETLAND	FACW	67-99%
FACULTATIVE	FAC	34-66%
FACULTATIVE UPLAND	FACU	1-33%
UPLAND	UPL	Less than 1%

* Based upon information contained in the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987).

Obligate and facultative wetland indicator species are hydrophytes that occur “in areas where the frequency and duration of inundation or soil saturation produce permanently or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present” (Environmental Laboratory 1987). Facultative indicator species may be considered wetland indicator species when found growing in hydric soils that experience periodic saturation.

Soils. Where possible, the top 22 inches of the soil profile was examined for hydric characteristics. Such characteristics include the presence of organic soils (Histosols), histic epipedons, aquic or peraquic moisture regime, presence of soil on hydric soil list, mottling indicated by the presence of gleyed or bright spots of colors (in the former case, blue grays; in the latter case, orange red, or red brown) within the soil horizons observed. Mottling of soils usually indicates poor aeration and lack of good drainage. Munsell Soil Notations (Kollmorgen Instr. Corp. 1990) were recorded for the soil matrix for each soil sample. The last digit of the Munsell Soil Notation refers to the chroma of the sample. This notation consists of numbers beginning with 0 for neutral grays and increasing at equal intervals to a maximum of about 20. Chroma values of the soil matrix which are one (1) or less, or two (2) or less when mottling is present, are typical of soils which have developed under anaerobic conditions.

In sandy soils, such as alluvial deposits in the bottom of drainage channels, hydric soil indicators include high organic matter content in the surface horizon and streaking of subsurface horizons by organic matter.

Hydrology. Each of the survey areas was examined for positive field indicators of wetland hydrology. Such indicators include visual observation of inundation and/or soil saturation, watermarks, drift lines, water-borne sediment deposits, water-stained leaves, and drainage patterns in wetlands. In the COE Omaha District, in which the project area is included, evidence must be sufficient to indicate continuous saturation for at least 5% of the growing season. For the project area, this means that soil saturation for 6 to 7 consecutive days is required.

Wetland boundaries were recorded with a Global Positioning System (GPS) unit with sub-meter accuracy. The location of each wetland sample point was also recorded with the GPS unit.

III. RESULTS

Wetland habitat types identified on the project site include wet meadow, marsh, fringe wetland, scrub shrub wetland, and riparian woodland. With the exception of one wetland on site (WL-2), the hydrology for all other wetlands was associated with the proximity of the Bighorn Canal (*i.e.*, seepage, diversions, and/or high water table). Figure 1 shows an aerial photograph of the site with the locations of all the wetlands. Figures depicting each individual wetland and associated sample point(s) are provided in Appendix A. Wetland data forms are provided in Appendix B. Photos of wetlands and sample points are provided in Appendix C. The following section describes representative wetlands surveyed within the project area, including dominant plant species and their indicator status, hydrology, and hydric soil characteristics. Information regarding each of the wetlands, including type, acreage, and a brief description, are provided in Table 1. A list of all plant species encountered during the wetland survey is provided in Appendix D.

Wet meadow wetlands were observed in several locations along the perimeter of the Bighorn Canal (WL-4a, WL-6; Figure 1). Plant species commonly identified in these wetlands includes slender wheatgrass (*Agropyron trachycaulum*; FAC), creeping bentgrass (*Agrostis stolonifera*; FAC+), meadow foxtail (*Alopecurus pratensis*; FACW), beaked sedge (*Carex rostrata*; OBL),

foxtail barley (*Hordeum jubatum*; FAC), Baltic rush (*Juncus balticus*; FACW+), and reed canarygrass (*Phalaris arundinacea*; FACW). Wetland hydrology in wet meadows was mostly associated with seepage and a high water table resulting from their close proximity to the Bighorn Canal. Additionally, they typically occurred in topographically lower positions on the landscape where surface water may collect. Soils in wet meadows were variable in both texture and color. They ranged from silty clays with low chroma values and distinct mottling to sandy loams with considerable organic streaking.

Table 1. Wetlands delineated at the Westside Irrigation District project.

Wetland ID	Wetland Type	Size (acres)
WL-1	Marsh	1.94
WL-2	Scrub shrub	0.52
WL-3a,b	Scrub shrub	0.12
WL-3c	Scrub shrub	0.82
WL-3d	Fringe wetland	0.02
WL-3e	Scrub shrub	0.1
WL-3f	Marsh	0.35
WL-4a	Wet meadow	0.01
WL-4b	Riparian woodland	0.85
WL-5a	Scrub shrub	0.81
WL-5b	Scrub shrub	1.36
WL-6	Wet meadow	0.67
	Total	**7.57**

Marsh wetland was mapped in two locations within the project area (WL-1, -3f; Figure 1). These wetlands were typically dominated by tall graminoid species including reed canarygrass (FACW), common threesquare (*Scirpus pungens*; OBL), softstem bulrush (*Scirpus validus*; OBL), and broadleaf cattail (*Typha latifolia*; OBL). Hydrology of the marsh wetlands was associated with a high water table, presumably created from the presence of the Bighorn Canal. Soils were typically saturated to the soil surface and portions of these wetlands were inundated (up to 8 inches). Soil texture and color varied, but abundant gley mottling was typically observed.

Fringe wetland was delineated along the portion of Fivemile Creek adjacent the Bighorn Canal (WL-3d; Figure 1). Dominant plant species, hydrology, and soil characteristics were similar to those observed in wet meadow habitat.

Scrub shrub and riparian woodland occurred along Alamo Creek, Fivemile Creek, and Tenmile Creek, in the vicinity of the Bighorn Canal (WL-2, 3ab, 3c, 3e, 4b, 5ab; Figure 1). Dominant tree and shrub species observed include plains cottonwood (*Populus deltoides*; FAC), Russian olive (*Elaeagnus angustifolia*; FAC), whiplash willow (*Salix lasiandra*; FACW+), sandbar willow (*Salix exigua*; OBL), tamarisk (*Tamarix chinensis*; FACW), and prickly rose (*Rosa acicularis*; FACU). Dominant herbaceous species included cattail, reed canarygrass, and beaked sedge. Hydrology was associated with drainage channel depressions and proximity to the Bighorn Canal. Soils typically had low chroma values and some mottling. One scrub shrub wetland was observed at an impoundment along an unnamed, intermittent tributary to Tenmile

Creek, along the southern boundary of the site (WL-2; Figure 1). Dominant species included plains cottonwood and whiplash willow around the perimeter of the shallow pond, with sparse broadleaf cattail within the pond. This wetland occurred far from the Bighorn Canal. Its hydrology was associated with its location in a large depression within an impounded, intermittent drainage. Clay soils with gleys and/or low chroma values were observed at this wetland.

IV. LITERATURE CITED

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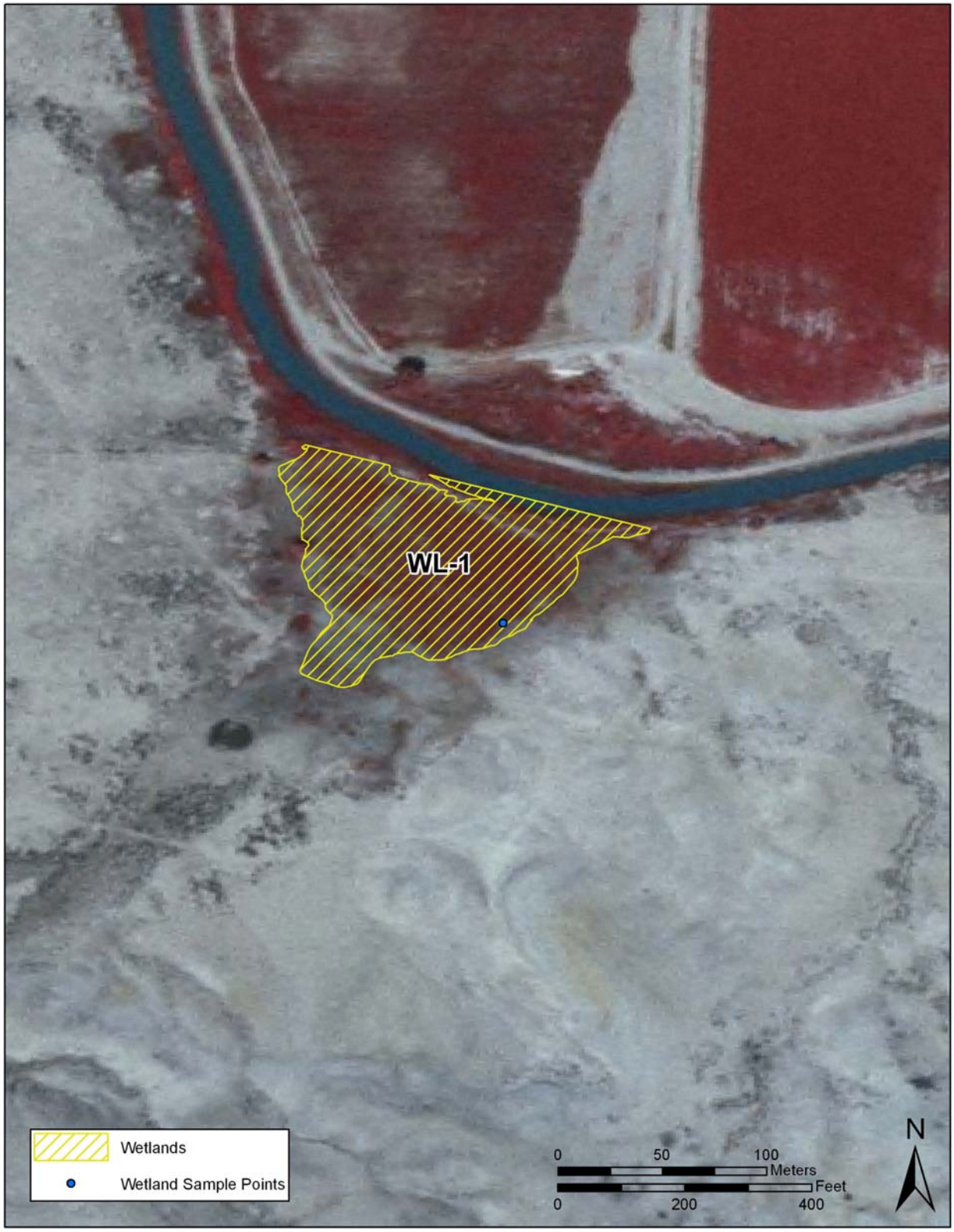
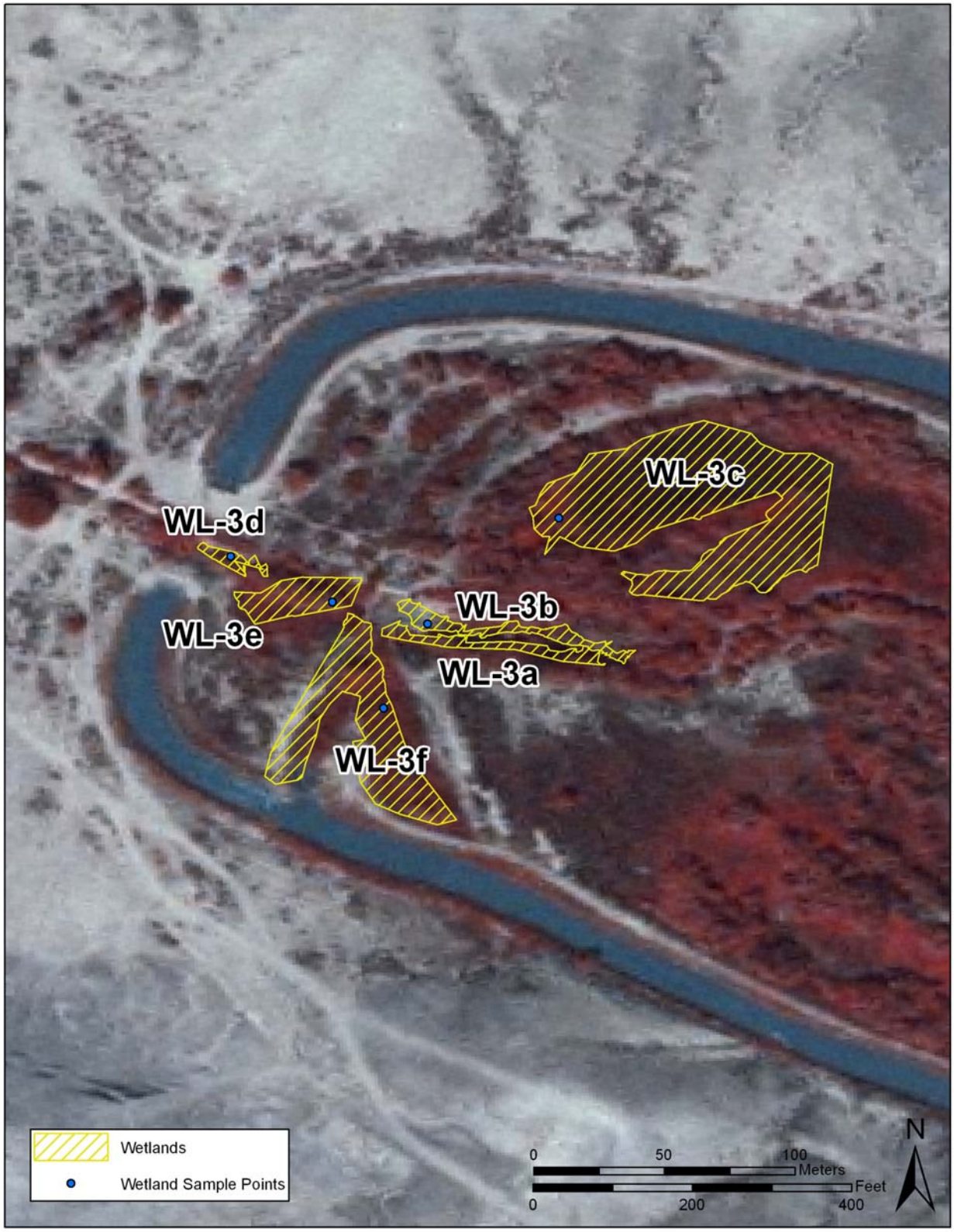
Appendix A. Figures for wetlands delineated for the Westside Irrigation District project.

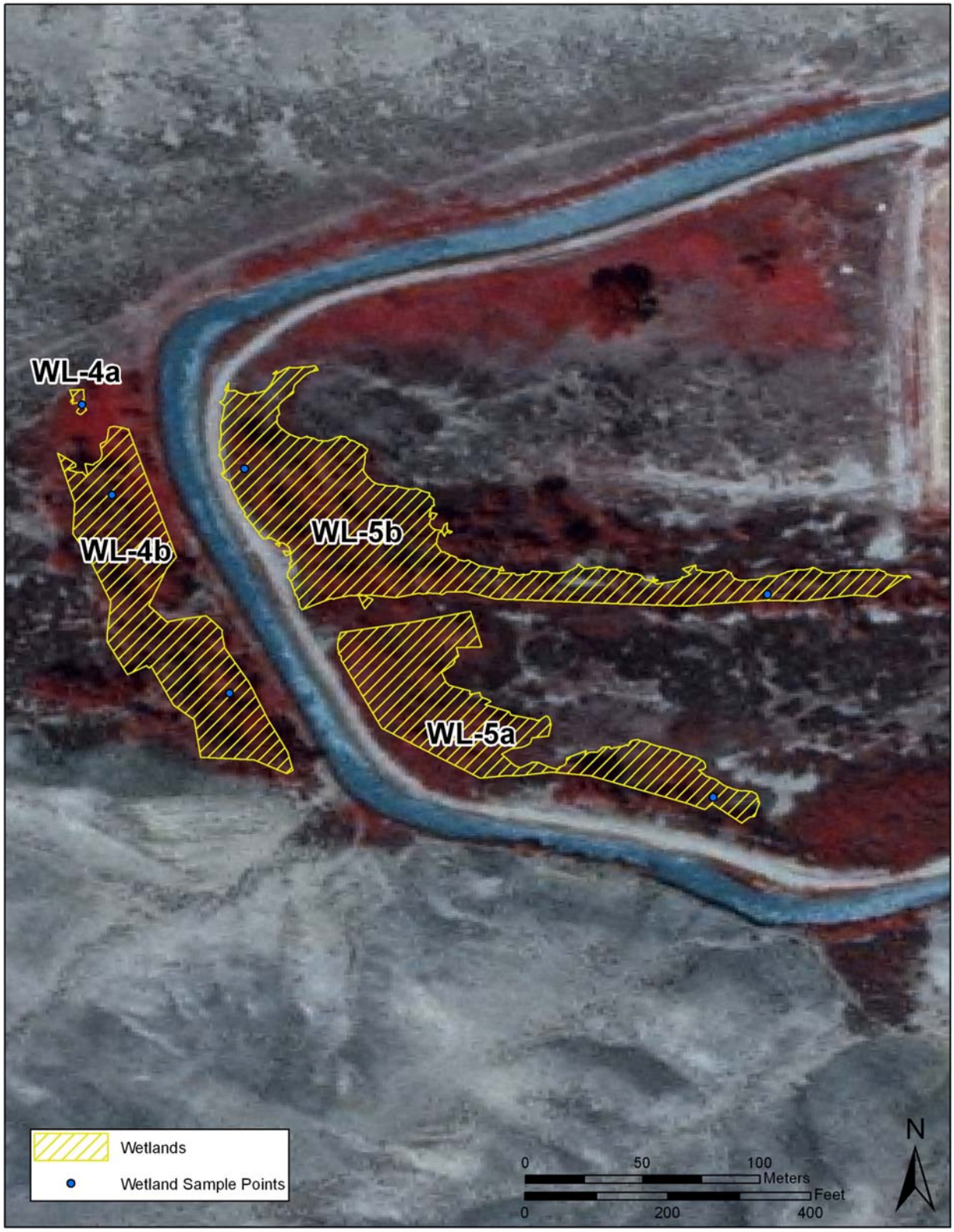


Map 1. Location of wetland 1 and associated sample point.

Map 2. Location of wetland 2 and associated sample point.



Map 3. Location of wetland 3 and associated sample points.



Map 4. Location of wetland 4 and 5 with associated sample points.

Map 5. Location of wetland 6 and associated sample point.

Appendix B. Data forms for wetlands delineated at the Westside Irrigation District project.

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Westside Irrigation District			Date: 9/12/05
Applicant/Owner:			County: Big Horn
Investigator: Kurt Flaig/Jeanette Flaig			State: Wyoming
Do Normal Circumstances exist on the site?	Yes X	No	Community ID: marsh
Is the site significantly disturbed (Atypical situation?)	Yes	No X	Transect ID:
Is the area a potential Problem Area? (If needed, explain on reverse.)	Yes	No X	Plot ID: WL-1

VEGETATION

Dominant Plant Species	% Cover	Stratum	Indicator
1. Scirpus microcarpus	40	Herb	OBL
2. Typha latifolia	15	Herb	OBL
3. Eleocharis palustris	10	Herb	OBL
4. Scirpus pungens	10	Herb	OBL
5. Hordeum jubatum	10	Herb	FAC
6.			
7.			
8.			
9.			
10.			
Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).	100%		
Remarks:			

HYDROLOGY

Recorded Data (Describe in Remarks) _____ Stream, Lake or Tide Gauge _____ Aerial Photographs (infrared) _____ Other _X_ No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: ___ Inundated ___ Saturated in Upper 12 Inches ___ Water Marks ___ Drift Lines ___ Sediment Deposits _X_ Drainage Patterns in Wetlands
Field Observations Depth of Surface Water ___None___ (in.) Depth to Free Water in Pit ___None___ (in.) Depth to Saturated Soil ___None___ (in.)	Secondary Indicators (2 or more required) ___ Oxidized Root Channels in upper 12 in. ___ Water-Stained Leaves ___ Local Soil Survey Data ___ FAC-Neutral Test ___ Other (Explain in Remarks)
Remarks: Wetland located at mouth of intermittent drainage, adjacent Bighorn Canal; wl is connected to canal through narrow channel (breach) in levee; portions of wl inundated up to 10 inches	

SOILS

Map Unit Name
(Series and Phase): _____ Drainage Class: _____

Field Observations
Taxonomy (Subgroup): _____ Confirm Mapped Type? Yes___ No___

Profile Description

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture,Concretions, Structure, etc.
0-6		10YR 5/2	7.5YR 3/4	Common/distinct	Silty clay

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
_X_ Reducing Conditions
___ Gleyed or Low-Chroma Colors
___ Concretions (iron)
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes_X_ No ___
Wetland Hydrology Present? Yes_X_ No ___
Hydric Soils Present? Yes_X_ No ___

Is this Sampling Point Within a Wetland?
Yes _X_ No ___

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Westside Irrigation District			Date: 9/13/05
Applicant/Owner:			County: Washakie
Investigator: Kurt Flaig/Jeanette Flaig			State: Wyoming
Do Normal Circumstances exist on the site?	Yes X	No	Community ID: scrub shrub
Is the site significantly disturbed (Atypical situation?)	Yes	No X	Transect ID:
Is the area a potential Problem Area? (If needed, explain on reverse.)	Yes	No X	Plot ID: WL-2

VEGETATION

Dominant Plant Species	% Cover	Stratum	Indicator
1. Salix lasiandra	45	Shrub	FACW+
2. Populus deltoides	35	Tree	FAC
3. Typha latifolia	10	Herb	OBL
4. Xanthium strumarium	5	Herb	FAC
5. Iva axillaris	5	Herb	FAC
6.			
7.			
8.			
9.			
10.			
Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).	100%		
Remarks: Majority of vegetation around perimeter/shoreline of small impoundment; impoundment appears to be slowly filling in with Typha			

HYDROLOGY

Recorded Data (Describe in Remarks) _____ Stream, Lake or Tide Gauge _____ Aerial Photographs (infrared) _____ Other _X_ No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: ___ Inundated ___ Saturated in Upper 12 Inches _X_ Water Marks ___ Drift Lines ___ Sediment Deposits _X_ Drainage Patterns in Wetlands
Field Observations Depth of Surface Water ___None___ (in.) Depth to Free Water in Pit ___None___ (in.) Depth to Saturated Soil ___None___ (in.)	Secondary Indicators (2 or more required) ___ Oxidized Root Channels in upper 12 in. ___ Water-Stained Leaves ___ Local Soil Survey Data ___ FAC-Neutral Test ___ Other (Explain in Remarks)
Remarks: Sample point along vegetated bank of shallow (up to 2' deep) impoundment	

SOILS

Map Unit Name
(Series and Phase): _____ Drainage Class: _____

Field Observations
Taxonomy (Subgroup): _____ Confirm Mapped Type? Yes___ No___

Profile Description

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture,Concretions, Structure, etc.
0-6		10YR 3/2	4/10GY	Common/prominent	Clay
6-16		5/10G	7.5YR 4/4	Many/prominent	Clay

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
_X_ Reducing Conditions
_X_ Gleyed or Low-Chroma Colors
___ Concretions (iron)
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes _X_ No ___
Wetland Hydrology Present? Yes _X_ No ___
Hydric Soils Present? Yes _X_ No ___

Is this Sampling Point Within a Wetland?
Yes _X_ No ___

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Westside Irrigation District			Date: 9/13/05
Applicant/Owner:			County: Washakie
Investigator: Kurt Flaig/Jeanette Flaig			State: Wyoming
Do Normal Circumstances exist on the site?	Yes X	No	Community ID: scrub shrub
Is the site significantly disturbed (Atypical situation?)	Yes	No X	Transect ID:
Is the area a potential Problem Area? (If needed, explain on reverse.)	Yes	No X	Plot ID: WL-3a,b

VEGETATION

Dominant Plant Species	% Cover	Stratum	Indicator
1. Elaeagnus angustifolia	60	Tree	FAC
2. Salix exigua	15	Shrub	OBL
3. Xanthium strumarium	30	Herb	FAC
4. Agropyron trachycaulum	30	Herb	FAC
5. Typha latifolia	10	Herb	OBL
6. Scirpus pungens	10	Herb	OBL
7. Phalaris arundinacea	10	Herb	FACW
8. Tamarix chinensis	10	Shrub	FACW
9.			
10.			
Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).	100%		
Remarks:			

HYDROLOGY

Recorded Data (Describe in Remarks)
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs (infrared)
_____ Other
_X_ No Recorded Data Available

Field Observations

Depth of Surface Water __None____ (in.)

Depth to Free Water in Pit __None____ (in.)

Depth to Saturated Soil __0_____ (in.)

Wetland Hydrology Indicators:
Primary Indicators:
___ Inundated
_X_ Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
_X_ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required)
___ Oxidized Root Channels in upper 12 in.
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks: Fringe wetlands along both banks of Tenmile Creek

SOILS

Map Unit Name
(Series and Phase): _____ Drainage Class: _____

Field Observations
Taxonomy (Subgroup): _____ Confirm Mapped Type? Yes___ No___

Profile Description

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture,Concretions, Structure, etc.
0-3		-----			Sand
3-14		2.5YR 4/2	4/5GY	Many/prominent	Sandy loam
14+		-----			Gravelly sand

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
_X_ Gleyed or Low-Chroma Colors
___ Concretions (iron)
___ High Organic Content in Surface Layer in Sandy Soils
_X_ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks: Soils in area are highly variable due to evident deposition and erosion

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes _X_ No ___
Wetland Hydrology Present? Yes _X_ No ___
Hydric Soils Present? Yes _X_ No ___

Is this Sampling Point Within a Wetland?
Yes _X_ No ___

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Westside Irrigation District			Date: 9/13/05
Applicant/Owner:			County: Washakie
Investigator: Kurt Flaig/Jeanette Flaig			State: Wyoming
Do Normal Circumstances exist on the site?	Yes X	No	Community ID: marsh
Is the site significantly disturbed (Atypical situation?)	Yes	No X	Transect ID:
Is the area a potential Problem Area? (If needed, explain on reverse.)	Yes	No X	Plot ID: WL-3c

VEGETATION

Dominant Plant Species	% Cover	Stratum	Indicator
1. Typha latifolia	80	Herb	OBL
2. Phalaris arundinacea	10	Herb	FACW
3. Scirpus validus	10	Herb	OBL
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).	100%		
Remarks:			

HYDROLOGY

Recorded Data (Describe in Remarks) _____ Stream, Lake or Tide Gauge _____ Aerial Photographs (infrared) _____ Other _X_ No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: ___ Inundated _X_ Saturated in Upper 12 Inches ___ Water Marks ___ Drift Lines ___ Sediment Deposits _X_ Drainage Patterns in Wetlands
Field Observations Depth of Surface Water ___None___ (in.) Depth to Free Water in Pit ___10___ (in.) Depth to Saturated Soil ___0___ (in.)	Secondary Indicators (2 or more required) ___ Oxidized Root Channels in upper 12 in. ___ Water-Stained Leaves ___ Local Soil Survey Data ___ FAC-Neutral Test ___ Other (Explain in Remarks)
Remarks: Wetland within large depression adjacent Bighorn Canal and Tenmile Creek	

SOILS

Map Unit Name
(Series and Phase): _____ Drainage Class: _____

Field Observations
Taxonomy (Subgroup): _____ Confirm Mapped Type? Yes___ No___

Profile Description

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture,Concretions, Structure, etc.
0-16		10YR 4/2	2.5Y/N	Many/prominent	Silty clay

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
_X_ Reducing Conditions
_X_ Gleyed or Low-Chroma Colors
___ Concretions (iron)
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes_X_ No ___
Wetland Hydrology Present? Yes_X_ No ___
Hydric Soils Present? Yes_X_ No ___

Is this Sampling Point Within a Wetland?
Yes _X_ No ___

Remarks: Eastern boundary of wetland was cut off because of project boundary, but wetland extends further east (outside project boundary)

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Westside Irrigation District			Date: 9/13/05
Applicant/Owner:			County: Washakie
Investigator: Kurt Flaig/Jeanette Flaig			State: Wyoming
Do Normal Circumstances exist on the site?	Yes X	No	Community ID: fringe wetland
Is the site significantly disturbed (Atypical situation?)	Yes	No X	Transect ID:
Is the area a potential Problem Area? (If needed, explain on reverse.)	Yes	No X	Plot ID: WL-3d

VEGETATION

Dominant Plant Species	% Cover	Stratum	Indicator
1. Phragmites australis	60	Herb	FACW+
2. Scirpus pungens	20	Herb	OBL
3. Xanthium strumarium	10	Herb	FAC
4. Agropyron trachycaulum	10	Herb	FAC
5.			
6.			
7.			
8.			
9.			
10.			
Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).	100%		
Remarks:			

HYDROLOGY

Recorded Data (Describe in Remarks) _____ Stream, Lake or Tide Gauge _____ Aerial Photographs (infrared) _____ Other _X_ No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: ___ Inundated _X_ Saturated in Upper 12 Inches ___ Water Marks _X_ Drift Lines _X_ Sediment Deposits ___ Drainage Patterns in Wetlands
Field Observations Depth of Surface Water ___None___ (in.) Depth to Free Water in Pit ___None___ (in.) Depth to Saturated Soil ___None___ (in.)	Secondary Indicators (2 or more required) ___ Oxidized Root Channels in upper 12 in. ___ Water-Stained Leaves ___ Local Soil Survey Data ___ FAC-Neutral Test ___ Other (Explain in Remarks)
Remarks: Wetland spans channel of Tenmile Creek	

SOILS

Map Unit Name
(Series and Phase): _____ Drainage Class: _____

Field Observations
Taxonomy (Subgroup): _____ Confirm Mapped Type? Yes___ No___

Profile Description

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture,Concretions, Structure, etc.
0-16		-----	3/10Y	Many/prominent	Loamy sand

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
___ Gleyed or Low-Chroma Colors
___ Concretions (iron)
___ High Organic Content in Surface Layer in Sandy Soils
_X Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks: Difficult to determine matrix color because of high sand content; organic streaking throughout profile

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes_X No ___
Wetland Hydrology Present? Yes_X No ___
Hydric Soils Present? Yes_X No ___

Is this Sampling Point Within a Wetland?
Yes_X No ___

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Westside Irrigation District			Date: 09/13/05
Applicant/Owner:			County: Washakie
Investigator: Kurt Flaig/Jeanette Flaig			State: Wyoming
Do Normal Circumstances exist on the site?	Yes X	No	Community ID: scrub shrub
Is the site significantly disturbed (Atypical situation?)	Yes	No X	Transect ID:
Is the area a potential Problem Area? (If needed, explain on reverse.)	Yes	No X	Plot ID: WL-3e

VEGETATION

Dominant Plant Species	% Cover	Stratum	Indicator
1. Salix exigua	60	Shrub	OBL
2. Phragmites australis	20	Herb	FACW+
3. Elaeagnus anugustifoliua	10	Tree	FAC
4. Xanthium strumarium	5	Herb	FAC
5. Agropyron trachycaulum	5	Herb	FAC
6.			
7.			
8.			
9.			
10.			
Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).	100%		
Remarks:			

HYDROLOGY

Recorded Data (Describe in Remarks) _____ Stream, Lake or Tide Gauge _____ Aerial Photographs (infrared) _____ Other _X_ No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: ___ Inundated _X_ Saturated in Upper 12 Inches ___ Water Marks _X_ Drift Lines ___ Sediment Deposits ___ Drainage Patterns in Wetlands
Field Observations Depth of Surface Water ___None___ (in.) Depth to Free Water in Pit ___None___ (in.) Depth to Saturated Soil ___0___ (in.)	Secondary Indicators (2 or more required) ___ Oxidized Root Channels in upper 12 in. ___ Water-Stained Leaves ___ Local Soil Survey Data ___ FAC-Neutral Test ___ Other (Explain in Remarks)
Remarks: Fringe wetland along Tenmile Creek; includes portions of secondary stream terrace. Soil pit saturated to soil surface.	

SOILS

Map Unit Name
(Series and Phase): _____ Drainage Class: _____

Field Observations
Taxonomy (Subgroup): _____ Confirm Mapped Type? Yes___ No___

Profile Description

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture,Concretions, Structure, etc.
0-16		10YR 4/2	2.5Y/5G	Many/prominent	Sandy loam

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
_X_ Gleyed or Low-Chroma Colors
___ Concretions (iron)
___ High Organic Content in Surface Layer in Sandy Soils
_X_ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes_X_ No ___
Wetland Hydrology Present? Yes_X_ No ___
Hydric Soils Present? Yes_X_ No ___

Is this Sampling Point Within a Wetland?
Yes _X_ No ___

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Westside irrigation District			Date: 09/13/05
Applicant/Owner:			County: Washakie
Investigator: Kurt Flaig/Jeanette Flaig			State: Wyoming
Do Normal Circumstances exist on the site?	Yes X	No	Community ID: marsh
Is the site significantly disturbed (Atypical situation?)	Yes	No X	Transect ID:
Is the area a potential Problem Area? (If needed, explain on reverse.)	Yes	No X	Plot ID: WL-3f

VEGETATION

Dominant Plant Species	% Cover	Stratum	Indicator
1. Phragmites australis	50	Herb	FACW+
2. Typha latifolia	20	Herb	OBL
3. Carex rostrata	15	Herb	OBL
4. Scirpus validus	10	Herb	OBL
5. Cirsium arvense	5	Herb	FACU
6.			
7.			
8.			
9.			
10.			
Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).	100%		
Remarks:			

HYDROLOGY

Recorded Data (Describe in Remarks) _____ Stream, Lake or Tide Gauge _____ Aerial Photographs (infrared) _____ Other _X_ No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: ___ Inundated _X_ Saturated in Upper 12 Inches ___ Water Marks ___ Drift Lines ___ Sediment Deposits ___ Drainage Patterns in Wetlands
Field Observations Depth of Surface Water ___None___ (in.) Depth to Free Water in Pit ___10___ (in.) Depth to Saturated Soil ___0___ (in.)	Secondary Indicators (2 or more required) ___ Oxidized Root Channels in upper 12 in. ___ Water-Stained Leaves ___ Local Soil Survey Data ___ FAC-Neutral Test ___ Other (Explain in Remarks)
Remarks: Wetland spans two, connected slough-like channels. Channels presumably function as diversion of overflow channels from Bighorn Canal.	

SOILS

Map Unit Name
(Series and Phase): _____ Drainage Class: _____

Field Observations
Taxonomy (Subgroup): _____ Confirm Mapped Type? Yes___ No___

Profile Description

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture,Concretions, Structure, etc.
0-4		10YR 4/1	2.5N	Common/prominent	Sandy clay
4-16		10YR 4/1	2.5N	Many/prominent	Sandy loam

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
_X_ Gleyed or Low-Chroma Colors
___ Concretions (iron)
___ High Organic Content in Surface Layer in Sandy Soils
_X_ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes_X_ No ___
Wetland Hydrology Present? Yes_X_ No ___
Hydric Soils Present? Yes_X_ No ___

Is this Sampling Point Within a Wetland?
Yes _X_ No ___

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Westside Irrigation District			Date: 09/14/05
Applicant/Owner:			County: Big Horn
Investigator: Kurt Flaig/Jeanette Flaig			State: Wyoming
Do Normal Circumstances exist on the site?	Yes X	No	Community ID: wet meadow
Is the site significantly disturbed (Atypical situation?)	Yes	No X	Transect ID:
Is the area a potential Problem Area? (If needed, explain on reverse.)	Yes	No X	Plot ID: WL-4a

VEGETATION

Dominant Plant Species	% Cover	Stratum	Indicator
1. Carex rostrata	70	Herb	OBL
2. Scirpus pungens	20	Herb	OBL
3. Xanthium strumarium	5	Herb	FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).	100%		
Remarks:			

HYDROLOGY

Recorded Data (Describe in Remarks)
_____ Stream, Lake or Tide Gauge
_____ Aerial Photographs (infrared)
_____ Other
_X_ No Recorded Data Available

Field Observations

Depth of Surface Water ___None___ (in.)

Depth to Free Water in Pit ___None___ (in.)

Depth to Saturated Soil ___0___ (in.)

Wetland Hydrology Indicators:
Primary Indicators:
___ Inundated
_X_ Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
___ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required)
___ Oxidized Root Channels in upper 12 in.
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks: Wetland located within small depression near Bighorn Canal; portions of wetland inundated up to 3 inches.

SOILS

Map Unit Name
(Series and Phase): _____ Drainage Class: _____

Field Observations
Taxonomy (Subgroup): _____ Confirm Mapped Type? Yes___ No___

Profile Description

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture,Concretions, Structure, etc.
0-4		10YR 4/1	2.5/N	Common/prominent	Sandy clay loam
4-16		10YR 4/1	2.5/N	Many/prominent	Clay loam

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
_X_ Gleyed or Low-Chroma Colors
___ Concretions (iron)
_X_ High Organic Content in Surface Layer in Sandy Soils
_X_ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes_X_ No ___
Wetland Hydrology Present? Yes_X_ No ___
Hydric Soils Present? Yes_X_ No ___

Is this Sampling Point Within a Wetland?
Yes _X_ No ___

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Westside Irrigation District			Date: 09/14/05
Applicant/Owner:			County: Big Horn
Investigator: Kurt Flaig/Jeanette Flaig			State: Wyoming
Do Normal Circumstances exist on the site?	Yes X	No	Community ID: riparian woodland
Is the site significantly disturbed (Atypical situation?)	Yes	No X	Transect ID: Sample point 1
Is the area a potential Problem Area? (If needed, explain on reverse.)	Yes	No X	Plot ID: WL-4b

VEGETATION

Dominant Plant Species	% Cover	Stratum	Indicator
1. Elaeagnus angustifolia	25	Tree	FAC
2. Salix lasiandra	15	Shrub	FACW+
3. Typha latifolia	35	Herb	OBL
4. Carex rostrata	35	Herb	OBL
5. Alopecurus pratensis	15	Herb	FACW
6. Agrostis stolonifera	15	Herb	FAC+
7.			
8.			
9.			
10.			
Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).	100%		
Remarks:			

HYDROLOGY

Recorded Data (Describe in Remarks) _____ Stream, Lake or Tide Gauge _____ Aerial Photographs (infrared) _____ Other _X_ No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: ___ Inundated _X_ Saturated in Upper 12 Inches ___ Water Marks ___ Drift Lines ___ Sediment Deposits _X_ Drainage Patterns in Wetlands
Field Observations Depth of Surface Water ___None___ (in.) Depth to Free Water in Pit ___8_____ (in.) Depth to Saturated Soil ___0_____ (in.)	Secondary Indicators (2 or more required) ___ Oxidized Root Channels in upper 12 in. ___ Water-Stained Leaves ___ Local Soil Survey Data ___ FAC-Neutral Test ___ Other (Explain in Remarks)
Remarks: Wetland located adjacent Bighorn Canal and is bisected by intermittent drainage.	

SOILS

Map Unit Name
(Series and Phase): _____ Drainage Class: _____

Taxonomy (Subgroup): _____ Field Observations Confirm Mapped Type? Yes___ No___

Profile Description

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture,Concretions, Structure, etc.
0-5		10YR 2/1	2.5/N	Few/distinct	Silt loam
5-16		10YR 4/1	2.5/N	Many/prominent	Silty clay

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
_X_ Reducing Conditions
_X_ Gleyed or Low-Chroma Colors
___ Concretions (iron)
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes_X_ No ___
Wetland Hydrology Present? Yes_X_ No ___
Hydric Soils Present? Yes_X_ No ___

Is this Sampling Point Within a Wetland?
Yes _X_ No ___

Remarks: Although the wetland was identified as riparian woodland, it includes small, open areas dominated by emergent vegetation (see dominant plant species list).

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Westside Irrigation District			Date: 09/14/05
Applicant/Owner:			County: Big Horn
Investigator: Kurt Flaig/Jeanette Flaig			State: Wyoming
Do Normal Circumstances exist on the site?	Yes X	No	Community ID: riparian woodland
Is the site significantly disturbed (Atypical situation?)	Yes	No X	Transect ID: Sample point 2
Is the area a potential Problem Area? (If needed, explain on reverse.)	Yes	No X	Plot ID: WL-4b

VEGETATION

Dominant Plant Species	% Cover	Stratum	Indicator
1. Elaeagnus angustifolia	5	Tree	FAC
2. Salix amygdaloides	10	Tree	FACW+
3. Salix lasiandra	15	Shrub	FACW+
4. Carex rostrata	30	Herb	OBL
5. Typha latifolia	25	Herb	OBL
6. Glycyrrhiza lepidota	20	Herb	FAC+
7. Agrostis stolonifera	10	Herb	FAC+
8.			
9.			
10.			
Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).	100%		
Remarks:			

HYDROLOGY

Recorded Data (Describe in Remarks) _____ Stream, Lake or Tide Gauge _____ Aerial Photographs (infrared) _____ Other _X_ No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: ___ Inundated _X_ Saturated in Upper 12 Inches ___ Water Marks ___ Drift Lines ___ Sediment Deposits ___ Drainage Patterns in Wetlands
Field Observations Depth of Surface Water ___None___ (in.) Depth to Free Water in Pit ___10___ (in.) Depth to Saturated Soil ___o___ (in.)	Secondary Indicators (2 or more required) ___ Oxidized Root Channels in upper 12 in. ___ Water-Stained Leaves ___ Local Soil Survey Data ___ FAC-Neutral Test ___ Other (Explain in Remarks)
Remarks: Sample point located adjacent Big Horn Canal levee; hydrology presumably associated with canal seepage.	

SOILS

Map Unit Name
(Series and Phase): _____ Drainage Class: _____

Field Observations
Taxonomy (Subgroup): _____ Confirm Mapped Type? Yes___ No___

Profile Description

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture,Concretions, Structure, etc.
0-3		10YR 4/1			Silt loam
3-16		2.5Y 4/2	7.5YR 4/4	Common/distinct	Clay

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
_X_ Reducing Conditions
_X_ Gleyed or Low-Chroma Colors
___ Concretions (iron)
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes_X_ No ___
Wetland Hydrology Present? Yes_X_ No ___
Hydric Soils Present? Yes_X_ No ___

Is this Sampling Point Within a Wetland?
Yes _X_ No ___

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Westside Irrigation District			Date: 09/14/05
Applicant/Owner:			County: Big Horn
Investigator: Kurt Flaig/Jeanette Flaig			State: Wyoming
Do Normal Circumstances exist on the site?	Yes X	No	Community ID: scrub shrub
Is the site significantly disturbed (Atypical situation?)	Yes	No X	Transect ID:
Is the area a potential Problem Area? (If needed, explain on reverse.)	Yes	No X	Plot ID: WL-5a

VEGETATION

Dominant Plant Species	% Cover	Stratum	Indicator
1. Salix exigua	60	Shrub	OBL
2. Typha latifolia	20	Herb	OBL
3. Rosa acicularis	5	Shrub	FACU
4. Rhus trilobata	5	Shrub	NI
5. Atriplex micrantha	5	Herb	NOL
6. Hordeum jubatum	5	Herb	FAC
7.			
8.			
9.			
10.			
Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).	75-100%		
Remarks: Using 50/20 rule, salix, typha, atriplex (NOL), and hordeum were counted as dominants, so either 75% or 100% of dominants are FAC or greater.			

HYDROLOGY

Recorded Data (Describe in Remarks)	Wetland Hydrology Indicators:
_____ Stream, Lake or Tide Gauge	Primary Indicators:
_____ Aerial Photographs (infrared)	___ Inundated
_____ Other	_X_ Saturated in Upper 12 Inches
_X_ No Recorded Data Available	___ Water Marks
	___ Drift Lines
Field Observations	___ Sediment Deposits
	_X_ Drainage Patterns in Wetlands
Depth of Surface Water ____0_____ (in.)	Secondary Indicators (2 or more required)
	___ Oxidized Root Channels in upper 12 in.
Depth to Free Water in Pit ____8_____ (in.)	___ Water-Stained Leaves
	___ Local Soil Survey Data
Depth to Saturated Soil ____0_____ (in.)	___ FAC-Neutral Test
	___ Other (Explain in Remarks)
Remarks: Wetland within channel-like depression along base of Bighorn Canal levee; receives water from small diversion in creek channel and presumably seepage from canal.	

SOILS

Map Unit Name
(Series and Phase): _____ Drainage Class: _____

Field Observations
Taxonomy (Subgroup): _____ Confirm Mapped Type? Yes___ No___

Profile Description

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture,Concretions, Structure, etc.
0-3		10YR 3/1			Silty clay loam
3+		10YR 4/2	2.5/N	Few/prominent	Clay

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
_X_ Reducing Conditions
_X_ Gleyed or Low-Chroma Colors
___ Concretions (iron)
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes_X_ No ___
Wetland Hydrology Present? Yes_X_ No ___
Hydric Soils Present? Yes_X_ No ___

Is this Sampling Point Within a Wetland?
Yes _X_ No ___

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Westside Irrigation District			Date: 09/15/05
Applicant/Owner:			County: Big Horn
Investigator: Kurt Flaig/Jeanette Flaig			State: Wyoming
Do Normal Circumstances exist on the site?	Yes X	No	Community ID: scrub shrub
Is the site significantly disturbed (Atypical situation?)	Yes	No X	Transect ID: Sample point 1
Is the area a potential Problem Area? (If needed, explain on reverse.)	Yes	No X	Plot ID: WL-5b

VEGETATION

Dominant Plant Species	% Cover	Stratum	Indicator
1. Elaeagnus angustifolia	50	Tree	FAC
2. Salix lasiandra	30	Shrub	FACW+
3. Typha latifolia	45	Herb	OBL
4. Carex roastrata	40	Herb	OBL
5. Sonchus uglinosus	10	Herb	NOL
6. Mentha arvensis	5	Herb	FAC
7.			
8.			
9.			
10.			
Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).	100%		
Remarks:			

HYDROLOGY

Recorded Data (Describe in Remarks) _____ Stream, Lake or Tide Gauge _____ Aerial Photographs (infrared) _____ Other _X_ No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: ___ Inundated _X_ Saturated in Upper 12 Inches ___ Water Marks ___ Drift Lines ___ Sediment Deposits _X_ Drainage Patterns in Wetlands
Field Observations Depth of Surface Water ___None___ (in.) Depth to Free Water in Pit ____6____ (in.) Depth to Saturated Soil ____0____ (in.)	Secondary Indicators (2 or more required) ___ Oxidized Root Channels in upper 12 in. ___ Water-Stained Leaves ___ Local Soil Survey Data ___ FAC-Neutral Test ___ Other (Explain in Remarks)
Remarks: Large wetland complex with inclusions of small emergent wetlands; wetland spans creek channel and is situated adjacent the Big Horn Canal.	

SOILS

Map Unit Name
(Series and Phase): _____ Drainage Class: _____

Field Observations
Taxonomy (Subgroup): _____ Confirm Mapped Type? Yes___ No___

Profile Description

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture,Concretions, Structure, etc.
0-4		2.5Y 4/2			Clay loam
4-16		3/10Y			Clay loam

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
_X_ Reducing Conditions
_X_ Gleyed or Low-Chroma Colors
___ Concretions (iron)
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes_X_ No ___
Wetland Hydrology Present? Yes_X_ No ___
Hydric Soils Present? Yes_X_ No ___

Is this Sampling Point Within a Wetland?
Yes _X_ No ___

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Westside Irrigation District			Date: 09/15/05
Applicant/Owner:			County: Big Horn
Investigator: Kurt Flaig/Jeanette Flaig			State: Wyoming
Do Normal Circumstances exist on the site?	Yes X	No	Community ID: scrub shrub
Is the site significantly disturbed (Atypical situation?)	Yes	No X	Transect ID: Sample point 2
Is the area a potential Problem Area? (If needed, explain on reverse.)	Yes	No X	Plot ID: WL-5b

VEGETATION

Dominant Plant Species	% Cover	Stratum	Indicator
1. Salix lasiandra	10	Shrub	FACW+
2. Salix exigua	10	Shrub	OBL
3. Typha latifolia	70	Herb	OBL
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).	100%		
Remarks:			

HYDROLOGY

Recorded Data (Describe in Remarks) _____ Stream, Lake or Tide Gauge _____ Aerial Photographs (infrared) _____ Other _X_ No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: _X_ Inundated _X_ Saturated in Upper 12 Inches ___ Water Marks ___ Drift Lines ___ Sediment Deposits ___ Drainage Patterns in Wetlands
Field Observations Depth of Surface Water ___0-2___ (in.) Depth to Free Water in Pit ___0___ (in.) Depth to Saturated Soil ___0___ (in.)	Secondary Indicators (2 or more required) ___ Oxidized Root Channels in upper 12 in. ___ Water-Stained Leaves ___ Local Soil Survey Data ___ FAC-Neutral Test ___ Other (Explain in Remarks)
Remarks: Sample point located below Big Horn Canal levee.	

SOILS

Map Unit Name
(Series and Phase): _____ Drainage Class: _____

Field Observations
Taxonomy (Subgroup): _____ Confirm Mapped Type? Yes___ No___

Profile Description

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture,Concretions, Structure, etc.
0-16		10YR 4/1			Silt loam

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
_X_ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
_X_ Gleyed or Low-Chroma Colors
___ Concretions (iron)
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes_X_ No ___
Wetland Hydrology Present? Yes_X_ No ___
Hydric Soils Present? Yes_X_ No ___

Is this Sampling Point Within a Wetland?
Yes _X_ No ___

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Westside Irrigation District			Date: 09/15/05
Applicant/Owner:			County: Big Horn
Investigator: Kurt Flaig/Jeanette Flaig			State: Wyoming
Do Normal Circumstances exist on the site?	Yes X	No	Community ID: wet meadow
Is the site significantly disturbed (Atypical situation?)	Yes	No X	Transect ID:
Is the area a potential Problem Area? (If needed, explain on reverse.)	Yes	No X	Plot ID: WL-6

VEGETATION

Dominant Plant Species	% Cover	Stratum	Indicator
1. Phalaris arundinacea	75	Herb	FACW
2. Rumex crispus	5	Herb	FAC+
3. Hordeum jubatum	5	Herb	FAC
4. Cirsium arvense	5	Herb	FACU+
5. Alopecurus pratensis	5	Herb	FACW
6.			
7.			
8.			
9.			
10.			
Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).	100%		
Remarks:			

HYDROLOGY

Recorded Data (Describe in Remarks) _____ Stream, Lake or Tide Gauge _____ Aerial Photographs (infrared) _____ Other _X_ No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: ___ Inundated ___ Saturated in Upper 12 Inches ___ Water Marks ___ Drift Lines ___ Sediment Deposits _X_ Drainage Patterns in Wetlands
Field Observations Depth of Surface Water ___None___ (in.) Depth to Free Water in Pit ___None___ (in.) Depth to Saturated Soil ___None___ (in.)	Secondary Indicators (2 or more required) ___ Oxidized Root Channels in upper 12 in. ___ Water-Stained Leaves ___ Local Soil Survey Data ___ FAC-Neutral Test ___ Other (Explain in Remarks)
Remarks: Wetland located adjacent Bighorn Canal, hydrology presumably associated with canal seepage/high water table.	

SOILS

Map Unit Name
(Series and Phase): _____ Drainage Class: _____

Field Observations
Taxonomy (Subgroup): _____ Confirm Mapped Type? Yes___ No___

Profile Description

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture,Concretions, Structure, etc.
0-3		10YR 3/2	7.5YR 3/4	Common/distinct	Silt loam
3-16		10YR 4/2	7.5YR 3/4	Many/distinct	Silt clay loam

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
_X_ Reducing Conditions
___ Gleyed or Low-Chroma Colors
___ Concretions (iron)
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes_X_ No ___
Wetland Hydrology Present? Yes_X_ No ___
Hydric Soils Present? Yes_X_ No ___

Is this Sampling Point Within a Wetland?
Yes _X_ No ___

Remarks:

Appendix C. Photos of wetlands delineated at the Westside Irrigation District project.

Wetland 1.

Wetland 2.

Wetland 3a and b.

Wetland 3c.

Wetland 3d.

Wetland 3e.

Wetland 3f.

Wetland 4a.

Wetland 4b.

Wetland 5a.

Wetland 5b.

Wetland 6.

Appendix D. Plants encountered during wetland surveys at the Westside Irrigation District project.

FAMILY	COMMON NAME	SCIENTIFIC NAME	Wetland Indicator Status (Reg 9)
Alismataceae	Northern water plantain	*Alisma triviale*	NOL
	Arumleaf arrowhead	*Sagittaria cuneata*	OBL
Anacardiaceae	Skunkbush sumac	*Rhus trilobata*	NI
Apiaceae	Water hemlock	*Cicuta douglasii*	OBL
Asclepidaceae	Showy milkweed	*Asclepias speciosa*	FAC+
Asteraceae	Big sagebrush	*Artemisia tridentata*	NOL
	Gray rabbitbrush	*Chrysothamnus nauseosus*	NOL
	Canada thistle	*Cirsium arvense*	FACU+
	Curly-cup gumweed	*Grindelia squarrosa*	FACU
	Povertyweed	*Iva axillaris*	FAC
	Sow thistle	*Sonchus uglinosus*	NOL
	Common cocklebur	*Xanthium strumarium*	FAC
Brassicaceae	Whitetop	*Cardaria draba*	NOL
	Tumble mustard	*Sysimbrium* sp.	----
Chenopodiaceae	Amaranth	*Amaranthus* sp.	----
	Twoscale saltbush	*Atriplex micrantha*	NOL
	Pitseed goosefoot	*Chenopodium berlandieri*	NOL
	Red goosefoot	*Chenopodium rubrum*	FACW+
	Halogeton	*Halogeton glomeratus*	NOL
	Russian thistle	*Salsola tragus*	UPL
Cyperaceae	Nebraska sedge	*Carex nebrascensis*	OBL
	Beaked sedge	*Carex rostrata*	OBL
	Creeping spikerush	*Eleocharis palustris*	OBL
	Panicled bulrush	*Scirpus microcarpus*	OBL
	Common threesquare	*Scirpus pungens*	OBL
	Softstem bulrush	*Scirpus validus*	OBL
Elaeagnaceae	Russian olive	*Elaeagnus angustifolia*	FAC
Equisetaceae	Horsetail	*Equisetum* sp.	----
Fabaceae	Wild licorice	*Glycyrrhiza lepidota*	FAC+
	White sweetclover	*Melilotus alba*	FACU
	Yellow sweetclover	*Melilotus officinalis*	FACU
Grossulariaceae	Gooseberry	*Ribes* sp.	----
Juncaceae	Baltic rush	*Juncus balticus*	FACW+
Lamiaceae	Field mint	*Mentha arvensis*	FAC
Onagraceae	Fringed willowherb	*Epilobium ciliatum*	FACW-
Poaceae	Slender wheatgrass	*Agropyron trachycaulum*	FAC
	Creeping bentgrass	*Agrostis stolonifera*	FAC+
	Meadow foxtail	*Alopecurus pratensis*	FACW
	American sloughgrass	*Beckmannia syzigachne*	OBL
	Smooth brome	*Bromus inermis*	NOL
	Cheatgrass	*Bromus tectorum*	NOL
	Barnyardgrass	*Echinochloa crusgalli*	FACW
	Canada wildrye	*Elymus canadensis*	FAC
	Foxtail barley	*Hordeum jubatum*	FAC
	Reed canarygrass	*Phalaris arundinacea*	FACW
	Common reed	*Phragmites australis*	FACW+
	Bristlegrass	*Setaria* sp.	----
	Sand dropseed	*Sporobolus cryptandrus*	FACU-
Polygonaceae	Curly dock	*Rumex crispus*	FAC+
	Golden dock	*Rumex maritimus*	FACW+

Rosaceae	Prickly rose	*Rosa acicularis*	FACU
Salicaceae	Plains cottonwood	*Populus deltoides*	FAC
	Peachleaf willow	*Salix amygdaloides*	FACW
	Sandbar willow	*Salix exigua*	OBL
	Whiplash willow	*Salix lasiandra*	FACW+
Sarcobataceae	Greasewood	*Sarcobatus vermiculatus*	FACU+
Tamaricaceae	Tamarisk	*Tamarix chinensis*	FACW
Typhaceae	Broadleaf cattail	*Typha latifolia*	OBL

APPENDIX G

RARE PLANT SURVEY REPORT

Westside Irrigation District Rare Plant Survey Report

Big Horn County and Washakie County, Wyoming

Prepared for:

Westside Irrigation District

Prepared by:

Kurt Flaig

Western **E**co**S**ystems **T**echnology
2003 Central Ave.
Cheyenne, WY 82001

Report Date: October14, 2005

INTRODUCTION

The proposed project involves the conveyance of a parcel of land, comprising approximately 16,500 acres, from the Bureau of Land Management (BLM) to the Westside Irrigation District (WID). The parcel is located in southern Big Horn County and northern Washakie County, immediately west of Worland, Wyoming. WID proposes to use those portions of the parcel that are irrigable and that avoid impacts to wildlife, recreation, sensitive environmental areas, and other land uses. The majority of the project area is potentially suitable for irrigation by center pivot sprinkler systems. Irrigation water would be obtained by pumping water from the Bighorn River at three locations. Each site would contain two pumps together capable of pumping 80 cfs, a pump station and fore bay.

The majority of the 16,500-acre parcel is dominated by sagebrush steppe. Although extensive tracts of salt desert shrub occur immediately adjacent the site to the west, only small, scattered inclusions of this habitat were observed within the parcel. Four intermittent drainages convey water across the site in an easterly direction into the Bighorn River. The 4 tributaries, listed from north to south, include Alamo, Fivemile, Sixmile, and Tenmile Creeks. All of these drainages are culverted beneath the Bighorn (irrigation) Canal, which borders the site on the east. Three impoundments (stockponds) were observed on site, 1 of which contained standing water and supported hydrophytic vegetation.

This report has been prepared to document a survey that was conducted for two rare plant species with the proposed project area. The two species include Ute ladies'-tresses orchids (*Spiranthes diluvialis*), a federally-listed threatened plant species, and persistent sepal yellowcress (*Rorippa calycina*), a BLM-sensitive plant species (BLM Worland Field Office). The survey was conducted within areas of suitable habitat in the proposed project area.

Spiranthes diluvialis

Ute ladies'-tresses is a perennial forb in the orchid family. It was first described as a species by C. J. Sheviak in 1984. At the time of its discovery, the orchid was only known from Colorado and Utah. In January of 1922 it was listed as a federally Threatened species. Since its listing, additional populations of the orchid have been found in Colorado, Idaho, Montana, Nevada, Utah and Wyoming.

Ute ladies'-tresses orchid typically blooms from late July through August, and in some cases into September (USFWS 1992), although blooms have been recorded from early July to as late as October (Jennings 1989). Stems of the orchid typically reach 20 to 50 cm in height, rising from thick tuberous roots that depend on mycorrhizal fungi for enhanced water and nutrient absorption.

Spiranthes diluvialis primarily occurs on moist soils in mesic or wet meadows near springs, lakes, or perennial streams featuring relatively open vegetative cover. Jennings (1990) and Coyner (1989) reported that the orchid seems to require "permanent subirrigation", indicating a close affinity with floodplain areas where the water table is close to the surface throughout the growing season, but it is not tolerant of permanent standing water. Although the orchid often colonizes early successional riparian habitats (e.g., point bars, sand bars), it is generally believed

that it possesses a very low reproductive rate (*i.e.*, it recruits relatively few individuals to the overall population each year) (Coyner 1991). Furthermore, research has shown that individual plants can remain dormant for several growing seasons or produce only vegetative shoots, complicating inventory and study of its population structure.

Rorippa calycina

Persistent sepal yellowcress formerly had Federal Status as a Category 2 (C2) species, defined as a taxa for which current information indicates that proposing to list as endangered or threatened is possible, but more biological information is needed. Persisitent sepal yellowcress is currently considered a sensitive species by the BLM in Wyoming (Worland and Rawlins Field offices).

This rhizomatous, perennial herb in the mustard family occurs primarily along moist, sandy to muddy banks of streams, stock ponds, and man-made reservoirs near the high-water line. It is typically found at elevations ranging from 3,660 to 6,800 feet. The flowering period for the species extends from May to July, and the fruiting period extends from June through September (WYNDD). Persistent sepal yellowcress is known from 24 occurrences in Wyoming, from the Bighorn Basin, North Platte River drainage, Green River, and Wind River basins in Albany, Big Horn, Carbon, Fremont, Park, Sweetwater, and Washakie counties (WYNDD).

METHODS

All potential habitats within the proposed project area were thoroughly surveyed on foot from September 12-15, 2005. In general, parallel transects were walked through the wetlands concentrating in areas that most closely met the habitat descriptions for Ute ladies'-tresses (e.g., open wet meadows characterized by grasses, sedges, rushes and a lack of dense overstory or deeply shaded areas) and persistent sepal yellowcress, so that thorough coverage of all suitable habitats were achieved. Plant species observed during the survey were recorded (Appendix A). The surveys were performed by qualified WEST botanists Kurt Flaig and Jeanette Flaig.

RESULTS

Surveys for Ute ladies'-tresses orchid and persistent sepal yellowcress were conducted in a variety of wetland habitat types on site. These include emergent wet meadow, shallow marsh, fringe wetland, riparian scrub-shrub wetland, and forested wetland. Although the latter two wetland types are typically too dense with overstory vegetation for the two species, they featured small inclusions of open areas dominated by emergent vegetation. As a result, all portions of these wetland types were surveyed. No Ute ladies'-tresses or persistent sepal yellowcress were observed on site and they are presumed absent from the survey area.

All but one of the wetlands identified within the project area were in the immediate vicinity of, and associated with, the Bighorn Canal. This sole, isolated wetland occurred within an impoundment on a tributary to Tenmile Creek, along the southern boundary of the site. This shrub-scrub wetland was dominated by small plains cottonwoods (*Populus deltoides*) and whiplash willow (*Salix lasiandra*), which sparsely encircled a shallow pond. The pond

supported scattered patches of broadleaf cattail (*Typha latifolia*). The overall site, including its heavy clay soils, provided very marginal habitat for Ute ladies'-tresses orchids.

The remaining wetlands on site occurred along the Bighorn Canal, and were either associated with seepage from the levee or with a high water table (from the presence of the large canal). Emergent wetlands were observed along the canal and along the portions of the 4 tributaries in the immediate vicinity of the canal. To the west of the Bighorn Canal, each of these tributaries occurred as dry washes, and, with the exception of some scattered cottonwoods, supported no hydrophytic vegetation. Once culverted beneath the canal, the creeks became perennial, and supported a variety of hydrophytic vegetation. Hydrology is presumably a result of seepage, high water table, and canal water diversions into the tributaries. Forested wetlands were dominated by Russian olive (*Elaeagnus angustifolia*) and whiplash willow (*Salix lasiandra*) trees, and generally included scattered patches of open, emergent wetlands. Species that were commonly observed within emergent wetland and shallow marsh on site included slender wheatgrass (*Agropyron trachycaulum*), creeping bentgrass (*Agrostis stolonifera*), meadow foxtail (*Alopecurus pratensis*), beaked sedge (*Carex rostrata*), foxtail barley (*Hordeum jubatum*), Baltic rush (*Juncus balticus*), reed canarygrass (*Phalaris arundinacea*), curly dock (*Rumex crispus*), common threesquare (*Scirpus pungens*), softstem bulrush (*Scirpus validus*), broadleaf cattail, and cocklebur (*Xanthium strumarium*).

The majority of emergent wetlands and portions of the forested and scrub-shrub wetlands on site provide at least marginal habitat for Ute ladies'-tresses and persistent sepal yellowcress. However, the overall site elevation is approximately 1,000 feet below the known elevation range of the orhid in Wyoming, and it is therefore unlikely for the species to occur. No Ute ladies'-tresses or persistent sepal yellowcress were found on site.

DETERMINATION

It is determined that the proposed project would not likely affect any individuals or populations of Ute ladies'-tresses and persistent sepal yellowcress within the survey area.

Literature Cited

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Jennings, W. F. 1990. Final Report – *Spiranthes diluvialis*. Report for The Nature Conservancy under the Colorado Natural History Small Grants Program. The Nature Conservancy, Boulder, Colorado. 29pp.

U.S. Fish and Wildlife Service (USFWS). 1992. Final Rule to List the plant *Spiranthes diluvialis* (Ute ladies'-tresses) as a Threatened species. Federal Register 57 (12): 2048-2054.

APPENDIX A
PLANT SPECIES OBSERVED
DURING THE WESTSIDE IRRIGATION DISTRICT
RARE PLANT SURVEY

FAMILY	COMMON NAME	SCIENTIFIC NAME
Alismataceae	Northern water plantain	*Alisma triviale*
	Arumleaf arrowhead	*Sagittaria cuneata*
Anacardiaceae	Skunkbush sumac	*Rhus trilobata*
Apiaceae	Water hemlock	*Cicuta douglasii*
Asclepidaceae	Showy milkweed	*Asclepias speciosa*
Asteraceae	Big sagebrush	*Artemisia tridentata*
	Gray rabbitbrush	*Chrysothamnus nauseosus*
	Canada thistle	*Cirsium arvense*
	Curly-cup gumweed	*Grindelia squarrosa*
	Povertyweed	*Iva axillaris*
	Sow thistle	*Sonchus uglinosus*
	Common cocklebur	*Xanthium strumarium*
Brassicaceae	Whitetop	*Cardaria draba*
	Tumble mustard	*Sysimbrium* sp.
Chenopodiaceae	Amaranth	*Amaranthus* sp.
	Twoscale saltbush	*Atriplex micrantha*
	Pitseed goosefoot	*Chenopodium berlandieri*
	Red goosefoot	*Chenopodium rubrum*
	Halogeton	*Halogeton glomeratus*
	Russian thistle	*Salsola tragus*
Cyperaceae	Nebraska sedge	*Carex nebrascensis*
	Beaked sedge	*Carex rostrata*
	Creeping spikerush	*Eleocharis palustris*
	Panicled bulrush	*Scirpus microcarpus*
	Common threesquare	*Scirpus pungens*
	Softstem bulrush	*Scirpus validus*
Elaeagnaceae	Russian olive	*Elaeagnus angustifolia*
Equisetaceae	Horsetail	*Equisetum* sp.
Fabaceae	Wild licorice	*Glycyrrhiza lepidota*
	White sweetclover	*Melilotus alba*
	Yellow sweetclover	*Melilotus officinalis*
Grossulariaceae	Gooseberry	*Ribes* sp.
Juncaceae	Baltic rush	*Juncus balticus*
Lamiaceae	Field mint	*Mentha arvensis*
Onagraceae	Fringed willowherb	*Epilobium ciliatum*
Poaceae	Slender wheatgrass	*Agropyron trachycaulum*
	Creeping bentgrass	*Agrostis stolonifera*
	Meadow foxtail	*Alopecurus pratensis*
	American sloughgrass	*Beckmannia syzigachne*
	Smooth brome	*Bromus inermis*
	Cheatgrass	*Bromus tectorum*
	Barnyardgrass	*Echinochloa crus-gali*
	Canada wildrye	*Elymus canadensis*

	Foxtail barley	*Hordeum jubatum*
	Reed canarygrass	*Phalaris arundinacea*
	Common reed	*Phragmites australis*
	Bristlegrass	*Setaria* sp.
	Sand dropseed	*Sporobolus cryptandrus*
Polygonaceae	Curly dock	*Rumex crispus*
	Golden dock	*Rumex maritimus*
Rosaceae	Prickly rose	*Rosa acicularis*
Salicaceae	Plains cottonwood	*Populus deltoides*
	Sandbar willow	*Salix exigua*
	Whiplash willow	*Salix lasiandra*
Sarcobataceae	Greasewood	*Sarcobatus vermiculatus*
Tamaricaceae	Tamarisk	*Tamarix chinensis*
Typhaceae	Broadleaf cattail	*Typha latifolia*

APPENDIX H

RIGHTS-OF-WAY AUTHORIZATIONS

Rights-of-way Authorizations
Within the
Westside Irrigation District Land Conveyance Project

HOLDER	CASE TYPE	SERIAL NUMBER
Red Butte Pipe Line Co. 539 S. Main St. Findlay, OH 45840	Pipe Line	WYB-0013281 WYW-066684 WYW-0022960
RT Communications Inc. 130 S. 9th Worland, WY 82401	Telephone Line	WYW-047872 WYW-079581
Big Horn Canal District PO Box 697 Basin, WY 82410	Irrigation Canal	WYW-059856
High Plains Power Inc. PO Box 630 Thermopolis, WY 82443	Power Line	WYW-061490 WYW-0031231
BLM-Worland Field Office	Road	WYW-081757
Vernon E. Faulconer Inc. PO Box 7995 Tyler, TX 75711	Access Road (Five Mile Field)	WYW-094011
WellStar Corp. 11990 Grant St. #550 Northglenn, CO 80233	Access Road (Ten Mile Road) (Well #41X-16)	WYW-094085
Devon Energy Prod. Co LP 20 N. Broadway #1500 Oklahoma City, OK 73102-8260	Access Road (Worland Unit Wells) Pipe Line (Worland Field – Gathering)	WYW-094087 WYW-153873
West River Service District 946 West River Road Worland, WY 82401	Water Pipe Line	WYW-094097

PacifiCorp d/b/a Rocky Mountain Power 2840 East Yellowstone Ave. Casper, WY 82609	Power Line	WYW-108430 WYW-108432 WYW-136531 WYW-142426 WYW-144853 WYW-159549 WYW-0044411
Express Pipe Line Partnership 800 Werner Ct #352 Casper, WY 82601	Pipe Line	WYW-128830
Ms. Barb Chancellor Right-of-way Program Wyoming Dept. of Transportation 5300 Bishop Blvd. Cheyenne, WY 82009-3340	Mineral Material Site (Blue Pit) Highway (Ketchum's Corner)	WYW-132806 WYW-134046
Washakie County PO Box 260 Worland, WY 82401	Access Road	WYW-134050
Cabot Oil & Gas Corp. 600 17th St. #1900 N Denver, CO 80202	Access Road (Corral Creek Wells)	WYW-159515
Jack J. Grynberg 5299 DTC Blvd. #500 Greenwood Village, CO 80111	Access Road (Yaz Federal Well #1-15)	WYW-165007
Williston Basin Pipeline PO Box 131 Glendive, MT 59330	Pipe Line	WYW-0001185 WYW-0275301

APPENDIX I

PREHISTORIC PERIODS

Paleoindian Stage

Although the specifics of human passage into this continent remain heavily debated, there is little doubt that people were here towards the end of the Pleistocene, a period marked by cooler temperatures, a moister climate, a wider distribution of resources and less seasonal variability than exists in modern times.

The Paleoindian Stage (~11,500-8,000 B. P.) is generally characterized by high residential mobility and low population density. The peoples of the time period are seen as specialized hunters of large megafauna, including the now extinct mammoth, giant bison, camel, and ground sloth, as well as many other big game species. To a lesser extent, small animal and plant resources were also procured (McNees et. al. 1999). McNees et al. (1999) refers to this period as the Northwest Plains Pleistocene-Holocene Transition Adaptation.

The Clovis Complex (~11,500-10,900 B. P.) represents the earliest Paleoindian occupation that has been well established in the United States. There is more recent data indicating that a pre-Clovis occupation may have existed, though the data is still inconclusive. The Clovis Period is characterized by large, well made fluted points, often associated with faunal remains, including the extinct mammoth. The Colby site (48WA322) in the Bighorn Basin suggests planned mammoth hunting (Frison and Todd 1986). Portions of the remains of at least eight mammoths were recovered (Frison et. al. 1996). Other mammal remains were also recovered in much smaller numbers. These included bison, camel, horse, pronghorn and jackrabbit (Frison et. al. 1996).

The Goshen Complex (Frison 1996), which some archaeologists ascribe as coeval with Clovis, may represent the beginnings of a transition from a specialized big-game hunting adaptation to part-time bison-hunting adaptation (Frison et al. 1996; McNees et al. 1999). Goshen Complex sites date around 11,300-11,000 B. P. (Frison et al. 1996; McNees et. al. 1999). The Goshen complex was first described at the Hell Gap site in Wyoming (Frison et. al. 1996). Goshen points are very similar to Plainview and Midland points. Frison et al. (1996) suggest that the Goshen complex should be referred to as Goshen-Plainview when dealing in the Northern Plains, because the relationships among Goshen, Folsom, Plainview, and Midland are unclear.

The Folsom complex (10,900-10,200 B.P.), whose hunting adaptations appear to concentrate on taking bison, are often seen as the descendants of the Clovis Complex. Folsom points are characteristic of this complex, being smaller and more finely crafted than the preceding Clovis points. Major Folsom sites are generally located in topographic areas conducive to bison hunting by means of traps and drives (Frison et al. 1996). The Hanson Site (48BH329), located in northeast Bighorn Basin contained both fluted and unfluted Folsom points (Frison and Bradley 1980). The Midland Complex (10,700-10,400 B. P.) slightly overlaps Folsom and Agate Basin. The points are similar to Goshen and Folsom, though Midland points are not fluted. Some non-fluted points have been found in Folsom assemblages, again raising question to the relationship of the Midland complex to Goshen, Folsom, and Plainview (Frison et al. 1996).

Following the Folsom, the Late Paleoindian period is characterized by a proliferation of projectile point types and a shift to a broader subsistence base in mountain and foothill contexts (Frison 1992). The Agate Basin complex (10,500-10,000 B. P) is possibly a continuation of the

Goshen and Folsom complexes. The long and narrow Agate Basin points are thought to have been ideal for hunting bison and other large game (Frison and Stanford 1982). Efficient use of arroyo traps is evident during this complex (Frison et. al. 1996). The Hell Gap complex point (10,000-9,500 B. P.), according to Frison (1991), point likely developed from the Agate Basin point. The two point types differ only slightly in that the Hell Gap points are wider and have a shoulder (Frison et al. 1996).

Alberta points (9,000-9,500 B. P.), first recognized in Canada, has broad stems and sharp shoulders and as such are hafted differently (Frison et al. 1996). The Alberta-Cody complex points (~10,000 B. P.) are similar to Cody and Alberta, thus the name. The Cody complex (8,800-9,300 B. P.) is characterized by Scottsbluff and Eden points. These points are found in a wide range of environmental settings. The Horner site (48PA29) is a Cody complex site within the Bighorn Basin (Frison and Todd 1987). This site yielded a large assemblage of Cody Knives and Eden and Scottsbluff projectile points (Frison 1991).

The Foothill-Mountain Paleoindian period (~8,000-10,000), proposed by Frison (1992) reflects a dichotomy between Foothill/Mountain and Plains groups. The foothill-mountain groups participated in a broad spectrum hunting and gathering strategy similar to the Archaic period, while the plains groups tended toward a more specialized big game, particularly bison, strategy (Frison et al. 1996). Frison originally proposed that the dichotomy between the Foothill/Mountain and Plains groups began around 10,000 B.P. and ended around 8,000 B. P. (Frison et. al. 1996). However, Frison (1991) also states that there is enough evidence to suggest that the dichotomy persisted in various degrees throughout the prehistoric periods. Sites that provide evidence for this dichotomy in the Bighorn Basin region include Medicine Lodge Creek (48BH499), Little Canyon Creek Cave (48WA323), and Brush Shelter (48SW324) (Frison 1991). These cave and rock shelter sites produced fewer diagnostic points than is common in Plains sites. The points that are present differ from those found in Plains sites (Frison 1991). The Foothill-Mountain Paleoindian component at Medicine Lodge Creek site showed little evidence of Bison procurement. Instead, mule deer and mountain sheep were more commonly relied on for subsistence (Frison 1991).

Archaic Stage

The shift from the Paleoindian Stage to the Archaic Stage is marked by the change from stemmed and lanceolate points to side-notched varieties and a change in subsistence practices (Francis 1983; Frison 1991, Larson 1997). Frison (1991) breaks the Archaic period into three periods: Early, Middle, and Late.

The Early Plains Archaic (8,000-4,000 B. P.) is arguably the least understood and most controversial of the prehistoric periods. Previous thought was that during the Altithermal, an arid climactic period of warmer temperatures, the plains would have been unable to support sufficient bison populations for a cooperative bison-hunting subsistence strategy (McNees et al. 1999). Currently it is believed that a bison hunting adaptation continued on some level throughout the Altithermal, though the general bison population and human activity was lower (McNees et al. 1999). The paucity of early Archaic sites may also reflect poor site preservation and visibility. The Early Plains Archaic is marked by the appearance of side-notched points (Bitterroot/Northern side-notched points) and, according to Frison et al. (1996), an increase in

plant resource usage. Leigh Cave (48BH304), a rock shelter in the foothills of eastern Bighorn Basin with Early and Middle Archaic components, showed evidence of plant use including wild onion, buffalo berry, thistle, wild rose, wild rye, and yucca (Frison and Huseas 1968, Frison 1991). The roasting pits in this site had remains of roasted Mormon Crickets (Frison 1991).

The Middle Plains Archaic (~4,000-3,000 B. P.), as Frison (1991) describes it, is characterized by the presence of McKean complex projectile points (Frison 1991). The Altithermal ended, more modern climates were established, and the modern subspecies of bison had evolved (Frison et al. 1996). Stone circles, or tipi rings, begin to appear in the archaeological record. Stone circles, fire or roasting pits, slab lined pits, and grinding stones became more prevalent. The McKean complex is defined by the McKean lanceolate point, which have deep to shallow basal notching, as well as Duncan points, Hanna points, and Mallory side-notched points (Frison et al. 1996). The McKean complex appears to have overlain a variety of distinct settlement and subsistence strategies in a wide geographical area (McNees et al. 1999). The McKean complex is well represented in the Bighorn Basin. The Dead Indian Creek Site (48PA551), located in a small basin northwest of the Bighorn Basin, is a winter camp that shows extensive use of mule deer and lesser use of mountain sheep (Frison 1991). The site yielded grinding slabs and manos, suggesting at least some plant resource utilization (Frison 1991) and possibly a house pit (Frison 1991). Other sites with a Middle Plains Archaic component in the Bighorn Basin include Medicine Lodge Creek (48BH499), Granite Creek Rock Shelter (48BH330), Leigh Cave (48BH304), The Bighorn Canyon Sites (Sorenson and Bottleneck), Paint Rock V (48BH349), and Beehive (48BH346) (Frison 1991, Hall 1998).

The Late Plains Archaic (~3,000-1,500 B. P.) showed an increase in sites as evidenced by the rise in the number of radio carbon dates (Frison 1991; Frison et al 1996). Projectile point styles of this period include Pelican Lake, Yonkee, Besant (Frison 1991). The use of caves and rock shelters in the Absaroka and Bighorn Mountains was prevalent during this period. The Spring Creek Cave and Daugherty sites, located on the western slopes of the Bighorn Mountains, yielded basketry fragments, woodworking debris, bark cordage, sinew, hide, feathers, shell, porcupine quills, and wooden and elk antler digging tools (Frison 1991; Frison et al 1996). Both sites show evidence for atlatl and dart manufacturing and use (Frison et al. 1996). The digging tools suggest recovery of plant resources such as wild onion, sego lily, bitterroot, and biscuitroot (Frison et al. 1996).

Late Plains Prehistoric Stage

There is no clear boundary between the Late Plains Archaic and the Late Prehistoric periods. The transition between the two periods appears to represent an overlap of technological traditions further complicated by an apparent Archaic hunting and gathering life way which continued in the Bighorn Basin almost into the Historic period (Frison et al. 1996). The Late Plains Prehistoric period is marked by a change in projectile point types and sizes related to the adoption of the bow and arrow, and use of ceramics (Frison 1991). The end of the Late Plains Prehistoric period is placed at the onset of the dramatic changes that the acquisition of European-American trade goods, horses (Ewers 1955), firearms, and population movements and dislocations wrought on the settlement and subsistence patterns (McNees et al. 1999).

Avonlea represents the first appearance of groups using exclusively bow and arrow technology (Hall 1998). Avonlea sites are typically located in and around buttes which, according to Frison

(1991), suggests either a defensive tactic or a need for greater visibility. Slab-lined pits are common in Avonlea sites (Frison 1991). Avonlea sites in the Bighorn Basin appear to be a local variation since the basin was unsuitable for large bison herds due to climatic conditions (Frison 1991). Instead, Avonlea groups in the Bighorn Basin region focused on mule deer and bighorn sheep as their primary faunal resource (Hall 1998). The Beehive site (48BH346), Medicine Lodge Creek (48BH499), and Wortham Shelter (48BH730) are examples of sites in the Bighorn Basin with an Avonlea component (Frison 1991).

Pottery is another marker of the Late Plains Prehistoric period, though it started to appear near the end of the Late Plains Archaic period (Frison 1991). Besant complex sites have Woodland-type ceramics, sites with Plains side-notched and tri-notched points have Intermountain Tradition ceramics (interpreted as Shoshonean) and Mandan-Hidatsa Tradition (interpreted as Crow Indian) ceramics. These ceramic traditions are often seen as incursion from outside groups into the region. According to McNees et al (1999) the Mandan Tradition complex was associated primarily with the foothills of the Bighorn Mountains and adjacent areas of Montana and South Dakota. A number of distinct groups resided in the region by the Late Prehistoric period (McNees et al. 1999).

APPENDIX J

HISTORIC STAGES

Historic Stage Narrative

The first Europeans likely to have penetrated into the region of present Wyoming, on the western side of the Powder River Basin, were French explorers Louis-Joseph and François La Vérendrye in 1742 – 1743 (Burpee 1927). France had little chance to successfully exploit the center of North America and the United States purchased the Louisiana Territory from France in 1803. Economic advancement and western expansion were the primary goals outlined by President Jefferson when he ordered Lewis and Clark westward on their mission of discovery beginning in 1804 (Larson 1978). The Lewis and Clark expedition explored the Missouri River north of Wyoming on their trek west, but several in their group lead by Colter left the expedition to explore the Three Forks region of the Upper Missouri River. Colter became the first white man (American or European) to explore the mountains, valleys, and basins of northwestern Wyoming (Skarsten 1964).

The fur trade in Wyoming expanded after the early part of the century, with a number of rendezvous occurring in southern Wyoming (Goetzmann 1966). The fur trade ended in the late 1830s, to be followed a number of years later by settlers coming from the east, initially for the gold fields of California and later to settle the region. The trappers had explored the region and could provide the approaching settlers with information on passable routes, location of water, forage for animals, etc.

The major routes west for settlers and gold prospectors were the Oregon/Mormon, Overland, and Cherokee Trails. All of these trails traversed southern Wyoming well south of the Bighorn Basin. However, an emigrant trail was soon established through the Bighorn Basin. The 1864 Bridger emigrant trail resulted from the early exploration and discoveries made by Jim Bridger as a fur trapper and trader (1823-1842). The road he pioneered began along the Oregon Trail near present-day Casper and proceeded north through the Bighorn Basin, then west to the Montana gold fields (Lowe 1997, 1999). Once this road was established, settlement of the Big Horn began. The Bridger Trail became an important freight route for wagons carrying supplies during the early settlement of the Bighorn Basin in the 1880s and 1890s prior to the construction of the railroad. The trail connected the basin with Billings to the north and Casper to the south.

The first recorded attempt at gold exploration in the Bighorn Basin occurred in 1864 when James and Granville Stuart had prospected along the Bighorn River (Lowe 1999). Troubles with hostile Indians prevented much exploration until the Fort Laramie and fort Bridger Treaties of 1868 (Larson 1978). The Big Horn Mining Association was organized in Cheyenne in the spring of 1870 with the purpose of exploring the basin's mineral potential (Larson 1978; Lindsay 1932). The expedition failed to find any evidence of gold in the southwestern portion of the basin. However, seven years after the Battle of the Little Bighorn and a gold rush in the Black Hills, miners again flowed into the Bighorn Basin. This attempt to find gold also failed. Gold was finally discovered in the early 1890s in the Kirwin District west of Meeteetse. However, gold mining never became a major industry in the basin.

Although a number of people had entered the Bighorn Basin via the Bridger Trail and a number of later roads, the settlement of the basin intensified after the railroad was built into the basin. In 1901, a branch of the Chicago, Burlington & Quincy Railroad was built from Montana to Cody, Wyoming. By 1907, the line had been extended south to Worland and reached Thermopolis in

1909 (Larsen 1978; Overton 1965). This new rail line provided a more expedient transportation link for people in the Bighorn Basin and it provided local shipping centers for the cattle, oil, and lumber industries of Cody, Lovell, Greybull, Worland, and Thermopolis, linking them to distant markets (Overton 1965).

Following the railroad, automobile highways soon found their way into the Bighorn Basin. The proliferation of the automobile became the catalyst fostering the evolution of Wyoming's transportation network, transforming it from one of unimproved roads into a maintained highway system (Beard 1933). By 1924 modern highways had penetrated the Bighorn Basin.

The first large herds of cattle were brought into the Bighorn Basin between 1879 and 1883, and the initial stocking of the northern ranges occurred during this period (Larson 1978). Cattle ranching became very prominent in the basin and a number of towns including Cody, Meteetsee, and Lovell were founded due to the cattle industry (Lowe 1999). The first sheep were brought into the basin as early as 1876. The natural vegetation of the Bighorn Basin was better suited for sheep than cattle. The number of cattle in the basin declined as the sheep population increased between 1888 and 1900 (Lindsay 1932).

Charlie Worland is credited with the first sheep operation in the Bighorn Basin., but he lost much of his herd to the severe winter of 1886-1887. The sheep industries recovered from the bad winter and by the late 1890s over 70,000 sheep were located in the Meeteetse area (Lindsay 1932). In the late Nineteenth Century and into the early Twentieth Century stock raising suffered from three significant problems. The first was weather problems that caused the death of many cattle, the second was overgrazing of the range, and the third was serious, and sometimes violent, disputes between the cattlemen and sheep men. Overstocking the range resulted in diminished forage and leaner cattle which had less market value. Two dry summers in 1885-1886, followed by a brutal winter in 1886-1887 caused herds to be from fifty percent to ninety percent in Wyoming including the Bighorn Basin (Frink et al. 1956). Following the cattle die-off, range was now available sheep. Sheep men and their herds increased and cattlemen took a militant view of increasing encroachment of sheep on the range, the fencing of homesteads that curtailed grazing on the federal lands, and the fact that the range was again overstocked and overgrazed. This was compounded by the overall misunderstanding of cattlemen about the impact that sheep had on the environment in general and cattle in particular (Larson 1978). A number of violent incidents throughout Wyoming resulted in the death of sheep and their owners or herders. The violence climaxed with the Ten Sleep raid in the spring of 1909. Two wealthy woolgrowers and a herder were killed, their wagons burned, and the dogs and a couple dozen sheep killed.

While the livestock industry brought only sparse settlement to the central and northern basins of Wyoming, agricultural development of Wyoming's arable lands was necessary to provide the impetus for growth, and irrigation was the key component for successful agriculture (Larson1978). The reclamation movement and the introduction of irrigated agriculture in the Bighorn Basin in the 1890s, transformed the regions provided the necessary catalyst for a population growth, and the establishment of towns.

Passage of the *Carey Act* in 1894 provided federal and state aid to irrigation projects. The federal government donated up to one million acres of lands to each western state with the stipulation that

the land must be reclaimed and settled. This legislation gave promoters and settlers the opportunity to undertake ambitious projects to convert sagebrush-covered lands into farms. The major watercourses of the Bighorn Basin (the Bighorn, Greybull, and Shoshone Rivers) provided ample water to interest settlers in the region's agricultural prospects. In the mid-1890s, a number of *Carey Act* projects were begun by private interests with state approval and guidance, although these often proved difficult to complete. These projects spawned a population influx into the Bighorn Basin, and the growing need for administrative services was answered in 1897 by the formation of Big Horn County (Larson 1978).

The Twentieth Century brought greater federal involvement in reclamation with passage of the *Newlands Act* in 1902. The first federal project and the biggest in the Bighorn Basin was the Shoshone Project in 1905 (Larson 1978; Churchill 1979). Cultivation of sugar beets as a cash crop was introduced into the Bighorn Basin in the early 1900s. Once the success of beet cultivation in the Bighorn Basin was assured, a sugar factory was built in Lovell in 1916, and another sugar factory was established in Worland in 1917 (Lindsay 1932).

The reclamation projects resulted in the construction of ditches and canals across the Bighorn Basin. The Big Horn Canal, in the Westside project area, began as the Lawson Canal, a small ditch on the west side of the Bighorn River between Gooseberry and Fifteenmile Creeks. The Big Horn County Irrigation Company was formed in 1902 to irrigate lands south of Basin, Wyoming. The company filed an enlargement and extension of the Lawson Ditch to irrigate 16,295 acres as a cooperative canal association. However, the company was unable to fund construction, and the Big Horn Irrigation Company was organized. This company, who had a contract with the State of Wyoming for the construction of a permanent canal to irrigate a total of 20,000 acres and had a number of financial backers. Construction began in 1905, and the canal was completed to the Greybull River in May 1908. When completed, the canal extended 50 miles to the Greybull River and irrigated over 20,000 acres (Wasden 1973). The Big Horn Canal is currently maintained and in operation.

The final industry to become prominent in the economy of the Bighorn Basin was the extraction of fossil fuels. Small-scale coal mining in the Bighorn Basin began in the 1890s. The early "wagon mines" in the basin were operated by local ranchers who traded or sold coal to residents in nearby communities. Coal mining on a commercial scale occurred in the basin only after the railroad extended its line south through the basin along the Bighorn River. Coal production rose to its highest level in 1919, remaining between 450,000 and 550,000 tons per year through 1929. During the Depression, production plummeted after 1929 to around 200,000 tons and fell further in the late 1930s to less than 100,000 tons. During World War II, there was a small surge in production, but by the late 1940s, mining activity again declined; and when the railroad converted from coal to diesel power in the mid-1950s, annual production dropped to less than 10,000 tons (Lowe 1999, Glass et al. 1975).

The oil and gas industry in the Bighorn Basin began in the mid-1880s, and beginning in the first decade of the twentieth century, the area's prolific deposits of natural gas were tapped for industrial and domestic use beginning in 1916 (Larson 1978). A boom in the oil and gas industry occurred around World War I that continued through the early 1920s, but a saturated market and the national economic depression in the 1930s precipitated a steady decline in the production of oil and gas in

the Bighorn Basin after 1923 (Larson 1978; Lindsay 1932). The situation was reversed in World War II. The increased industrial demand brought on by American involvement in the war led to increased production of Wyoming oil, including product from the Bighorn Basin fields (Larson 1978). The extraction of gas and oil in the basin is on-going and will probably expand as the demand for fossil fuels increases domestically and internationally.