

1.0 INTRODUCTION

In 1985, in response to concerns about the quality of discharge from irrigated areas, the U.S. Department of the Interior (DOI) created the Irrigation Drainage Program to determine if water quality was being affected on lands for which the DOI had responsibility by irrigation discharge. As a result of that investigation the Kendrick Irrigation Project was one of the top nine areas of concern in the Western United States. According to USGS surface water quality monitoring data, the North Platte River near Casper Wyoming contains levels of Selenium that have exceeded the standard for that constituent. Monitoring of tributaries of the Platte as well as some small lakes and ponds in the area have also indicated levels of selenium exceeding the standard. The Kendrick Irrigation Project, completed in 1946 providing water conveyance infrastructure for irrigation needs for up to 24,000 of the 110, 000 acres within the project area, was identified by an Inter-bureau Task Group comprised of federal agencies responsible for management of natural resources, as the primary cause of elevated levels of selenium in the Platte River, its tributaries, and small ponds and lakes in the area.

The Board of Supervisors of the Natrona County Conservation District (NCCD), being locally elected officials with the State mandated responsibility for the conservation of renewable natural resources, determined to assume a proactive approach on water quality issues within the Kendrick Watershed. It is the intention of the NCCD, through acquisition of credible water quality related data as defined in the Enrolled Act #47 by the Wyoming State Legislature, to develop a local watershed management strategy that will maintain community values through science based land use planning on a watershed scale. To that end the DCCD, in cooperation with the Casper-Alcova Irrigation District, formed the Kendrick Watershed Committee comprised of local landowners, community leaders, and representatives from state and federal agencies with resource management responsibility. This group, in cooperation with University of Wyoming staff and graduate students, provided the content of this Sampling and Analysis Plan.

This Sampling and Analysis Plan (SAP), the initial step in developing a local watershed management strategy, was developed in order to lay the groundwork for a watershed scale assessment of surface water quality. When implemented, this SAP will also provide a foundation from which the interrelationships between geology, hydrology, climate, soil chemistry, and irrigation water management can be understood. That understanding will allow for science based land use management decisions that will improve the integrity of the resources found within the Kendrick Watershed while maintaining the economic and cultural values that serve as the foundation of the quality of life within the project area.

This SAP was written to meet the requirements of the State of Wyoming Enrolled Act #47, Wyoming Statute 35-11-103 (c) also known as the Credible Data Bill (Legislation) and when executed in conjunction with the Quality Assurance Project Plan found in appendix B, utilizing the protocols found in the Standard Operating Procedures found in appendix C, also meets the Quality Assurance/Quality Control requirements of the Wyoming Department of Environmental Quality, Water Quality Division, and the United States Environmental Protection Agency.

2.0 PROJECT GOAL & OBJECTIVES

The structure and the content of this SAP are determined by the goals and objectives of both the Kendrick Watershed Steering Committee and the Board of Supervisors of the Natrona County Conservation District (NCCD), with assistance from a technical group comprised of representatives from the University of Wyoming, the Natural Resources Conservation Service, and the Wyoming Department of Environmental Quality. Coordination meetings were held during June 2001 with the Steering Committee, Board Supervisors, and the technical group. The intent of these meetings was to establish project goals and objectives, establish the technical parameters under which this sampling and analysis plan would be developed, and to discuss strategies for potential usage of the information resulting from this project.

PROJECT GOAL -

It is the intent of the Kendrick Watershed Project to reduce the level of selenium in the Platte River and its tributaries, to the extent possible, while maintaining the integrity of the Kendrick water conveyance system, and promoting and practicing science based proactive resource management through Best Management Practices when opportunities present themselves.

PROJECT OBJECTIVES -

- Assemble all available historical water quality/quantity related data for the Kendrick watershed to determine what additional data is required to develop a comprehensive watershed plan during the first year of the project.
- Analyze historic and current water quality related data to establish what impacts various irrigation practices have on the level of selenium in the Platte River and the soils in the Kendrick watershed.
- Establish when and where selenium exceeds EPA standards within the Kendrick Watershed
- Establish what the expected “natural background” contribution of selenium to the Platte River from the Kendrick Watershed and the surrounding areas.
- Determine if historic and current water quality related data support the “designated uses” for the waterbodies within the Kendrick watershed.
- Determine affect flood and sprinkler irrigation practices have on the selenium content in the soil profile when compared to undisturbed soils in geologically similar locations.
- Determine what the impacts of other land use activities, such as subdivision and industrial water usage, within the project area have on the level of selenium in the Platte River and its tributaries.

3.0 **BACKGROUND**

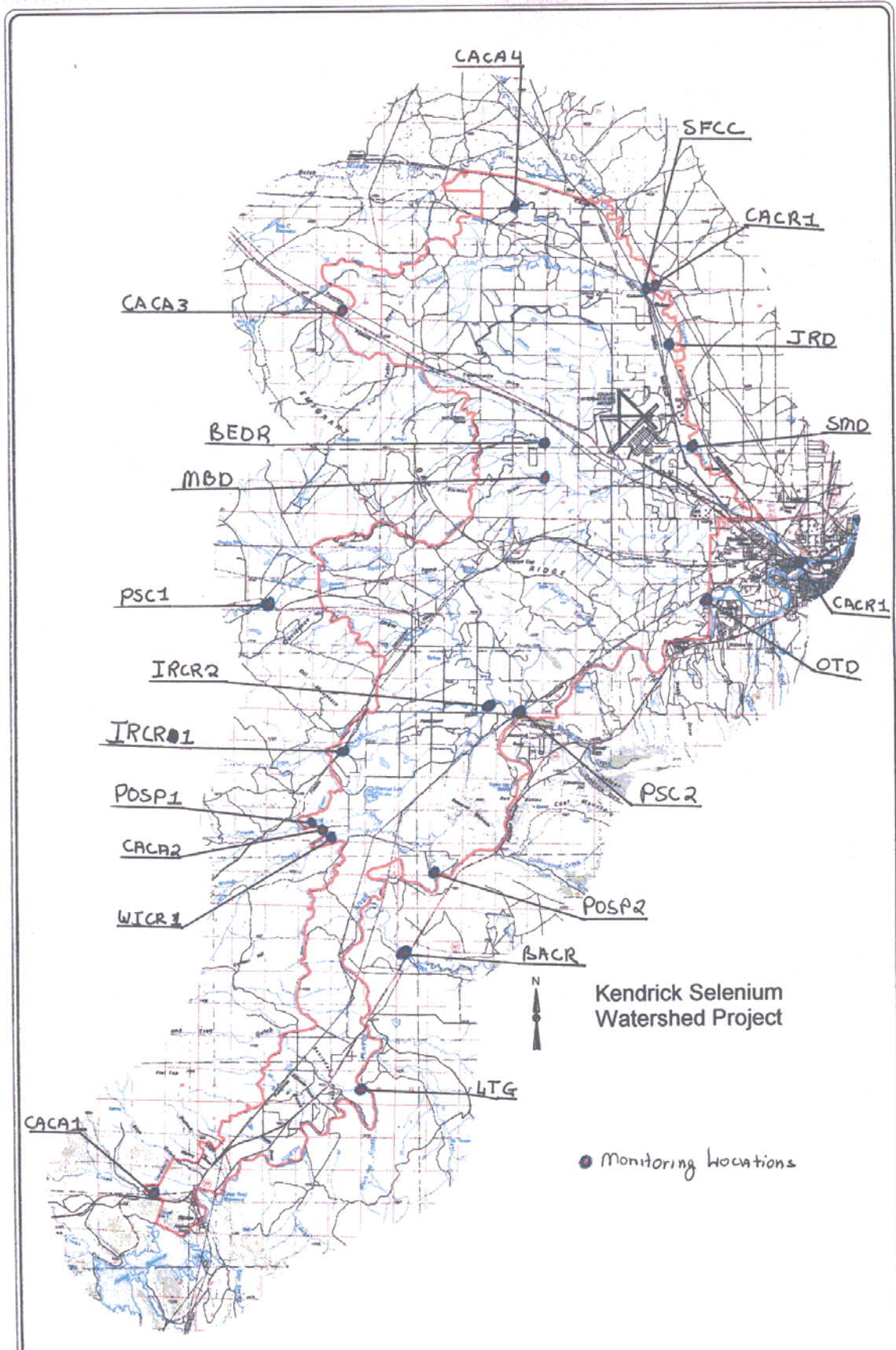
The Kendrick Selenium Watershed Project area is located within the Middle North Platte watershed HUC# 10180007 and contains numerous small streams, drainages and ponds with the North Platte River being the major water feature in the watershed. The sixty three (63) mile long Casper Canal and the 150 miles of laterals, authorized and constructed west and north of the Platte River as a part of the 1933 National Industrial Recovery Act, are the main water conveyance system for the Casper-Alcova Irrigation District (CAID). The Irrigation District removes water from the Alcova Reservoir for distribution to cropland west of Casper. Along with the canal and laterals, there are also approximately 43 miles of open and closed drains¹. The wastewater, water transported in the canals and laterals but not utilized for irrigation, flows through these drains and other creeks from the project area and ultimately into the Platte River. The average annual volume of water diverted from Alcova reservoir by the CAID is approximately 73,000 acre feet.

Most of the soils in the project area are derived principally from Cretaceous formations of marine origin and contain varying levels of naturally occurring selenium (seleniferous), which is readily dissolved and transported by surface and groundwater. The predominate formation is Cody Shale, which contains gray soft shale and lenticular sandstone beds with grey limey shale present at the base of the shale layer. This shale stratum acts as a confining layer upon which water percolating through the soil profile becomes “perched” and then moves horizontally until either it mixes with deeper groundwater reservoirs or the shale layer rises close enough to the surface for the groundwater to emerge as surface runoff or as seeps. It is the later that occurs most often in the Kendrick project area.

Extensive studies by the US Geological Survey (USGS), US Fish and Wildlife Service (USFWS) and the Bureau of Reclamation (BR) indicate that irrigation return flows from the Kendrick project contain high levels of selenium which result in selenium loading into the North Platte River and several streams, wetlands and reservoirs within the project area. These loadings have resulted in water quality standards exceedance in the North Platte River, Casper Creek, and lower Poison Spider Creek for selenium as well as documented impairments to wildlife in these and other waters within Kendrick; Oregon Trail Drain, Poison Spring Creek, Goose Lake, Rasmus Lee Lake, Thirtythree Mile Reservoir and Illco Pond. These waters have all been listed on Table A of the 303(d) Waterbodies with water quality Impairments list. However, existing mitigation projects are ongoing to improve the water quality in Goose Lake, Rasmus Lee Lake, Thirtythree Mile Reservoir and Illco Pond to protect migratory birds so these waters will not be included in this project.

¹ Area in which ditches are dug in order to drain excess groundwater to dry the area for cropping or other land use.

Although selenium at the Kendrick Reclamation Project (Kendrick), which is drained by Poison Spider, Poison Spring and Casper creeks and Oregon Trail Drain, is naturally found in the soils derived from the marine Cretaceous Cody shale, water quality is too complex to easily correlate geologic formations with geochemistry. The Department of the Interior's National Irrigation Water Quality Program (NIWQP) studies conducted in 1988 and 1989 indicated that all major tributaries of draining the Kendrick project had waterborne selenium concentrations from two to 160 times higher than concentrations upstream of the project. It is noteworthy that the Casper weather station recorded in 1988, 6.6 in. of precipitation (about one-half of average), an average air temperature of 47.0 (1.8 degrees above average) and pan evaporation totaled 61" at Pathfinder Dam about 9 mi southwest of the study area (National oceanic and Atmospheric Administration, 1989, p. 20). The NIWQP study further documented that irrigation tail-water was flushing salts containing large concentrations of selenium. The study provided that salt accumulation in the soil is caused by deep percolation of irrigation water which then causes the leaching and accumulation of salts near the soil surface. Additionally, the NIWQP study showed that the major tributaries draining Kendrick accounted for an average of 52 percent of the total selenium discharge measured on the North Platte River downstream of Casper.



4.0 PROJECT AREA DESCRIPTION

The project area is in Natrona County in central Wyoming. The Kendrick project area is located west of the city of Casper Wyoming and bounded by the North Platte River on the southeast, Casper Creek on the northeast, and Casper Canal on the north and west (fig. 1). The Kendrick area is about 188 sq. miles in total area but only about 24,000 acres (about 38 sq. mi.) are irrigated. Drainage from the Kendrick area is to the North Platte River. The drainage area of the North Platte River at Alcova Reservoir, at the upstream edge of the study area, is 10,800 sq. miles. A semiarid climate modifies the effects of warm summer months as well as the frigid winter months. In Casper, the temperature ranges from 104 degrees in June to -40 degrees in January. The mean monthly temperature is 67 degrees in the summer and 26 degrees in the winter. The average annual precipitation in Casper is 11.39 inches, with May being the month with the most precipitation, 1.96 inches.

The elevation of the Kendrick area ranges from about 5,000 to 6,000 ft above sea level. The topography is characterized by rolling hills vegetated with grasses and shrubs, including big sagebrush. Southeast of the project area, Casper Mountain rises over 3,000 feet above the valley floor and to the west the Granite Mountains are found. These mountains are the erosional remnants of the core of the Sweetwater Arch or Uplift. In the later geological history of the region, this area subsided somewhat to its present elevation and the Granite Mountains occupy an area that is depressed and bounded by east-west trending marginal normal faults. Natrona County's name came from the deposits of natron or sal soda which formed in shallow lakes in the area. Since the rainfall is so low, surface runoff in Spring gathers in shallow depressions and evaporates completely in the early summer. The flat floors of these ephemeral lakes contain clays, silt and saline material carried in by the runoff. Besides natron, glauber salt or mirabilite, epsom salts or epsomite, and trona may be deposited.

Soil in the study area is derived principally from Cretaceous formations of marine origin. The predominant formation is Cody Shale, with smaller outcrops of the underlying Frontier Formation and Mowry and Thermopolis Shales, the overlying Mesaverde Formation and the partly equivalent Niobrara Formation, and Steele Shale. The Cody Shale contains gray soft shale and lenticular sandstone beds; gray limey shale is present at the base of the Cody Shale. The other Cretaceous formations also include gray and black limey and carbonaceous shale beds, sandstone beds, thin coal beds, and bentonite beds. Several of the Cretaceous formations present in the Kendrick area have been described as seleniferous. Quaternary alluvium exists along the larger streams and in the northern part of the area, near the Natrona County International Airport.

Over 9,000 acres of wetlands and associated riparian areas occur within the Kendrick area. These areas are important resources to a large number of migratory birds, including waterfowl, shorebirds, waders, and other birds and provide habitat for other wildlife. Wetlands in the study area range from marshes to open water and consist of large closed basins, seep area, small reservoirs, stock ponds, and riparian areas saturated with groundwater

Forage crops are the most important in the Kendrick area and are used primarily for feeding livestock. The growing season in Casper is longer than in many other Wyoming communities, around 130 days. About 20,000 of 24,000 irrigable acres are harvested annually with alfalfa hay grown on about 55 percent of the irrigated land. The North Platte River and the alluvium along the river are the sources of water for many domestic and industrial supplies, as well as for municipal water supplies for Casper and adjacent communities. Much of the groundwater in the Kendrick area is too mineralized for domestic use. As a result, many of the farmers and ranchers transport drinking water from Casper. Livestock drink water from most of the creeks in the area, and in many places this is the only water available for them.

Prior to development of the irrigation plan for the Kendrick area, 90 percent of the land holdings were between 500 to 1,000 acres but most of the land was 640-acre homesteads. Much of the land was used as free range by adjoining ranches because many of the holdings were in small, unproductive, unfenced, and unleased tracts of land owned by nonresidents. Engineering, economic, and soil studies for the Kendrick area were completed in 1930 under an agreement between the Bureau of Reclamation and the State of Wyoming. Originally irrigation of 66,000 acres of land was planned. The Kendrick Irrigation Project was authorized as part of the National Industrial Recovery Act of 1933 and construction began that year. By 1939, 63 mi of main canal and 150 mi of lateral canals and ditches were completed. A total of 42 mi of unlined drains had been completed in the Kendrick area. Irrigation water was first made available in the Kendrick area in 1946. Irrigated area increased from 1,046 acres in 1946 to about 24,000 acres in 1989.

The boundary of the Kendrick area corresponds to the boundary of the Gasper-Alcova Irrigation District (CAID). The water supply for the CAID is stored in two reservoirs on the North Platte River: Seminoe Reservoir, 70 mi southwest of Casper, and Alcova Reservoir, 30 mi southwest of Casper. Water for irrigation use in the Kendrick project area is primarily supplied via the Casper Canal from the Alcova Reservoir. The average annual volume of water diverted from the reservoir to the canal is 3.05 acre-ft per irrigated acre. The volume of water delivered to the land via the canal and lateral system ranges from 1.75 to 2.58 acre-ft per acre per year. a small quantity of irrigation water is obtained from ground-water or stream flow diversions from creeks in the Kendrick area.

About 43 mi of both open and closed drains in the Kendrick area include the Kramer, Townsend, Middaugh, Townsend Branch, Middle Branch, Bergesson Branch, Oregon Trail, Miller, Lovelace Meyer, Johnson-Dye, Garbutt, Johnson Reservoir, Sheppard, and Radden Drains. The wastewater from the Kendrick area flows through these drains as well as through streams tributary to the North Platte River. Wastewater is water transported in the canals and laterals but not used for irrigation. Wastewater quantity ranges from 2,000 - 8,000 acre-ft per year. Tail water is water that is applied to fields and either runs off or seeps into drains from subsurface flow.

4.01 Stream Classification Definitions and Designated Use

The Kendrick project lies within USGS hydrologic unit #10180007, the Middle North Platte unit. A revised version of the Chapter 1, Wyoming Water Quality Rules and Regulations was approved recently and will have an effect on the waters within the Kendrick project. The revisions include reclassification of most of the waters in the State. To best understand what the effects will be on the Kendrick project the following section will first provide the definitions of the new classification system and then present what the new classifications of the waters in the Kendrick are.

Class 1/Outstanding Waters. Class 1 waters are those surface waters in which no further water quality degradation by point source discharges other than from dams will be allowed. Non-point sources of pollution shall be controlled through implementation of appropriate best management practices. Pursuant to Section 7, the water quality and physical and biological integrity which existed on the water at the time of designation will be maintained and protected. In designating Class 1 waters, the Environmental Quality Council shall consider water quality, aesthetic, scenic, recreational, ecological, agricultural, botanical, zoological, municipal, industrial, historical, geological, cultural, archaeological, fish and wildlife, the presence of significant quantities of developable water and other values of present and future benefit to the people.

Class 2/Fisheries and Drinking Water. Class 2 waters are waters, other than those designated as Class 1, that are known to support fish or drinking water supplies or where those uses are attainable. Class 2 waters may be perennial, intermittent or ephemeral and are protected for the uses indicated in each sub category listed below. There are four subcategories of Class 2 waters.

- (i) **Class 2AB.** Class 2AB waters are those known to support game fish populations or spawning and nursery areas at least seasonally and all their perennial tributaries and adjacent wetlands. Class 2AB waters include all permanent and seasonal game fisheries and can be either "cold water" or "warm water" depending upon the predominance of cold water or warm water species present. All Class 2AB waters are designated as cold water game fisheries unless identified as a warm water game fishery by a "ww" notation. Unless it is shown otherwise, these waters are presumed to have sufficient water quality and quantity to support drinking water supplies and are protected for that use. Class 2AB waters are also protected for nongame fisheries, fish consumption, aquatic life other than fish, primary contact recreation, wildlife, industry, agriculture and scenic value uses.
- (ii) **Class 2A.** Class 2A waters are those that are not known to support game fish but are used for public or domestic drinking water supplies including their perennial tributaries and adjacent wetlands. Uses designated on Class 2A waters include drinking water, aquatic life other than fish, primary contact recreation, wildlife, industry, agriculture and scenic value.

- (iii) Class 2B. Class 2B waters are those known to support game fish populations or spawning and nursery areas at least seasonally and all their perennial tributaries and adjacent wetlands and where it has been shown that drinking water uses are not attainable pursuant to the provisions of Section 33. Class 2B waters include permanent and seasonal game fisheries and can be either "cold water" or "warm water" depending upon the predominance of cold water or warm water species present. All Class 2B waters are designated as cold water game fisheries unless identified as a warm water game fishery by a "ww" notation. Uses designated on Class 2B waters include game and nongame fisheries, fish consumption, aquatic life other than fish, primary contact recreation, wildlife, industry, agriculture and scenic value.
- (iv) Class 2C. Class 2C waters are those known to support only nongame fish populations or spawning and nursery areas at least seasonally including their perennial tributaries and adjacent wetlands. Class 2C waters include all permanent and seasonal nongame fisheries and are considered "warm water". Uses designated on Class 2C waters include nongame fisheries, fish consumption, aquatic life other than fish, primary contact recreation, wildlife, industry, agriculture, and scenic value.

Class 3/Aquatic Life Other than Fish. Class 3 waters are waters, other than those designated as Class 1, that are intermittent, ephemeral or isolated waters and because of natural habitat conditions, do not support fish populations or spawning, or certain perennial waters which lack the natural water quality to support fish (e.g., geothermal areas). Class 3 waters provide support for invertebrates, amphibians, or other flora and fauna which inhabit waters of the state at some stage of their life cycles. Uses designated on Class 3 waters include aquatic life other than fish, recreation, wildlife, industry, agriculture and scenic value. Generally, waters suitable for this classification have wetland characteristics, and such characteristics will be a primary indicator used in identifying Class 3 waters. There are three subcategories of Class 3 waters.

- (i) Class 3A - Be presently supporting nongame fish only. Class 3A waters are isolated waters including wetlands that are not known to support fish populations or drinking water supplies and where those uses are not attainable.
- (ii) Class 3B - Have the hydrologic and natural water quality potential to support nongame fish only. Class 3B waters are intermittent and ephemeral streams with sufficient hydrology to normally support and sustain communities of aquatic life including invertebrates, amphibians, or other flora and fauna which inhabit waters of the state at some stage of their life cycles. In general, 3B waters are characterized by frequent linear wetland occurrences or impoundments within or adjacent to the stream channel over its entire length. Such characteristics will be a primary indicator used in identifying Class 3B waters.

- (iii) Class 3C - Include nursery areas or food sources for nongame fish only. Class 3C waters are perennial streams without the natural water quality potential to support fish or drinking water supplies but do support wetland characteristics. These may include geothermal waters and waters with naturally high concentrations of dissolved salts or metals or pH extremes.

Class 4/Agriculture, Industry, Recreation and Wildlife. Class 4 waters are waters, other than those designated as Class 1 which are determined to not have the hydrologic or natural water quality potential to support fish and include all intermittent and ephemeral streams. Class 4 waters shall receive protection for agriculture uses and wildlife watering, where it has been determined that aquatic life uses are not attainable pursuant to the provisions of Section 33 of these regulations. Uses designated on Class 4 waters include primary contact recreation, wildlife, industry, agriculture and scenic value.

- (i) Class 4A. Class 4A waters are artificial canals and ditches that are not known to support fish populations.
- (ii) Class 4B. Class 4B waters are intermittent and ephemeral stream channels that have been determined to lack the hydrologic potential to normally support and sustain aquatic life pursuant to the provisions of Section 33(b) of these regulations. In general, 4B streams are characterized by only infrequent wetland occurrences or impoundments within or adjacent to the stream channel over its entire length. Such characteristics will be a primary indicator used in identifying Class 4B waters.
- (iii) Class 4C. Class 4C waters are all waters that have been determined to lack the potential to normally support and sustain aquatic life. Class 4C includes, but is not limited to effluent-dominated streams where it has been determined removing a source of pollution to achieve full attainment of aquatic life uses would cause more environmental damage than leaving the source in place.

Table 1. Stream Reclassifications in, or near, the Kendrick Project

Waterbody	Previous Classificatio n	Current Classificatio n
North Platte River – Natrona County Road Bridge Hwy 309 (Goose Egg Bridge) to the Alcova Dam	2	1
North Platte River (Remainder)	2	2AB
South Fork Casper Creek	4	3B
Clarks Gulch	4	3B
North Fork Casper Creek	3	2C
Middle Fork Casper Creek	3	2C
Six Mile Draw	4	3B
Poison Spider Creek (lowermost mile)	3	2AB
Poison Spider Creek (from class 2AB section upstream 5 miles)	3	2C
Poison Spider Creek (remainder)	4	3B
Iron Creek	4	3B
Meadow Creek	4	3B
Poison Spring Creek	4	3B
Willow Creek	4	3B
Bates Creek	3	2AB
Stinking Creek	4	2C
Bolton Creek	4	2C
Bear Creek	3	2C
Matheson Creek	4	3B
Oregon Trail Drain	4	3B
Garden Creek	3	2AB
Casper Creek	2	2AB
Casper Canal		4A

5.0 SAMPLING DESIGN

The sampling design was developed with the intent of accomplishing as many of the project objectives as stated in section 2.0 of this SAP. The components of a good quality Sampling Design include: Statistical Design, Scale of Study, Sampling Parameters and Collection Methods, Sampling Location/Type/Frequency and Duration. Each component will be addressed in the following subsections.

5.1 Statistical Design

Various sampling designs produce data with varying statistical results. The choice of which design to use is dependant upon the projects goals and objectives. The water quality problem, selenium levels in the North Platte River and its tributaries in the Kendrick project area, has already been well documented thus eliminating the need for baseline data. The primary question is where are the highest concentrations of selenium within the Kendrick system originating from? This information can best be obtained by implementing a reconnaissance based investigative methodology. Chemical, physical and biological data obtained from the Kendrick Watershed will provide an assessment of the relative constituent contribution to the Platte River from each of the drainages found within the project area. “Control” monitoring locations outside the irrigation project but still within similar geologic formations will be utilized for comparative purposes. Also, given the quantity of data available from previous investigations, a number of monitoring locations will be comparable to water quality data obtained earlier thus allowing trends in the water quality in the area to be established.

Reconnaissance based sampling designs are used to determine the magnitude and/or extent of the water quality issue. Appropriately located sampling sites, sampled with sufficient frequency, will provide the data required to prioritize selenium concentration areas within the Kendrick project. Once identified, the Steering Committee can allocate cost share funding commensurate with the level of severity of the problem, thereby addressing the areas of greatest need first. Additional historical data will be obtained to supplement the findings of the current monitoring efforts and to help develop an information and education program in the local community.

A secondary issue is the interaction between the soils, the underlying geology, and the capillary action of water moving through the soil profile involving various irrigation practices. The NRCS will assist with the secondary issues so for the purposes of this document, only the primary water quality issue will be addressed.

5.2 Scale of Study

To best understand what effect water use management decisions within the Kendrick project has on the water quality of the Platte River, a sampling design based upon a sub-watershed scale is appropriate. While it is preferable to work on a watershed scale, the available water quality data so strongly supports conclusions regarding the source(s) of selenium additional research and investigation would not likely produce results that would differ from previous findings.

5.3 Sampling Parameters and Collection Methods

The conservation district and its contractors will collect credible data comprised of physical, chemical, and biological parameters according to credible data legislation. To insure defensible and credible data, collection procedures for each parameter listed below will be completed according to established standard collection protocols. Each parameter's collection methodology can be found in Appendix C.

5.3.1 Physical Parameters

1. BURP Monitoring: BURP, or ***Beneficial Use Reconnaissance Protocol***, monitoring will occur utilizing the latest version of the Wyoming Department of Environmental Quality field data sheets. The physical parameters consist of primary, secondary, and tertiary categories that provide an assessment of the condition of the micro-habitat characteristics that directly and indirectly affect macroinvertebrates, as well as the adjacent terrestrial conditions of the waterbody. The components of the physical assessment can be found in Figure 2. Note that while this assessment method relies upon a qualitative (visual assessment) methodology, quality assurance quality control (QAQC) protocols require that at least one in every ten (1 in 5 recommended) assessments performed be completed utilizing the quantitative methodology provided in the quality assurance project plan (QAPP) in Appendix B. The quantitative methodology allows for the "calibration" of the monitoring staff, thereby minimizing error when visually assessing habitat characteristics.
2. Velocity/Discharge: Determining discharge is critical in assessing water quality. To establish the rate of discharge with a flow meter, flow velocity is measured at 60% total depth from the water's surface at sufficient intervals in a cross section of the stream to provide 20 – 25 readings. Data is then calculated to determine discharge rate.
3. Temperature: Stream water temperature influences growth, distribution and survival of aquatic organisms and fish. Temperature related data will be obtained with field instruments in-situ.
4. Photo Documentation: Photographs, preferably digital, will be taken in a panorama using cardinal directions beginning facing upstream and ending facing downstream from both banks if possible. Visual records are valuable in supporting the qualitative aspects of the BURP.

Table 2. BURP Parameters

Parameters	Units	How Measured	Sample Type
Bank Vegetation Protection	N/A	Field Analysis	Qualitative
Bank Stability	N/A	Field Analysis	Qualitative
Bankfull Channel Shape	N/A	Field Analysis	Qualitative
Canopy Cover Over Stream	N/A	Field Analysis	Qualitative
Channelization/Alter	N/A	Field Analysis	Qualitative
Color, Odor, and Sheen	N/A	Field Analysis	Qualitative
Coordinates	lat./long	Garmin GPS Unit	N/A
Discharge	ft ³ /sec	Global probe & cross-section	Integrated
Embeddedness (silt covering) Rating	N/A	Field Analysis	Qualitative
Riffle Gradient	N/A	Field Analysis	Quantitative
Instream Cover for Fish	N/A	Field Analysis	Qualitative
Photo Points	N/A	Field Analysis	Quantitative
Pool/Riffle Ratio	N/A	Field Analysis	Qualitative
Predominant Soil Type	N/A	Field Analysis	Qualitative
Predominant Geology, Surficial	N/A	Field Analysis	Qualitative
Primary and Secondary Land Use	N/A	Field Analysis	Qualitative
Relative Abundance of Aquatic Biota	N/A	Field Analysis	Qualitative
Riparian Zone Width	N/A	Field Analysis	Qualitative
Rosgen Stream Channel Classification	N/A	Field Analysis	Qualitative
Site Sketch	N/A	N/A	Qualitative
Stream Substrate Composition	N/A	N/A	Qualitative
Width/Depth Ratio	N/A	Field Analysis	Quantitative

5.3.2 Chemical Parameters

Sampling for water chemistry will follow the standard sampling methodologies provided in Appendix C. Water samples will be integrated samples collected by passing the sampler vertically across the stream channel while moving it horizontally within the water column. All sampling containers and lids will be rinsed thoroughly (three times) in ambient water prior to securing the water sample. Water obtained for in-situ instantaneous field measurements will consist of integrated samples combined in a two gallon bucket. Refer to Parameters, Units, Analytical Methods, SOPs, Preservatives, Holding Times section of this SAP for the parameters and preservation methods. Water chemistry parameters to be sampled are:

1. Specific Conductance (field)
2. Dissolved Oxygen (field)
3. pH. (both)
4. Oxygen Reduction Potential (field)
5. Total Suspended Solids (lab)
6. Total Selenium (lab)
7. Selenate (lab)
8. Selenite (lab)
9. Arsenic (lab)

Table 3. Surface water quality chemistry parameters to be sampled

Parameters	Units	Sample Volume	Preservative	Holding Time	Detection Limit	Measured	Sample Type
Conductance, Specific	mhos/cm	N/A	N/A	N/A	5 mhos/cm	YSI probe	Instantaneous
Dissolved Oxygen	mg/l	N/A	N/A	N/A	0.1 mg/L	YSI probe	Instantaneous
Ph	%H	N/A	N/A	N/A	0.1 of a pH unit	YSI probe	Instantaneous
Oxygen Reduction Potential		N/A	N/A	N/A		field analysis	Instantaneous
Total Suspended Solids	mg/l	200 ml	Cool to 4°C	7 days	2 mg/l	lab analysis	Integrated
Total Selenium	mg/l				.001 mg/l	lab analysis	Integrated
Selenate (+6)	mg/l				.001 mg/l	lab analysis	Integrated
Selenite (+4)	mg/l				.001 mg/l	lab analysis	Integrated
Arsenic	mg/l				.001 mg/l	lab analysis	Integrated

5.3.3 *Biological Parameters*

Biological sampling methodology will be followed as outlined in Appendix C and will consist of a composite of eight randomly selected sites within a 100' riffle. At a minimum, Double Blind QA/QC sampling protocol will be used at every tenth sample site at a minimum. Biological parameters to be sampled are macroinvertebrates. Evaluation of macroinvertebrate community structure serves as an indicator of long-term water quality and provides comparative criterion for chemical and physical parameter results.

Table 4. Biological Parameters to be Sampled

Parameters	Units	Sample Volume	Preservative	Holding Time	Detection Limit	Measured	Sample Type
Macroinvertebrates	N/A	N/A	Alcohol 95% or higher	N/A	N/A	lab analysis	Integrated

5.4 *Sampling Site Locations*

To evaluate the Kendrick area during the reconnaissance phase of this assessment, a water chemistry sampling site location isolating creeks and drainage areas will be

required. Additionally, sampling along the length of the Casper canal will occur. Placement just upstream of each tributary's confluence with the Platte River will result in data that will provide a accurate characterization of conditions found in that drainage. Biological monitoring sites will be located in a manner to indicate change in the benthic community structure spatially. Additionally, the U.S. Geological Survey will be approached to collect water samples from the North Platte river at two of their existing stations, just below the Alcova reservoir and at Casper.

Criteria for the water chemistry locations

- Landowner Permission
- Ease of Access
- Above and below areas of suspected variation in selenium content
- Correlation with past water quality monitoring programs

Additional Criteria for Physical and Biological Sampling

- At Least ¼ Mile Upstream of Confluence
- 100' Riffle Representative of Other Riffles in Drainage
- 4 Pools Within Study Reach. Study Reach Defined as 20 X Bankfull Width
- Average Stream Flow Velocity Between 0.5 and 3.3 Feet per Second
- Straight Channel Section
- At Least ¼ Mile from Bridges or Road Crossings
- Accessibility to Stream ¼ Mile both Up and Down Stream of Riffle

Although these criteria need to be adhered to as closely as possible they are provided for general guidance only. Selection of specific monitoring locations will be determined through coordination with land owners/managers and personnel experienced in BURP water quality monitoring.

A control or reference location that is not underlain by Cody Shale should also be identified. The location must have had minimal or no unnatural land disturbance upstream of its location and must be geologically and hydrologically representative of the locations that are to be compared against it. If no location can be found within the watershed that can qualify as a control or reference site, the WDEQ Reference Stream project can be utilized for comparative data. Sites that enter the Platte River from Casper Mountain side may be considered if the flow regimes allow for year-round sampling. For specific monitoring locations refer to map in Appendix A.

The following table contains the general areas within which a specific sampling reach should be located and the ID code for that location once identified. These locations are contingent upon landowner approval and may have to be modified. Note: It was the desire of the Steering Committee to identify and monitor waterbodies outside of the irrigation district which were still influenced by marine shale geology for comparative

purposes. However, given the drought conditions currently being experienced in Natrona County, upon field inspection all waterbodies uninfluenced by irrigation practices were found to be dry with the exception of Bates Creek. Therefore, if climatic conditions return to an average precipitation regime in the next two years more “control” sites may be added.

Table 5. NCCD Monitoring Locations and Codes

CODE	WATERBODY	DESCRIPTION
BACR	Bates Creek - Control	Immediately West of the Bates Creek / Highway 220 Intersection.
LTG	Lone Tree Gulch	Confluence with North Platte River
CACA1	Casper Canal	Headwater of the Canal Near Alcova
WICR1	Willow Creek	Headwaters of the Creek East of the Casper Canal
POSP1	Poison Spring Creek	Headwaters of the Creek East of the Casper Canal
CACA2	Casper Canal	North of Poison Spring Creek Intersection
POSP2	Poison Spring Creek	Confluence with North Platte River
PSC2	Poison Spider Creek	Confluence with North Platte River
IRCR2	Iron Creek	County Road 308 Just Upstream of Confluence with Poison Spider Creek
PSC1	Poison Spider Creek	Where Creek crosses Poison Spider Road West of Canal
IRCR1	Iron Creek	Intersection of County Roads 319 & 315
MBD	Middle Branch Drain	33 Mile Road @ 1 mile north of Intersection with Zero Road
BEDR	Bergesson Drain	33 Mile Road @ 1 mile south of Intersection with Hwy 20/26
CACA3	Casper Canal	Just North of Intersection with Hwy 20/26
CACA4	Casper Canal	End of Main Canal
CACR1	Casper Creek	Four Miles Due North of Natrona County Airport Just Upstream of Confluence with South Fork
SFCC	South Fork Casper Creek	Four Miles Due North of Natrona County Airport Just Upstream of Confluence with Casper Creek
JRD	Johnson Reservoir Drain	Two Miles Due North of Natrona County Airport Just Upstream of Confluence with Casper Creek
SMD	Six Mile Draw	Six Mile Road Just Upstream of Confluence with Casper Creek Due East of Natrona County Airport
CACR2	Casper Creek	Confluence with North Platte River
OTD	Oregon Trail Drain	Confluence with North Platte River

5.5 *Sampling* Frequency

Water Chemistry sampling will occur a minimum of once a month with the following exceptions. 1) During spring runoff events additional samples will occur at 48 – 72 hour intervals dependant upon runoff duration. The intent is to gain additional data

from the “first flush” of the runoff event. Additional monitoring will occur annually in the Casper Canal in May when the water is first turned into the canal.

Biological sampling will occur in the fall during low flow periods.

5.6 *Sample Labeling*

Each sample will be labeled with a permanent, waterproof marking pen, such as a “Sharpie” on write-in-rain™ paper. The sample identification will be recorded on the bottle, on the Chain of Custody form, on the lab’s analytical report, and in the field logbook. At a minimum, sample labels must include:

1. Sampler’s initials as recorded in the field log book
2. Julian or consecutive day of the year followed by 01 (for year 2001)
3. The time, using a 24 hour clock (military time)
4. Station ID code. Station ID location codes are located in *Table 5, Monitoring Locations and Codes* of this SAP. Quality Control samples, such as blanks and duplicates will have the numerical identification for each in conjunction with the site identification.

Example Label:

Surface Water Chemistry Sample
Date: 15501 Time: 0940
Sample number: 1 of ? (consecutive number if multiple samples are taken)
Sampler: RG
Sample ID #: CACA11550101
Preservative: none

Explanation of Sample ID

Sample ID #: CACA11550101

CACA1 = Casper Canal location 1

15501 = Julian Day equivalent to June 4, 2001

01 = normal sample as opposed to a blank or duplicate sample

Quality Control Duplicate Example

Sample ID: CACA115501**02**

CACA1 = Casper Canal location 1

15501 = Julian Day = to June 4, 2001

02 = Duplicate sample

Quality Control Blank Example

Sample ID: CACA115501**03**

CACA1 = Casper Canal location 1

15501 = Julian Day = to June 4, 2001

03 = Blank sample

*Table 6. Sample Quality Control Measures to Ensure Credible Data
(see Appendix B for the Quality Control Measures Methodology)*

Parameter	QC Check	Frequency	Acceptable Range	Corrective Actions
Blanks	Contamination which might affect	1 per trip	Pass/Fail	Notify appropriate staff; repeat procedure; find contamination

	analytical results			source; decide whether to accept or disallow data.
Chain of Custody Form	Laboratory notes errors and omissions on sheet and in laboratory database	Each group of samples shipped to the lab	No errors or omissions	Notify appropriate staff; audit and train the field sampler; test results from samples which are sent to the laboratory without a Chain of Custody form are not suitable for use in legal actions
Chain of Custody Seal	Laboratory records on Chain of Custody Form and in Laboratory database	Each container of samples shipped to the lab	No errors or omissions	Notify sampler and appropriate management; audit and train the field sampler; test results from samples which do not have a seal are not suitable for legal actions
Dissolved Oxygen	Written record of calibration.	Daily before each use	Instrument specific	Verify altitude; if still not correct return meter to YSI Incorporated for repair or replacement
Duplicates	Required	1 every 10 sample sites per trip per parameter (1 minimum)	Required	Notify appropriate staff if missing; audit and train field sampler. Water Quality Specialist decides whether to accept or disallow data.
Macroinvertebrate Sampling	Duplicate samples submitted as a blind test to lab	10% of all samples	90%	Audit and train field sampler.
pH	2 point meter check with pH 7 and 10 buffer standards	Daily before each use	±5%	Repeat field check; if still not correct return meter to YSI Incorporated for repair or replacement
Sample Preservation	Sample label and Chain of Custody agrees with parameter SOP	All samples	No errors or omissions	Notify appropriate staff; resample; data is flagged to indicate that it should not be entered in a database or used for decision making
Temperature	Annual calibration against a thermometer traceable to an NBS thermometer	Annually	On the calibration mark	Repeat measurement with different thermometer; if not correct contact YSI Incorporated

The water quality technical staff will be responsible for understanding the Quality Assurance/Quality Control (QA/QC) Plan from each contract laboratory and for providing QA/QC guidance to all samplers. A copy of each laboratory's QA/QC plan will be kept on file at the District Office.

5.7 Chain of Custody

Samples will be sealed and preserved appropriately prior to shipment (see Appendix C for Chain of Custody) and be accompanied by a Chain of Custody (COC) form.

1. It is mandatory to submit a completed and signed COC form with the samples.
2. The lab receives the COC form and signs it.

3. The lab returns the completed COC form to the Natrona County Conservation District.
4. The district files the original in the COC file and maintains it indefinitely.

6.0 HEALTH AND SAFETY

Safety must be a primary concern at all times and in all sampling situations for field sampling personal. In any marginal or questionable situation, samplers are required to assume worst-case conditions and use safety precautions and equipment appropriate to that situation. Samplers who encounter conditions which, in their best professional judgment, may exceed the protection of their safety equipment or may in any way represent a potential hazard to human health and safety should immediately leave the area and contact their supervisor.

During field sampling there should be a minimum of two sampling personnel present. Shoulder length gloves will be worn when sampling surface water. Samplers will thoroughly wash hands and arms with bacterial soap after sampling and before eating or drinking. In the field, antibacterial wipes should be used prior to eating or drinking. Samplers should be familiar with basic first aid and CPR. Samplers should have current vaccinations for Hepatitis A and Tetanus.

Samplers are strongly recommended to carry a cell phone. Samplers will inform a supervisor when they leave for the field, where they will be sampling, and their estimated time of return. The supervisor will initiate the emergency action plan below if the samplers have not returned to the office within the allotted time. To avoid worry and concern, samplers will call the office if they are running behind schedule.

6.1 *Emergency Action Plan*

A supervisor or personnel on duty will be notified of the departure time of each sampling trip, know the itinerary, persons involved, and estimated time of return. The contact person(s) will also know whom to contact to initiate rescue efforts. If samplers have not returned or reported on time, the supervisor or personnel on duty will contact the Natrona County Sheriffs Department at (307) 235-9282 .

7.0 LABORATORIES

<u>Labs</u>	<u>Parameters</u>
ENERGY LABORATORIES, INC. Casper, Wyoming toll free- (888) 235-0515 local- 235-0515	Water Chemistry & Fecal Series

sgarling@energylab.com	
AQUATIC BIOLOGY ASSOCIATES, INC. 3490 NW Deer Run Rd. Corvallis, OR 97330 Telephone: (541) 752-1568 E-mail: wisseman@aquaticbio.com	Macroinvertebrates

Samples will be packed with ice packs in coolers and the cooler sealed with packing tape to be delivered the best available method with Chain of Custody form. Coolers and sample bottles are obtained by contacting the lab at least two weeks in advance of sampling date. Be sure to call the lab before delivering samples.

Prior to being shipped, macroinvertebrate samples to be sent to the ABA Lab will first be drained then filled with fresh preservative and then placed in coolers supplied by ABA, sealed with packing tape and shipped via UPS ground service with chain of custody form. All contract labs will follow their Quality Assurance/Quality Control protocols as set forth in Appendix B.

All test results from contract laboratories will be delivered via email in Excel or Access spreadsheets. Excel and Access have the ability to produce charts and graphs and to perform statistical manipulation. Statistical manipulation will include the number of samples, mean, maximum, minimum, and the standard deviation.

7.1 Laboratory Results and Data Archiving

The originals of the lab results will be kept in the Natrona County Conservation District office and copies will be stored at a secure location to be determined. If changes are made to the originals, the copies will be amended immediately. The Water Quality Specialist will be responsible for transferring specific paper records to an electronic format for statistical analysis.

One copy of the electronic records will be stored at the conservation district office and another back-up copy will be stored at a secure location to be determined. When changes are made to the office copy, the disks will be rotated and updated as soon as possible.

Table 7. Data Archiving

Record Type	Storage Location Original/Copy	Storage Duration	Responsible Party
Calibration Logs	NCCD / TBD	Indefinite	WQ Tech, District Manager
Chain of Custody	NCCD / TBD	Indefinite	WQ Tech, District Manager
Field Log Book	NCCD / TBD	Indefinite	WQ Tech, District Manager
Lab Results	NCCD / TBD	Indefinite	WQ Tech, District Manager
Maps	NCCD / TBD	Indefinite	WQ Tech, District Manager
Reports	NCCD / TBD	Indefinite	WQ Tech, District Manager
SAP, QAPP, SOP	NCCD / TBD	Indefinite	WQ Tech, District Manager

Spreadsheets	NCCD / TBD	Indefinite	WQ Tech, District Manager
Database Management System	NCCD / TBD	Indefinite	WQ Tech, District Manager

NCCD – Natrona County Conservation District

TBD

8.0 DATA ANALYSIS AND REPORTING

A consultant and/or University staff proficient in water quality monitoring will analyze all lab reports and field data. They will be responsible for analyzing the data and prepare as necessary, monthly, quarterly, and annual reports. The findings of the annual report will be utilized to determine if the goals and objectives of the watershed program are being met and what, if any, modifications to the sampling design are necessary.

9.0 AMENDMENTS & MODIFICATIONS

If problems arise with the sampling locations, number of samples per site, number/type of QC samples, sampling method/SOP, number of sites, database application program, or any other aspect of the SAP, it will be updated through modifications. Filing instructions will be included with each modification, which will most likely instruct the filer to place the modification in its relevant section. The modification will also include a notice of the amendment, which will be posted in the front of the SAP, before the title page. The most recent modification will be posted on top of former modifications. A log page, which will include modification number, date, general description of the modification, and the initials of the filer will be located in front of all the modifications. All sampling personnel in active status at the time of the modification will be verbally informed of the change(s).

10.0 EQUIPMENT CALIBRATION AND MAINTENANCE

The Water Quality Technician will be responsible for all equipment calibration and maintenance. All equipment will be calibrated according to the manufacturer’s recommendations. The original calibration log will be kept at the office to record calibrations completed, when, by whom, and dates of calibration solutions.

YSI 600 Multi-Parameter Water Quality Monitor/model# 600R – serial # 219777R

Parameter	Units	Calibration	Schedule	Maintenance	Schedule
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Conductance, Specific	mhos/cm	Solution	Daily	Charge Battery	Monthly
Dissolved Oxygen	Mg/L	Barometer x 25.4	Daily	Charge Battery	Monthly
pH	%H	Buffer Solutions 7/10	Daily	Charge Battery	Monthly
Temperature	°F		Yearly	Charge Battery	Monthly

Global Water Flow Probe

Parameter	Units	Calibration	Schedule	Maintenance	Schedule
Velocity	ft ³ /sec	33.31 ft ³ /sec	Annually	Replace Battery	As Needed

Garmin GPS 12/model# 190-00143-10, serial

Parameter	Units	Calibration	Schedule	Maintenance	Schedule
Location	Lat./long coordinates	None	None	4 AA Batteries	Annually

Surber Sampler Net Mesh 500um

Parameter	Calibration	Schedule	Maintenance	Schedule
Macroinvertebrate	None	None	Physical Inspection	At Use

Pentax IQ Zoom 105WR Date/serial

Parameter	Calibration	Schedule	Maintenance	Schedule
Photo Documentation	None	None	3 V Lithium Battery	As Needed

11.0 **FIELD LOG BOOKS**

Original field log books (see Appendix C for the Field Log Books methodology) will be kept at the office and copies of the pages will be kept at a secure location to be determined. Data Archiving section of this SAP. The methodology to be followed is critical to ensure credible data.

Key points are as follows:

The outside front cover must contain:

1. The samplers' printed names,
2. The from-to date periods covered by the log book (mm/dd/yy),
3. The sequential log book number.

The inside front cover must contain:

1. The signature identification of the samplers and all other persons who make entries in the logbook.
2. The samplers' chosen set of written initials must be shown.
 - a. These initials must be used for all entries in the logbook and for any sample labeling.
 - b. Any person making an entry must sign and initial the inside front cover of the logbook.

The log must have:

1. All pages sequentially numbered.
2. No pages removed.

All entries:

1. Must be made in permanent pen.
2. If pencil is used, the reason should be noted in the entry

All corrections:

1. Made with one line through the incorrect information, so that the original information can still be read.
2. The correct information is written in the next available space.
3. Corrections must be initialed and dated.
4. If an entire page is incorrect, one diagonal line is drawn through the entire page and the correct information is recorded in the next available space.

Procedure for change of personnel:

1. Samplers who resign or transfer must leave all logbooks.
2. Conservation District Board Supervisors must verify that all logbooks are complete, numbered, accounted for and filed.

Data recorder:

1. If a field crew appoints one member as data recorder, all participants involved in the collection of that data must sign the inside front cover, show their chosen initials beneath their signature, and initial and date the field log book entries.

12.0 **FIELD DATA FORMS**

The BURP Monitoring sheets utilized the Wyoming Department of Environmental Quality will be used as data forms. Parameters analyzed in the field will be collected with the YSI multi-probe on the data logger *and* recorded in the field log book *on-site*. The information on the data logger will be downloaded at the office for analysis. Storage of this data is covered in the Data Archiving section of this SAP. The field logbooks will serve as data forms for any other pertinent information.

13.0 DATA REVIEW AND VALIDATION

Conservation district staff will be responsible for receiving the data sheets and field log books, checking for omissions in identification, decimal placement, dates, times, units reported, and comments. Water quality technical staff collecting data will be contacted immediately if there are data gaps or if scheduled sampling times were missed.

It is the water quality technical staff's responsibility to evaluate raw data generated by the contract laboratories for appropriate numeric reduction, data quality, and accuracy. All data will be reviewed and reported in units specified at the detection level of the analysis methods used. To reduce data point loss, data that is reported as "less than" detection level should be incorporated at a value of 1/2 the detection level. Once data is generated, it will be compiled in a database file. During this data transfer, the information will be reviewed and verified in accordance with data quality objectives.

Data generated in the laboratory will be validated by performance checks such as a duplicates and blanks. Data will be reported in the units that have been designated to each parameter in the Analytical Methods, Holding Times, Parameters, and Sample Collection Methods section tables. Scientific notation will be used and significant figures will correlate with detection levels. Both graphing and narrative conclusions will be used to describe the water quality results and trend variations.