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WYOMING WATER DEVELOPMENT COMMISSION

KIRBY CREEK WATERSHED PLAN

EXECUTIVE SUMMARY

September 12, 2005

SUNRISE ENGINEERING, INC.
Afton, WY

IN ASSOCIATION WITH:

NORTH WIND, INC.
Cody, WY

ECI, INC.
Greenwood Village, CO

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Funded By:

The Wyoming Water Development Commission

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The Wyoming Water Development Commission (WWDC) authorized Sunrise Engineering, Inc. to complete a Level I reconnaissance study of the Kirby Creek Watershed. The Kirby Creek Coordinated Resource Management (CRM) group, working through the Hot Springs Conservation District, was seeking to evaluate the conditions of the drainage ways and creeks in the Kirby Watershed, including main-stem head cutting, and also to provide an assessment of the existing rangeland and riparian areas of the watershed. The information contained in this Study is intended as "baseline information" from which the District can continue to expand upon and begin implementation of the management practices discussed. The results of this study will be used to further prioritize, plan, and implement projects that will improve the condition of the watershed. Future basin improvement projects will address erosion, water quality, wildlife habitat, rangeland resources, and irrigation supply.

As part of the Study, Sunrise Engineering, Inc. was required to gather, review, and compile existing background information available through previously completed studies in the watershed.

1.2 LOCATION

The Kirby Creek Watershed is located north and east of Thermopolis in Hot Springs County. The watershed catchment consists of approximately 128,500 acres (201 sq-mi) of hilly grassland and flat valley bottom. Its headwater is Guffy Peak at the top of West Kirby Creek. It falls almost 4,000 feet to the Big Horn River over a distance of approximately 32 miles. The Kirby Creek Watershed is part of the Upper Bighorn River Watershed (USGS Cataloging Unit 10080007), a sub-basin to the larger Yellowstone River Watershed.

1.3 HISTORY

Prior to the development of a road through the Wind River Canyon, the Kirby Creek Watershed was used as a travel route into the Big Horn Basin from the south. The watershed was named for a Texas cowboy named Kris Kirby, who first brought cattle into the watershed around 1878. Several other families homesteaded the area shortly thereafter such as the Hayes and Reed families. Descendants of these families still live in the area today. After 1890, water rights were obtained and secured by a permit filed with the Wyoming State Engineer and is based on the "doctrine of prior appropriation." Irrigated farming was common in the early 1900s. Old irrigation ditches indicate that water may have been more available in early 1900s than it is today.

In 1914 the first oil well was drilled in the watershed. The drilling of oil in the first part of the 20th century brought roads and accessibility to the watershed.

Early photographs of Kirby Creek indicate that stream morphology was remarkably different than it is today. Undercut banks were uncommon and settlers indicated that they "could cross the creek on horseback at almost any location" (Milek 2001). This is not the case today, as the creek has downcut 30 or more feet in places.

Sometime between 1915 and 1920 drought struck the region, and coupled with subsequent catastrophic flooding, resulted in severe erosion along Kirby Creek.

2.0 WATERSHED DESCRIPTION AND INVENTORY

2.1 WATERSHED DESCRIPTION

The watershed is composed primarily of hills, hogbacks, anticlines, synclines, alluvial valleys and floodplains, stream channels and meadows. Elevations range from about 4260 ft to 8046 ft. Some trees and well-established riparian zones may be found in upper sections of the watershed. Beaver activity is also noted in these areas. Channel reaches with aggressive head-cutting are found lower in the watershed. Wetlands are uncommon with only the areas immediately adjacent to channels and reservoirs being considered wetlands. Channel down-cutting has resulted in a significant reduction in ground water depth. Areas where ground water was once a few feet deep now may be as much as 30 feet deep.

Average annual precipitation in the watershed ranges from 11 inches in the lower elevations to 19 inches in the higher elevations. The average temperature is 45.7ºF.

Three on-channel reservoirs are located on the main stem of Kirby Creek, two of which are in poor condition. There are also numerous stock reservoirs located on ephemeral draws within the watershed. Several of these are also in poor condition. Twelve irrigation diversions have been identified in the watershed with priority dates ranging from 1897 to 1918. Several of the diversions are unusable due to down cutting in the channel.

Land ownership of the watershed is divided among the Bureau of Land Management (BLM), approximately 65%, State lands (15%), and private ownership (20%). The primary surface land use of the watershed is rangeland agriculture. The BLM provides livestock rangeland leases. Other land uses include oil production, gas production, mining for bentonite, sand and gravel, residential living, and recreation. There are 56 active and 225 inactive oil and gas wells in the watershed. There are 340 miles of roads in the watershed, 320 of which are two-track.

The main class of vegetative cover in the Kirby Creek Watershed is Wyoming Big Sagebrush, covering 70% of the watershed. Other prominent species include Juniper

Woodland (12%), Desert Shrub (8%), Mixed Grass Prairie (4%) and Dry Land Crops (4%). Limber Pine Woodland covers a very small area at the headwaters of West Kirby Creek. Two invasive species, Tamarisk and Cheat Grass, can be found along the riparian corridor in the lower watershed and the upland range transects, respectively.

Soils in the watershed are derived from Cretaceous through Triassic shale and sandstones. Soils have formed in residual deposits and weathered from shale or sandstone bedrock, colluvium, alluvium, aeolian material, and gravel deposits (BLM 1978). Soils are generally shallow in the uplands, ranging in thickness from zero to 20 inches. Soils are high in exchangeable salts, including gypsum, calcium, and sodium. Soils are relatively deep in the bottomlands and consist of mostly clay, clay loam, or silty clay. At the time this report was written, there was no published soil survey for Hot Springs County and the Kirby Creek Watershed. Soils data is currently available in unpublished format from the BLM's Worland Field Office. Also available, is a soils map for Hot Springs County by Jack Iiams (date unknown).

Mule deer and antelope are prominent in the watershed. White tailed deer and elk can also be found. Several species of birds and rodents, as well as predators such as coyotes and badgers inhabit the watershed. Beaver activity has also been seen in some areas of Kirby Creek.

2.2 WATER QUALITY

The Kirby Creek watershed was tested in 2002 for physical, chemical, and biological parameters to determine the water quality as part of a study conducted by Hurley Geological Consulting in cooperation with Hot Springs Conservation District and was funded through the Wyoming Non-Point Source Task Force and the Wyoming Department of Environmental Quality. Measurements were taken at 15 sites throughout the watershed.

The physical parameters that were tested are temperature, turbidity, and total suspended solids (TSS). Temperatures were recorded from April to October. The temperatures varied from 26.6°C in June 2002 to 1.6°C in October 2002. Turbidity (water clarity) and TSS measurements were closely linked indicating that any coloration in the water is due to sediment resulting from storm events and livestock. TSS values varied from 1.6 to 68 mg/l and Turbidity varied from 0.9 to 69.5 NTUs.

The chemical parameters that were tested are pH, Total Dissolved Solids (TDS), and Dissolved Oxygen (DO), and cations and anions. A pH range of 6.8 to 8.7 will produce the highest diversity of aquatic life in a stream. Values of pH ranged from 8.0 to 8.65 and generally increased downstream, probably due to oil field impacts or constituents from geologic formations. Average TDS values for each site ranged from 442 mg/l to 5,285 mg/l, with a general increase in TDS values from upstream points to downstream points. The level of DO in a body of water is an indicator of general health and water quality. If the level of DO decreases below 4 to 5 mg/l, game fish will be driven out. East Kirby Creek appears to be losing dissolved oxygen downstream with values ranging from 10.85 to 4.39 mg/l. West Kirby and the main stem of Kirby Creek ranged from 10.55 to 12.32 mg/l.

Testing for cations and anions was performed at the Wyoming Department of Agriculture Laboratory for samples taken during 2002. The most dominant cation in the waters of Kirby Creek is sodium, followed by calcium, magnesium, and potassium. The presence of cations generally increases from upstream to downstream. The most dominant anion in the waters of Kirby Creek is bicarbonate, followed by carbonate, chloride, fluoride, orthophosphate, and nitrate. Sulfate was also extremely common in the water in Kirby Creek. Figure 2.14.4 shows that a majority of the dissolved solids in the waters of the Kirby Creek watershed are sulfate.

The biological parameters that were observed were fecal coliform bacteria and fish populations. Fecal coliform can enter the water directly through discharge or indirectly through runoff, septic system leakage, or other similar means. The presence of fecal coliform may indicate the presence of other, more dangerous bacteria and or viruses. Fecal coliform results varied from 0 to 553. Four different types of fish were observed as well as Northern Leopard frogs in the watershed by the Wyoming Game and Fish Department in 2002. The species were Lake Chub, Long Nose Dace, Mountain Sucker, and White Sucker. Kirby Creek is a Class 2C water (WDEQ) meaning it is estimated to have the potential to support only non-game fish populations.

3.0 UPLAND RANGE AND RIPARIAN METHODOLOGY

3.1 UPLAND RANGE AND RIPARIAN SURVEY

By examining the vegetation, soils, geomorphology, and climate of the Kirby Creek Watershed, the Kirby Creek CRM can target and better understand the sources of degradation. Ninety-four (94) upland range and seventy-two (72) riparian points were located in *key areas* of the Kirby Creek Watershed. Key areas are indicator areas that reflect what is happening on a larger scale as a result of on-the-ground management actions. Eighteen-inch wooden stakes were hammered into the ground at each point and GPS coordinates were recorded so that they could be located for future range monitoring studies. For each data type, three inventory methods were used. These are outlined below:

1. Upland Rangeland
    a. Rangeland Health Survey
    b. Vegetation Transects
    c. Digital Photographs

2. Riparian
    a. Proper Functioning Condition (PFC) Survey
    b. Riparian Transects
    c. Digital Photographs

4.0 FIELD SURVEY RESULTS AND DISCUSSION

4.1 UPLAND RANGELAND CONDITION

Results of the Upland Rangeland inventory indicate that considerable variation exists between upper and lower Kirby Creek. Rangeland health within upper Kirby Creek, including East Kirby Creek, West Kirby Creek, Ackles Fork, and Little V-H Draw, rates as “None to Slight” or “Slight to Moderate” deviation from the desired condition. Overall, the vegetative transects in the upper basin show adequate native plant cover in most areas and very few weedy or otherwise “undesirable” plant species.

Problem areas do exist in the upper watershed. For example, areas of dense cheatgrass have invaded many of the draws, particularly the bottomlands where excessive grazing has occurred. Limited grazing and fire suppression has led to the buildup of hazardous wildfire fuel conditions in the West Kirby Creek pastures. Wildfire risk should be mitigated in order to prevent soil erosion and the spread of invasive species.

Rangeland conditions within lower Kirby Creek are considerably poorer than in the upper basin. These areas are typical of the desert shrubland communities found in Wyoming’s Big Horn Basin. Many sites are dominated by greasewood, saltbush, halogeton, and cheatgrass, indicating both excessive grazing and poor quality soils. Many rangeland health points were rated as “Moderate” to “Extreme.” Rills and water flow paths, which indicate excessive erosion, are common in many of the pastures adjacent to Kirby Creek. High sedimentation was observed along Alkali Creek, Major Basin Draw, Rock Spring Draw, and Red Hole Road.

Several of the rangeland health surveys in the uplands within the lower basin rated as “None to Slight” to “Moderate.” Excessive grazing and invasive weeds appear to be problematic near water sources, mineral blocks, fence lines, and ridge tops. Upland Rangeland Results for both the upper and lower watershed are summarized below in Table 4.1.

TABLE 4.1 RANGE LAND RESULTS

Biotic Integrity	6	14	28	30	22
%	**Extreme**	**Moderate to Extreme**	**Moderate**	**Slight to Moderate**	**Non to Slight**
Soil Site Stability	0	11	24	37	28
Hydrologic Function	0	9	24	33	34

4.2 RIPARIAN CONDITION

The riparian condition of stream segments in the upper watershed is generally functional. Only a few points rated as “Non Functional”. These points were found in the uppermost part of the drainages. Many points rated as “Functioning at Risk” due to channel downcutting, a lack of coarse woody debris, and a lack of bank stabilizing plants. There is an adequate supply of hydrophytic plants in most locations; however, sedges and rushes are absent in many ephemeral draws.

Large, coarse woody debris is inadequate in most locations. It is unknown whether or not cottonwood and willows were naturally absent in the tributaries of Kirby Creek. Where present, these trees are old and decadent, indicating little to no reproduction.

Evidence of past erosion and channel alteration exists throughout the upper basin. Headcuts, many of which are now stabilized, indicate that severe erosion has occurred. Off-channel water diversions, such as irrigation ditches, are common. Many stock watering reservoirs have deteriorated through time either through sedimentation or dam failure. Breached dams have caused severe stream deterioration in several locations.

Road erosion and livestock grazing have caused severe degradation along Reed Creek. Cattle use the creek bottom as a trail through most of Reed Creek canyon. Overgrazing of riparian vegetation is severe. In addition, the county road has channelized the creek. Consequently, stream flow has increased in Reed Creek, causing excessive erosion and an unnatural, altered channel morphology.

Most PFC points in the lower watershed were rated as “Functional at Risk” with either an “Upward” or “Downward” trend. Many points were “Not Functional.” Stream downcutting, invasive plants, bank sloughing, lack of coarse woody debris, the absence of hydrophytic plants, piping, road erosion, and channelization were common problems noted along lower Kirby Creek, Alkali Creek, Major Basin Draw, and Red Hole Road.

The general state of lower Kirby Creek is that of a degraded system. Past erosion has been severe to extreme. Many banks along Kirby Creek are greater than 20 to 30 feet tall. The mainstem of Kirby Creek is substantially downcut along most of its length from the junction of Lake Creek to its confluence with the Big Horn River. The water table is too low in most reaches to support riparian vegetation (including sedges, rushes, shrubs, and trees). In most locations, the water table is 10 to 15 feet below the surrounding floodplain.

The unnamed ephemeral drainages which flow into Kirby Creek are generally in good condition. Although riparian vegetation is absent in many of these draws, they do not exhibit the same level of erosion, stream downcutting, and altered channel morphology that is found within Kirby Creek itself.

Riparian results for both the upper and lower watershed are summarized below in Table 4.2.

TABLE 4.2 – RIPARIAN RESULTS

Proper Functioning Condition	Functioning At Risk	Non Functional
33%	**49%**	**18%**

Riparian Condition

Although the results of the upland rangeland and riparian assessment described in this report are based upon a site-specific inventory of *key areas*, they can be applied at a pasture, allotment, ranch, or watershed basis with the understanding that heterogeneity may preclude averaging the data across a larger scale. If it is found that larger land units are relatively uniform both temporally and spatially, then data from a single field point can be used to infer the rangeland health or PFC of larger areas.

5.0 STREAM MORPHOLOGY

For each of the 72 riparian transects, cross sections were sketched and dimensioned, the vegetation described, and the conditions of the stream noted. The cross-sections were used to perform a Rosgen Level I Assessment of the stream conditions (1996 Applied *River Morphology*). Generally, channels lower in the watershed were classified as type E due to the lower channel slopes, higher sinuosity, and higher entrenchment ratio. Type G streams, with higher slopes, were found higher in the watershed. Some of the stream sections located near the drainage divide lacked a defined bed and bank channels. These sections were classified as swales, a stream type not found in the Rosgen classification system.

The upper catchment waterways and streams are, for the most part, in good shape. There are exceptions where deep gullying is occurring. Kirby Creek and other streams in the lower catchment are in various stages of gullying. Some are now downcutting in old gullies; some are new gullies in tributaries; some are in the depositional stage; at least one gully headcut has been structurally arrested; and some are healing.

6.0 WATERSHED MANAGEMENT PLAN

6.1 INTRODUCTION

As has been discussed in previous sections, the degradation of the Kirby Creek Watershed began in the early 1900’s. Some of the contributing factors of the degradation were overgrazing, severe drought, flooding, and the geological make up of the basin. As the stream channels began to down cut, the ground water became deeper. As the depth to ground water increased, the grasses were replaced with grease wood, which attributed to more erosion and head cutting of the channel. It is not feasible to restore approximately 100 years of down cutting with a few simple and inexpensive projects. A more realistic approach is to try to stop further down cutting of the watershed. This section will discuss methods in which this may be accomplished and identify some of the more problematic areas which are recommended to be addressed first.

6.2 GRAZING MANAGEMENT STRATEGIES

The following grazing management strategies will help reduce down cutting:

- Place riparian areas in a separate pasture with separate management objectives and strategies. This will allow management to gain control over the season, duration, and intensity of livestock use.
- Fence or herd livestock out of riparian areas for as long as necessary to allow vegetation and stream banks to recover.
- Control the timing of grazing to meet management objectives.
- Add more rest to the grazing cycle to increase plant vigor, allow stream banks to heal, or encourage more desirable plant species composition.
- Limit grazing intensity to a level which will maintain desired species composition and vigor.
- Use different types of livestock to obtain better forage utilization of a variety of species and better animal distribution.
- Permanently exclude livestock from riparian areas at high risk and with poor recovery potential when there is no feasible way to protect them while grazing adjacent uplands. Exclude livestock from the riparian area with stream corridor fencing.
- Limit grazing intensity and season of use to provide sufficient rest to encourage plant vigor, regrowth, and soil retention.
- Consider management strategies to allow for sufficient vegetation during periods of high flow to protect stream banks, dissipate stream energy, and trap sediment.
- Install water developments and mineral licks in the uplands to better distribute livestock in underutilized areas.
- Cross-fence riparian corridors to prevent livestock from using them as trails.

6.3 STREAM MORPHOLOGY AND EROSION CONTROL

Stopping the degradation caused by gulling and headcutting can also be accomplished by 1) stopping or impeding the most serious gully headcuts, those likely to cause the most damage of the stream channels and 2) restoring rangeland health thereby reducing the ‘piping’ at the deep gully banks in places where the adjacent land is judged most valuable. The Natural Resources Conservation Services Engineering Field Handbook, especially Chapters 10 and 16, (Wyoming Edition 2003), and the Stream Corridor Restoration Principles, Processes, and Practices (1998) are recommended for consideration in stopping gullying in the Kirby Creek catchment.

Beavers

Several studies have been performed in the past suggesting that the reintroduction of beavers in cold-desert, gully-cut streams can significantly reduce the elements which cause erosion as well as speed the recovery from erosion. These studies show that some of the benefits from having beavers in the area are a decrease in or reversal of the effects of erosion and an increase in wildlife and plant life.

As beavers settle into an area they build dams and lodges. These dams produce lower stream velocities by dissipating energy laterally across the dam rather than having the stream flows being concentrated vertically. This type of stream flow is less likely to produce an eroded stream channel. Benefits of beaver dams include: decreased number of particles suspended in the water, increased wildlife habitat, and increased wetland plant life.

In order for reintroduction to be successful, a suitable site must be chosen. Sites previously occupied by beaver are most likely to be successful for reintroduction. Other factors that make a site suitable include stream characteristics, available food and construction materials, and interaction with humans.

6.4 REHABILITATION OF EXITING RESERVOIRS

Two existing on-channel dams are in need of repair and are in danger of being washed out; 1) The Jones diversion dam and 2) The Norman Sanford reservoir. The loss of these structures would lead to renewed head-cutting. In addition, several small reservoirs are in need of repair. Reservoirs that have been breached are headcutting and causing large amounts of eroded soil to enter into the stream channels. It is recommended that an inventory be made of these reservoirs, and repairs prioritized. Once repairs have been made, the reservoirs will also assist in the distribution of cattle, as water is made available.

6.4.1 Summary of Management Plan

A Summary of the items discussed in the Sections 6.1 to 6.4 is shown below:

Stream Morphology and Erosion Control

1. The first priority is to stop or impede the most serious gully headcuts, those likely to cause the most damage.
2. The second priority is restore rangeland health thereby reducing the 'piping' at the deep gully banks in places where the adjacent land is judged most valuable.
3. Encourage beaver habitat by providing suitable stream characteristics, available food and construction materials.
4. Rehabilitation of reservoirs.

Grazing Management

1. Determine if the Rangeland Health Point can be applied to a larger area such as a pasture or allotment.

2. Determine and apply the best management strategy to rehabilitate problem areas.

6.5 Priority Areas

The area of greatest concern and in need of immediate repair is the **Jones Dam**. It is recommended that an initial condition assessment be made of the dam. The cost associated with this assessment is $9,500. The **Norman Stanford Reservoi**r is also in need of immediate repair. At this time, the owner and NRCS are in the processes of designing repairs and anticipate construction for the summer of 2005. The NRCS is also working to remedy a problem with **East Kirby Creek** where a new channel has formed and is following an oil pipeline trench. This area should be monitored closely as several smaller head-cuts may require stabilization after the stream has been returned to the original channel. **West Kirby Creek** has relatively new head-cutting and should receive immediate attention. **Reed Creek** is also an area of concern where road erosion and livestock grazing have caused severe degradation along the channel.

6.6 Permits

The application of hydromodification (in channel) best management practices (BMP's) is more carefully regulated than the application of BMP's in other activity areas. A Section 404 permit from the U.S. Army Corps of Engineers is required for activities relating to in-channel BMP's. Prior to issuing a 404 permit, the Corps must be presented with a Section 401 certification from DEQ indicating that the proposed project will not result in a violation of the state's water quality standards. Also, if the proposed improvements are diverting or consuming water, a permit must be obtained from the State Engineer's Office.

6.7 Financing

In order to qualify for grant monies and loans a legal entity such as a Watershed Improvement District will need to be formed. Once this is accomplished, the newly formed district will have the ability to obtain funding from various sources. After the CRM and other interested parties have had a chance to review the report and further prioritize the proposed projects, funding of these projects becomes the next key step. Funding agencies each have individual guidelines as to what project they are able to fund and projects that don't qualify. Once the prioritization of the projects has been accomplished, the funding will need a more thorough review to determine under which available funding the project qualifies. More than likely it will be a combination of funding agencies.

The funding agencies that will be further reviewed include: the Wyoming Water Development Commission (WWDC), the State Land Investment Board (SLIB), the Hot Springs County Conservation District (HSCD), and the Natural Resources Conservation Service (NRCS).