

2010

**WATER
QUALITY
MONITORING
ANNUAL
WORK PLAN**



**WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER QUALITY DIVISION
WATERSHED MANAGEMENT PROGRAM**

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Introduction

Regulatory Framework (Clean Water Act)

The current regulatory framework for water programs in the United States began with the Water Pollution Control Act of 1948. This was the first comprehensive statement of federal interest in clean water programs. In 1972, congress passed the Federal Water Pollution Control Act (Public Law 92-500), which is also known as the Clean Water Act (CWA). The goal of the CWA was to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. In 1977, an amendment was passed that established a goal of protecting and managing waters to insure "fishable and swimmable" conditions. The Act of 1972, the amendment of 1977, and the various other amendments that have occurred over the years together provide the basis for comprehensive state water quality monitoring strategies.

The United States Environmental Protection Agency (EPA) was assigned the dominant role in administering clean water programs across the Nation. The Wyoming Department of Environmental Quality (WDEQ) implements the CWA in Wyoming, while EPA provides oversight and direction to State programs and certifies the fulfillment of CWA requirements in the State. Wyoming is responsible for assessing all waters of the State to evaluate overall water quality condition and determine if they support designated uses.

The WDEQ monitoring program is responsible for collecting scientifically sound water quality monitoring data using established data collection methods, and assessing those data in a consistent manner. Approved assessment methods (WDEQ 2008a) provide guidance on using the monitoring data to determine designated use support of a waterbody. Wyoming water quality standards are the rules concerning designated uses and the associated water quality criteria (WDEQ 2007). Wyoming water quality standards consist of three parts: 1) surface water classes and associated uses; 2) numeric and narrative water quality criteria; and 3) antidegradation policy.

History of the Monitoring Program

The initiation of reference stream monitoring in 1992 marked the beginning of the WQD/WQD surface water monitoring program (hereinafter referred to as the monitoring program). The purpose of reference stream monitoring primarily is to obtain benchmark chemical, physical, and biological data from least anthropogenic-impacted stream sites within each ecoregion (Omernick and Gallant, 1987) of Wyoming. This data is used for assessing condition of other streams in the State. Reference stream data also is used to develop and revise the Wyoming Stream Integrity Index and the Wyoming RIVPACS models, both of which are tools used for assessing the biological integrity of Wyoming streams. Reference stream monitoring continues today, although now is a smaller, but still important, part of the overall monitoring program.

In the 1997 Total Maximum Daily Load (TMDL) work plan, the Monitoring Program was charged with collecting scientifically sound chemical, biological and physical monitoring data

for determining designated use support for over 300 stream segments, lakes, and reservoirs that, in 1996, had only anecdotal data suggesting that designated uses may not be fully supported. WDEQ committed to collect data from each waterbody within five years, followed by timely assessments of those data resulting in, where possible, determinations of designated use support. The large number of waterbodies requiring monitoring data for making use-support determinations within a period of five years necessitated a rapid screening type of approach.

The Beneficial Use Reconnaissance Project was implemented in 1998 to meet the needs of the 1997 TMDL workplan. This was essentially the first monitoring strategy. The purpose of this project was to collect the necessary monitoring data described previously using a rapid screening-type approach, similar to EPA's Rapid Bioassessment Protocol (RBP), that ultimately could be used to make designated use-support determinations. The monitoring program was founded on RBP and monitoring protocols developed for reference streams and Wyoming's National Pollutant Discharge Elimination System (WYPDES) permitting and compliance program. These protocols were later updated with several new components and summarized in a document entitled Standard Operating Procedures for Sample Collection and Analysis (WDEQ 2004).

From 1998 to 2003, the monitoring program worked through the monitoring directive of the 1997 TMDL workplan using the RBP-like approach, and where possible made designated use-support determinations. However, it was quickly realized that the assumption that most waters could be assessed with data from one rapid based monitoring event was impractical. Designated use determinations proved to be more complex than originally anticipated, and many streams required a more intensive, multi-year assessment than what the RBP-approach entailed, particularly when dealing with habitat degradation, stream channel instability and sediment pollution.

In 2004, a second monitoring strategy was implemented to guide the program for the subsequent five years (2004-2008). This strategy followed the recently published EPA guidance "Elements of a state water monitoring and assessment program (EPA, 2003)." While the monitoring program already possessed most of the ten elements, the EPA guidance was used as the template for the structure of the strategy document that built upon the 1997 TMDL work plan and incorporated multiple new approaches that together led WDEQ toward a more complete, comprehensive monitoring program that addressed all waters of the State. In 2008, the strategy was amended to include the 2009 field season and to transition into a new strategy that will be implemented in 2010.

The new ten year monitoring strategy (2010-2019) builds upon the successes of the 2004-2008 (and amended 2009) strategy with a new focus on a probabilistic rotating-basin approach. The probabilistic rotating-basin approach will significantly improve the ability of WDEQ to assess all waters in the State of Wyoming using an objective statistically randomized design.

Purpose of the Annual Work Plan

The purpose of the annual work plan is to provide citizens, nonprofit groups, and federal, state, and local agencies background on the Monitoring Program, a list of streams to be sampled, and statewide and regional contact information for Monitoring Program staff.

Designated Uses of Water in Wyoming

Designated uses for waterbodies (Table 1) are those that either currently exist, or have the potential to exist, and are based on their associated surface water classifications as specified in Chapter 1 of Wyoming Water Quality Rules and Regulations (WDEQ 2007).

Table 1 - Designated uses of Wyoming waters as described in Chapter 1 of the Wyoming Water Quality Rules and Regulations (WDEQ 2007).

Designated Use	Description
Agriculture	For purposes of water pollution control, agricultural uses includes irrigation or stock watering.
Fisheries	Fisheries includes water quality, habitat conditions, spawning and nursery areas, and food sources necessary to sustain populations of game and nongame fish.
Industry	Industrial use protection involves maintaining a level of water quality useful for industrial purposes.
Drinking water	Drinking water use involves maintaining a level of water quality that is suitable for potable water or intended to be suitable after receiving conventional treatment.
Recreation	Recreational use protection involves maintaining a level of water quality that is safe for human contact.
Scenic value	Scenic value use involves the aesthetics of the aquatic systems (odor, color, taste, settleable and floating solids, etc.) and not necessarily related to landscape appearance.
Aquatic life other than fish	This use includes water quality and habitat necessary to sustain communities of aquatic life that are not significantly different than the communities expected to occur under minimal human disturbance for that watershed or ecological region.
Wildlife	Wildlife use includes protection of water quality to a level that is safe for contact and consumption by avian and terrestrial wildlife.
Fish Consumption	Fish consumption use involves maintaining a level of water quality that will prevent any unpalatable flavor and/or accumulation of harmful substances in fish tissue.

Designated Use Support

The Monitoring Program gathers both core and supplemental water quality parameters that are used to determine designated use support for Wyoming's streams, rivers, lakes, and

reservoirs. Designated use determinations will indicate whether a waterbody is in compliance with water quality standards and, when appropriate, is comparable to local and/or regional reference conditions. Reference stations represent stream locations that do not necessarily represent pristine water quality or biological conditions, but rather waters that are minimally or least impacted by human activities within a geographic or ecological region, watershed, or area of interest. Reference condition (an aggregation of reference station data) is the baseline against which monitoring data from non-reference streams is compared. Reference conditions represent realistic, attainable expectations for other streams and rivers; therefore a significant departure from reference condition can indicate impairment of designated uses, such as aquatic life.

Annual Work Plan, 2010 Field Season

Objectives

The primary objectives for the 2010 field season are:

- 1) Implement the probabilistic rotating basin survey
- 2) Conduct supplemental targeted monitoring for streams where existing data is not sufficient for a conclusive determination of designated use support
- 3) Continue re-sampling historic reference stations; when possible, identify and sample new reference stations to fill data gaps
- 4) Collect data to support potential future nutrient criteria development
- 5) Sample stations selected with the statewide probabilistic (random) survey design
- 6) Continue sampling as part of the large reservoir monitoring program

Probabilistic rotating basin surveys will serve as the primary method for assessing the current water quality condition of Wyoming's rivers and streams as required by all States under §305(b) of the CWA. Probabilistic rotating basin surveys are based on a stratified random survey design where a total of 50 primary sites are selected on perennial, non-headwater (>1st Strahler order) rivers and streams that are not located in national parks, United States Forest Service wilderness areas and the Wind River Reservation within each superbasin. Superbasins consist of two or more HUC 6 level watersheds that serve as the spatial scale for the probabilistic assessment. The superbasins are further stratified into aggregations of eight digit HUC units or "HUC 8 clusters." This additional stratification results in approximate equal spatial allocation of the 50 primary sites among all HUC 8 clusters within a superbasin. One hundred (100) oversample sites are generated for each superbasin using the same design to be used as replacements when a primary site cannot be sampled. Oversample sites generated for a HUC 8 cluster are only used as replacements for primary sites within the same HUC 8 cluster to maintain representativeness and minimize logistical complexities of sampling. Data from the randomly selected sites are used to make statistical inferences of the water quality condition within each superbasin. The incorporation of the probabilistic rotating basin surveys into the Monitoring Program will enable WDEQ, over time and at various scales, to better estimate statewide water quality condition, as well as determine trends in water quality

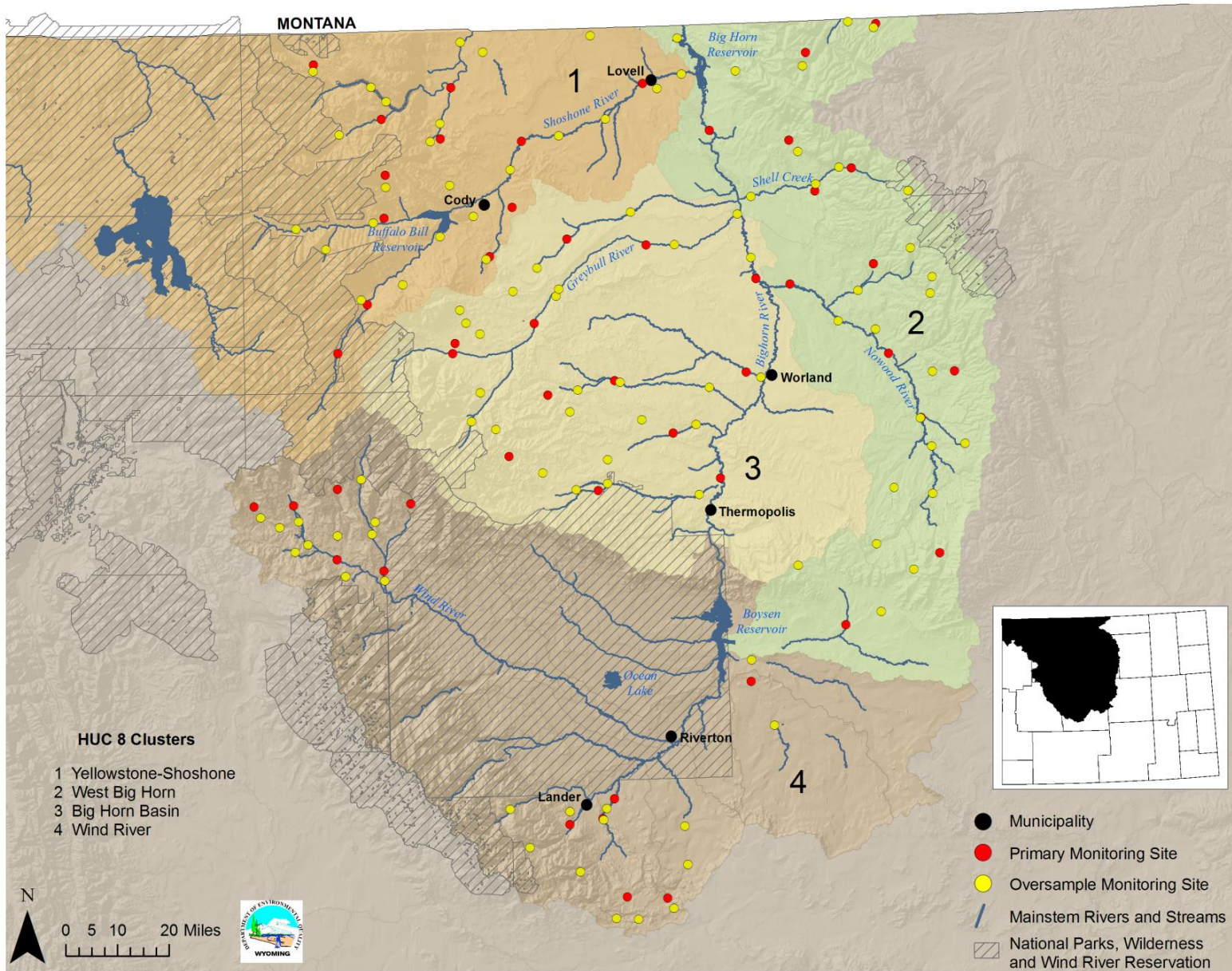
condition. Results from these surveys will also allow WDEQ to identify waters of high quality and those where designated use-support may be limited and are candidates for future targeted monitoring. Waterbodies designated for targeted monitoring will be based on a priority ranking derived from findings of the probabilistic rotating basin survey where results suggest impairments to designated use-support. 2010 marks the first year that probabilistic rotating basin surveys will be implemented by the Monitoring Program starting with sampling of the Bighorn/Yellowstone superbasin (Figure 1). Fifty random sites within the Bighorn/Yellowstone superbasin will be sampled in 2010 followed by analyses of the data in 2011, and targeted monitoring of priority waterbodies in 2012 and 2013.

Since 1998, the Monitoring Program has been implementing targeted monitoring for making designated use-support determinations on over 300 waterbodies that were part of the original monitoring directive set forth in the 1997 TMDL workplan. In many cases, data from the initial monitoring effort was not sufficient to make a determination on the level of designated use support. As of 2010, designated use determinations had or were expected to be made on approximately 65% of the sampled waterbodies. Interim determinations of "inconclusive data" had been made on many of the remaining 35%. Targeted monitoring to determine designated use support for some of the remaining 35% will continue in 2010. A few additional targeted waters that were not part of the original 1997 TMDL workplan directive but have been monitored in the recent past because of ongoing water quality concerns are also scheduled for 2010. All targeted waterbodies scheduled for 2010 were previously monitored in 2009. The additional year of monitoring will help to validate findings from 2009 and prior and provide information on temporal variability. A combination of core and supplemental chemical, physical, and biological parameters will be sampled at each site to provide adequate information for making designated use support determinations on these waterbodies.

Several of the existing WDEQ reference stations have been sampled only once, some of which were sampled over ten years ago. WDEQ will continue to rotate through existing reference stations to determine if they still meet reference criteria and to collect another set of data on each stream. Having multiple data sets from each reference station will assist in gaining a better understanding of conditions at these stations and to help understand how these stations vary in condition over time under relatively natural environmental conditions. This information will make WDEQ better able to formulate more accurate and precise criteria for assessing biological condition of streams. In addition, the current reference station network has gaps in the spatial coverage of Wyoming. Specifically, more reference data is needed in the interior areas of the plains and basin ecoregions. Filling these gaps will help facilitate better determinations of designated use support by helping to establish realistic goals for water quality and biological condition in these ecoregions.

A potential future revision to Wyoming's water quality standards involves development of numeric nutrient criteria (WDEQ 2008b, 2009). The Monitoring Program has and will continue to acquire the data necessary to support development of numeric nutrient criteria for Wyoming. Nutrient and associated response variable data will be collected at all reference and probabilistic sites and select targeted sites. Nutrient data from reference sites are especially important as it defines attainable conditions on which numeric criteria can be based.

Figure 1 – Primary and oversample sites selected for the probabilistic rotating basin survey of the Bighorn/Yellowstone superbasin.



In 2004, the Monitoring Program initiated the first statewide probabilistic survey to assess the current water quality condition of Wyoming's rivers and streams, evaluate trends over time, and to satisfy requirements under §305(b) of the CWA. The design of the statewide probabilistic survey was similar to that described previously for the probabilistic rotating basin survey. The first statewide probabilistic survey resulted in 64 stream sites sampled from 2004 to 2007. A second similar statewide survey was implemented in 2008. 2010 marks the third year of the second statewide probabilistic survey and is expected to conclude in 2011. With implementation of the probabilistic rotating basin survey that achieves the same goal of assessing the quality of the State's waters, statewide probabilistic surveys after 2011 will be suspended indefinitely. However, completion of the second statewide survey is important in that it will provide information on temporal variation in statewide water quality condition between the first statewide survey and implementation of the probabilistic rotating basin surveys. It is anticipated the results from the first and second statewide probabilistic surveys will be incorporated into WDEQ's 305(b)/303(d) Integrated Water Quality Assessment Report in the future.

Lake and reservoir monitoring was originally initiated as part of the original 1997 TMDL workplan directive. The need for additional data for these reservoirs, combined with the CWA directive of assessing all waters led to development of a sampling program for the ten largest reservoirs in the State. The ten largest reservoirs are sampled on a rotation where approximately four are sampled in any given year. Each reservoir is sampled for three consecutive years, followed by three years without sampling. The effort on major reservoirs will focus on identifying trends in water quality over time using various indicators. The four reservoirs scheduled for monitoring in 2010 are either beginning or into their second three-year monitoring periods.

Stream and Reservoir Sampling

The 2010 monitoring schedule is shown in Appendices 1 - 7. Hydrologic Unit Codes (HUCs) can be cross-referenced with Figure 2 to show locations of the watersheds. WDEQ regional offices in Cheyenne, Sheridan, and Lander will have sampling crews in the field in 2010. Contact information is shown below:

Statewide: Jeremy Zumberge, Monitoring Supervisor, Wyoming Dept. of Environmental Quality, Water Quality Division, 1866 S. Sheridan Ave, Sheridan, WY 82801, phone: 307-673-9337, email jzumbe@wyo.gov

Cheyenne region: Lanny Goyn or Eric Hargett, Wyoming Department of Environmental Quality, Water Quality Division, Herschler Bldg, 122 West 25th Street, Cheyenne, WY 82001, phone: 307-777-7781, email: lgoyn@wyo.gov or eharge@wyo.gov

Lander region: Tavis Eddy or Chad Rieger, Wyoming Department of Environmental Quality, Water Quality Division, 510 Meadowview Drive, Lander, WY 82520, ph. 307-332-3144, email: teddy@wyo.gov or criege@wyo.gov

Sheridan region: Jason Martineau or Lindsay Patterson, Wyoming Department of Environmental Quality, Water Quality Division, 1866 S. Sheridan Ave, Sheridan, WY 82801, Ph. 307-673-9337, email: jmarti5@wyo.gov or lpatte@wyo.gov

Crews will typically sample arid, lowland areas early in the season, followed by high elevation streams, foothill streams, and finally larger, lowland streams or rivers. The plan is to sample each stream during what is considered summer low flow conditions, while at the same time avoiding potential early snows at high elevations, and dry streams in more arid areas during late summer and early fall. Appendices 1 through 5 contain a list of waterbodies scheduled for sampling during the 2010 field season, including the regional office to which it is assigned, and the assessment category within which it falls. In all cases, access to sites on private land is contingent upon receiving landowner permission.

Appendix 1 - Reservoirs.

Appendix 2 - Previously monitored targeted waters, however, there remains insufficient data to make conclusive designated use-support determinations.

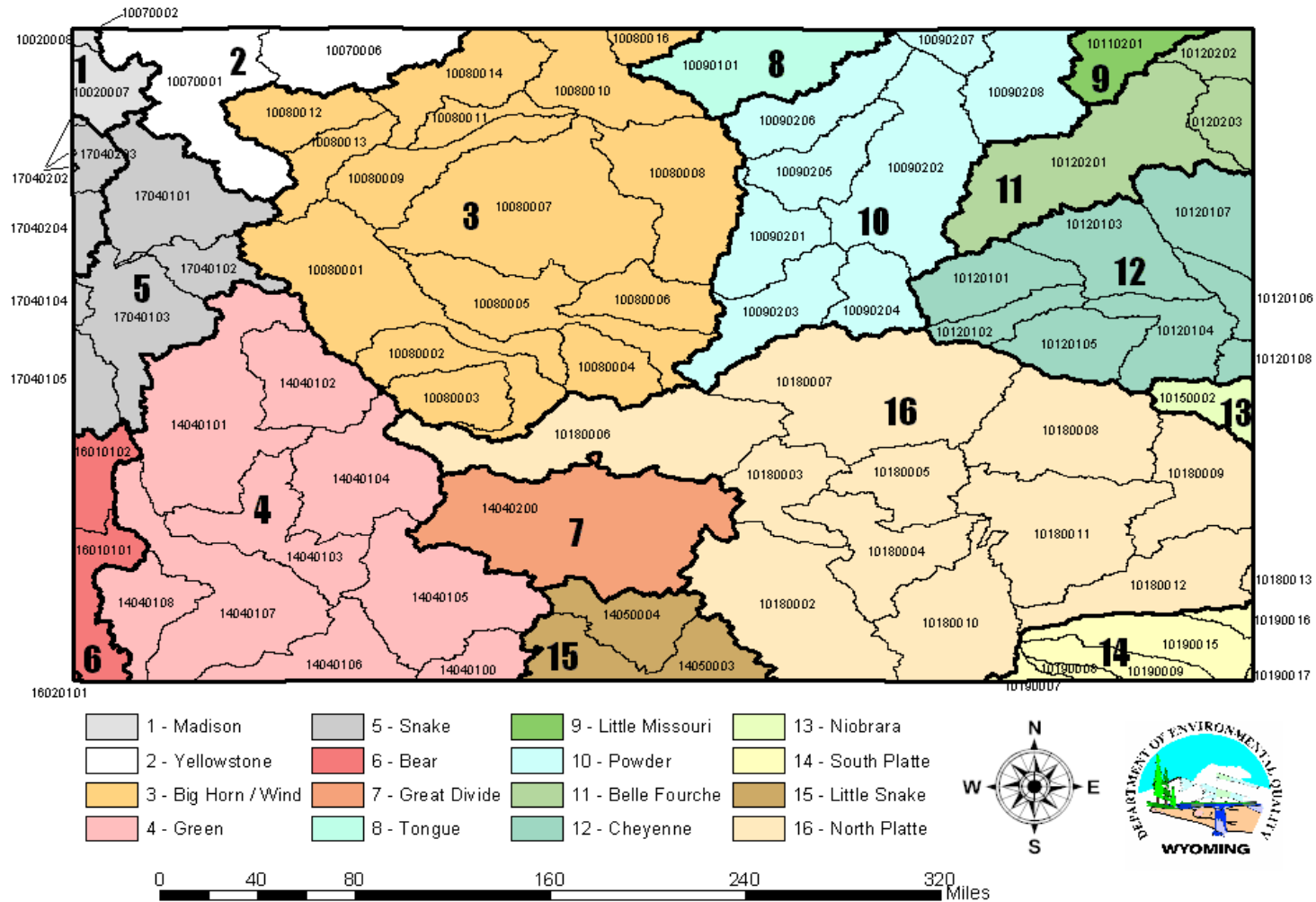
Appendix 3 - Existing or candidate reference streams. Reference streams represent the minimal or least-impacted condition for an ecological region or area of interest. Reference stream data are used as benchmarks against which non-reference stream condition is compared.

Appendix 4 - Sites selected for the probabilistic rotating basin survey in the Bighorn/Yellowstone superbasin. The list includes the 50 primary sites in addition to oversample sites used as substitutes when primary sites cannot be sampled. A total of 50 sites will be sampled in 2010. Sites on private land are contingent on receiving landowner permission.

Appendix 5 - Sites selected for the second statewide probabilistic survey. The list includes the remaining sites that can be sampled for the statewide survey. Approximately 11 sites will be sampled in 2010. Sites on private land are contingent on receiving landowner permission.

Figure 2 – Hydrologic basins of Wyoming.

HYDROLOGIC BASINS OF WYOMING



Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) procedures are a critical aspect of the WDEQ Monitoring Program. QA/QC affects the use, repeatability, and validation of monitoring data. QA/QC is involved in all aspects of the Monitoring Program, including:

- education and training of monitoring program field staff;
- sample collection and analysis;
- field audits
- data entry, management, and analysis;
- application, interpretation, and reporting of the data.

The Monitoring Program quality assurance plan (WDEQ 2001) can be obtained at: <http://deq.state.wy.us/wqd/watershed/Downloads/QA/10573-doc.pdf>.

Other WDEQ-Supported Monitoring Projects

USGS “Ambient” Fixed Station Water Quality Monitoring Network

WDEQ cooperates with the United States Geological Survey (USGS) to sample 19 locations across the state (Appendix 6). Sampling is generally conducted four times per year on a quarterly basis. Specific sampled parameters vary by site depending on objectives, but include field parameters, major ions, trace metals, nutrients, sediment, and/or bacteria. Sample locations are chosen for a variety of reasons, including monitoring of currently impaired waters, waters associated with Wyoming Pollutant Discharge Elimination System (WYPDES) permits, or trends in large river system water quality.

USGS “CBM” Fixed Station Water Quality Monitoring Network

WDEQ also contracts with the USGS to sample 43 locations in regions where coal-bed methane (CBM) development is present, most of which are in northeast Wyoming (Appendix 7). This project monitors water quality in areas affected by CBM development to determine trends and patterns, establish baseline data in areas that have received minimal or no CBM development, and to determine compliance with existing water quality standards and WYPDES permit conditions.

Coal Bed Natural Gas – Interagency Work Group Monitoring in NE Wyoming

The Powder River Basin Interagency Working Group (PRB IWG) was established as the forum for government agencies to address and discuss issues of common concern to all parties involved in permitting and monitoring of CBM development. Attention will also be given to issues that may result in cross-border effects requiring close coordination among the State and Federal agencies in Montana and Wyoming, and with Tribal governments. Through this

cooperative management effort, each agency will achieve greater operational efficiency, enhanced resource protection and will better serve the public.

To address one of the components of the PRBIWG mission, task groups were formed to address monitoring of natural resources potentially affected by CBM development (water quality and quantity, aquatic life, wildlife, and air). WDEQ employees are members of the water quality task group (WTG) and aquatic life monitoring task group (ATG). Both the WTG and ATG have developed monitoring plans for the affected areas of northeast Wyoming. The monitoring plans can be found through the following two links:

<http://www.wy.blm.gov/bfo/prbgroup/04minutes/surfacewatermonitoring06-16.pdf>.

<http://www.wy.blm.gov/prbgroup/docs/aquatics>

The USGS has been contracted to do most of the water quality and aquatic life monitoring in northeast Wyoming. A USGS web site and Fact Sheet describing the ATG monitoring plan can be found at <http://wy.water.usgs.gov/projects/atg/index.htm>. The USGS recently completed a report (Peterson et al. 2009) that describes findings from the 2005 and 2006 data collections that is available at <http://pubs.usgs.gov/sir/2009/5023/>. Many of the sites shown in Appendix 7 are part of the water quality task group monitoring plan. A Fact Sheet describing the WTG monitoring plan can be found at <http://pubs.water.usgs.gov/fs2005-3137>.

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WDEQ. 2008b. Wyoming nutrient criteria development plan. Wyoming Department of Environmental Quality, Water Quality Division, Cheyenne, Wyoming.

WDEQ. 2009. Wyoming nutrient criteria sampling and analysis plan. Wyoming Department of Environmental Quality, Water Quality Division, Cheyenne, Wyoming.

Appendix
2010 Monitoring Schedule

Appendix 1 – Reservoirs

Basin	Reservoir Name	HUC	Crew
Belle Fourche	Keyhole Reservoir	10120201	Sheridan
Bighorn	Boysen Reservoir	10080005	Sheridan/Lander
North Platte	Glendo Reservoir	10080014	Sheridan/Cheyenne
Green	Fontenelle Reservoir	14040101	Sheridan/Lander

Appendix 2 – Targeted waters

Basin	Stream	HUC	Crew
North Platte	Laramie River	10180010	Cheyenne
North Platte	Rock Creek	10180004	Cheyenne
Snake	Crow Creek	17040105	Lander
Green	Brooks Lake	10080001	Lander

Appendix 3 – Reference stations

Basin	Stream Name	HUC	Crew
North Platte	Bear Creek – Below Little Bear Creek (WHP21)	10180012	Cheyenne
North Platte	Fox Creek (new)	10180012	Cheyenne
North Platte	Bates Creek (SR25)	10180007	Cheyenne
North Platte	Medicine Bow River (SR6)	10180004	Cheyenne

Appendix 4 – Rotating Basin Probability Survey- Bighorn Yellowstone superbasin.

Survey ID	Stream	Type	Longitude	Latitude	HUC 8 Cluster	Crew
WY09C-101	Bighorn River	Base	-108.161431	43.736912	Big Horn Basin	Lander
WY09C-102	Middle Creek	Base	-108.821802	43.982444	Big Horn Basin	Lander
WY09C-103	Fifteenmile Creek	Base	-108.048414	44.029487	Big Horn Basin	Lander
WY09C-104	Unnamed Trib. to Greybull River	Base	-109.177400	44.132628	Big Horn Basin	Lander
WY09C-105	South Fork Owl Creek	Base	-108.635847	43.713518	Big Horn Basin	Lander
WY09C-106	Dobie Creek	Base	-107.996188	44.288785	Big Horn Basin	Lander
WY09C-107	South Fork Cottonwood Creek	Base	-108.978106	43.814861	Big Horn Basin	Lander
WY09C-108	Greybull River	Base	-108.867031	44.182471	Big Horn Basin	Lander
WY09C-109	Francs Fork	Base	-109.186673	44.104858	Big Horn Basin	Lander
WY09C-110	Dry Creek	Base	-108.730348	44.415675	Big Horn Basin	Lander
WY09C-111	Gooseberry Creek	Base	-108.560142	44.017263	Big Horn Basin	Lander
WY09C-112	Cottonwood Creek	Base	-108.338402	43.866320	Big Horn Basin	Lander
WY09C-113	Greybull River	Base	-108.421670	44.392429	Big Horn Basin	Lander
WY09C-114	Bridger Creek	Base	-107.699736	43.316557	West Big Horn	Sheridan
WY09C-115	Trapper Creek	Base	-107.752969	44.525984	West Big Horn	Sheridan
WY09C-116	Medicine Lodge Creek	Base	-107.535615	44.316854	West Big Horn	Sheridan
WY09C-117	Deep Creek	Base	-107.326231	43.505206	West Big Horn	Sheridan
WY09C-118	Beaver Creek	Base	-107.847387	44.669588	West Big Horn	Sheridan
WY09C-119	Canyon Creek	Base	-107.237977	44.009348	West Big Horn	Sheridan
WY09C-120	Otter Creek	Base	-107.375753	43.883961	West Big Horn	Sheridan
WY09C-121	Nowood River	Base	-107.864201	44.269216	West Big Horn	Sheridan
WY09C-122	Nowood River	Base	-107.492210	44.066120	West Big Horn	Sheridan
WY09C-123	Shell Creek	Base	-107.606686	44.585912	West Big Horn	Sheridan
WY09C-124	Bighorn River	Base	-108.159250	44.705297	West Big Horn	Sheridan
WY09C-125	Mann Creek	Base	-107.767889	44.911798	West Big Horn	Sheridan
WY09C-126	West Pass Creek	Base	-107.486115	44.983660	West Big Horn	Sheridan
WY09C-127	East Fork Wind River	Base	-109.362503	43.688372	Wind River	Lander
WY09C-128	Du Noir Creek	Base	-109.815131	43.688380	Wind River	Lander
WY09C-129	Beaver Creek	Base	-108.415310	42.572456	Wind River	Lander

WY09C-130	Sheep Creek	Base	-108.779707	42.785754	Wind River	Lander
WY09C-131	Horse Creek	Base	-109.644449	43.732635	Wind River	Lander
WY09C-132	Wind River	Base	-109.650452	43.536371	Wind River	Lander
WY09C-133	Little Popo Agie River	Base	-108.606355	42.853425	Wind River	Lander
WY09C-134	Little Popo Agie River	Base	-108.653127	42.799499	Wind River	Lander
WY09C-135	Wind River	Base	-109.968410	43.687014	Wind River	Lander
WY09C-136	East Fork Wind River	Base	-109.470656	43.502491	Wind River	Lander
WY09C-137	Muskrat Creek	Base	-108.070671	43.168028	Wind River	Lander
WY09C-138	Twin Creek	Base	-108.567827	42.579538	Wind River	Lander
WY09C-139	Clarks Fork Yellowstone River	Base	-109.712346	44.915679	Yellowstone Shoshone	Sheridan
WY09C-140	South Fork Shoshone River	Base	-109.516768	44.245293	Yellowstone Shoshone	Sheridan
WY09C-141	Skull Creek	Base	-109.216835	44.703456	Yellowstone Shoshone	Sheridan
WY09C-142	Sage Creek	Base	-109.033830	44.371760	Yellowstone Shoshone	Sheridan
WY09C-143	Sunlight Creek	Base	-109.447772	44.760662	Yellowstone Shoshone	Sheridan
WY09C-144	Dunn Creek	Base	-109.445345	44.484721	Yellowstone Shoshone	Sheridan
WY09C-145	Shoshone River	Base	-108.898048	44.691285	Yellowstone Shoshone	Sheridan
WY09C-146	Shoshone River	Base	-108.415766	44.842635	Yellowstone Shoshone	Sheridan
WY09C-147	Fly Creek	Base	-109.437661	44.604829	Yellowstone Shoshone	Sheridan
WY09C-148	Pat O'Hara Creek	Base	-109.171367	44.845013	Yellowstone Shoshone	Sheridan
WY09C-149	Unnamed tributary	Base	-108.942350	44.507964	Yellowstone Shoshone	Sheridan
WY09C-150	South Fork Shoshone River	Base	-109.634586	44.110964	Yellowstone Shoshone	Sheridan
WY09C-401	Dry Creek	O/S	-108.478236	44.484909	Big Horn Basin	
WY09C-402	Gooseberry Creek	O/S	-108.703751	43.994633	Big Horn Basin	
WY09C-403	Unnamed tributary	O/S	-108.778516	44.256910	Big Horn Basin	
WY09C-404	Spring Creek	O/S	-109.155425	44.224542	Big Horn Basin	
WY09C-405	Greybull River	O/S	-108.060755	44.470020	Big Horn Basin	
WY09C-406	Fifteenmile Creek	O/S	-107.991150	44.013281	Big Horn Basin	
WY09C-407	Bighorn River	O/S	-108.014234	44.348082	Big Horn Basin	
WY09C-408	Rawhide Creek	O/S	-109.079569	44.157386	Big Horn Basin	
WY09C-409	Grass Creek	O/S	-108.459915	43.905995	Big Horn Basin	
WY09C-410	Gooseberry Creek	O/S	-108.192550	43.991125	Big Horn Basin	

WY09C-411	North Fork Owl Creek	O/S	-108.598547	43.731697	Big Horn Basin	
WY09C-412	Little Rawhide Creek	O/S	-109.133167	44.188221	Big Horn Basin	
WY09C-413	Cottonwood Creek	O/S	-108.596469	43.798106	Big Horn Basin	
WY09C-414	Greybull River	O/S	-108.767756	44.277173	Big Horn Basin	
WY09C-415	Owl Creek	O/S	-108.246597	43.692952	Big Horn Basin	
WY09C-416	Middle Gooseberry Creek	O/S	-109.027066	43.890749	Big Horn Basin	
WY09C-417	Greybull River	O/S	-108.310392	44.390957	Big Horn Basin	
WY09C-418	North Fork Owl Creek	O/S	-108.720784	43.716840	Big Horn Basin	
WY09C-419	Cottonwood Creek	O/S	-108.248863	43.888606	Big Horn Basin	
WY09C-420	South Fork Wood River	O/S	-109.120189	43.913422	Big Horn Basin	
WY09C-421	Grass Creek	O/S	-108.736700	43.934329	Big Horn Basin	
WY09C-422	Cottonwood Creek	O/S	-108.848279	43.766645	Big Horn Basin	
WY09C-423	Gooseberry Creek	O/S	-108.539302	44.012689	Big Horn Basin	
WY09C-424	South Fork Dry Creek	O/S	-108.947488	44.274051	Big Horn Basin	
WY09C-425	Dry Creek	O/S	-108.850041	44.337672	Big Horn Basin	
WY09C-426	Dick Creek	O/S	-109.083103	43.993295	Big Horn Basin	
WY09C-427	Duncum Creek	O/S	-107.782302	44.875440	West Big Horn	
WY09C-428	Shell Creek	O/S	-108.005382	44.517524	West Big Horn	
WY09C-429	Buffalo Creek	O/S	-107.538645	44.134624	West Big Horn	
WY09C-430	Otter Creek	O/S	-107.378323	43.882758	West Big Horn	
WY09C-431	West Pass Creek	O/S	-107.495768	44.973555	West Big Horn	
WY09C-432	Crooked Creek	O/S	-108.273638	44.964961	West Big Horn	
WY09C-433	Canyon Creek	O/S	-107.324408	44.010615	West Big Horn	
WY09C-434	Trout Creek	O/S	-107.429248	43.462862	West Big Horn	
WY09C-435	Adelaide Creek	O/S	-107.388089	44.515491	West Big Horn	
WY09C-436	Red Canyon Creek	O/S	-107.596089	44.992541	West Big Horn	
WY09C-437	Buffalo Creek	O/S	-107.492884	43.692322	West Big Horn	
WY09C-438	Badwater Creek	O/S	-107.561156	43.349262	West Big Horn	
WY09C-439	Cottonwood Creek	O/S	-108.047658	44.868248	West Big Horn	
WY09C-440	Paint Rock Creek	O/S	-107.600987	44.244820	West Big Horn	
WY09C-441	Bates Creek	O/S	-107.569296	43.537504	West Big Horn	
WY09C-442	South Paint Rock Creek	O/S	-107.319445	44.228831	West Big Horn	

WY09C-443	Shell Creek	O/S	-107.655974	44.589702	West Big Horn	
WY09C-444	Nowood River	O/S	-107.344144	43.670941	West Big Horn	
WY09C-445	Nowood River	O/S	-107.681968	44.162402	West Big Horn	
WY09C-446	Buckskin Ed Creek	O/S	-107.310028	44.273721	West Big Horn	
WY09C-447	Shell Creek	O/S	-107.748762	44.545313	West Big Horn	
WY09C-448	Nowood River	O/S	-107.340467	43.803143	West Big Horn	
WY09C-449	Red Canyon Creek	O/S	-107.813884	44.637905	West Big Horn	
WY09C-450	West Bridger Creek	O/S	-107.874308	43.486824	West Big Horn	
WY09C-451	Trout Creek	O/S	-107.389639	44.356732	West Big Horn	
WY09C-452	South Fork Otter Creek	O/S	-107.210967	43.806259	West Big Horn	
WY09C-453	Wiggins Fork	O/S	-109.552148	43.758949	Wind River	
WY09C-454	Warm Spring Creek	O/S	-109.811606	43.558860	Wind River	
WY09C-455	Little Popo Agie River	O/S	-108.744559	42.652485	Wind River	
WY09C-456	Little Popo Agie River	O/S	-108.637701	42.826956	Wind River	
WY09C-457	Bear Creek	O/S	-109.500710	43.639079	Wind River	
WY09C-458	Wiggins Fork	O/S	-109.514570	43.605651	Wind River	
WY09C-459	Beaver Creek	O/S	-108.612463	42.520314	Wind River	
WY09C-460	Beaver Creek	O/S	-108.528298	42.516999	Wind River	
WY09C-461	Little Horse Creek	O/S	-109.647148	43.603416	Wind River	
WY09C-462	Jakeys Fork	O/S	-109.618189	43.489427	Wind River	
WY09C-463	Little Popo Agie River	O/S	-108.649600	42.795867	Wind River	
WY09C-464	Beaver Creek	O/S	-108.393639	42.543752	Wind River	
WY09C-465	Wind River	O/S	-109.944080	43.655989	Wind River	
WY09C-466	Wind River	O/S	-109.762323	43.578981	Wind River	
WY09C-467	Middle Popo Agie River	O/S	-108.934118	42.723508	Wind River	
WY09C-468	Poison Creek	O/S	-108.065649	43.227800	Wind River	
WY09C-469	Du Noir Creek	O/S	-109.796275	43.643885	Wind River	
WY09C-470	East Fork Wind River	O/S	-109.467534	43.475107	Wind River	
WY09C-471	Squaw Creek	O/S	-108.778476	42.820979	Wind River	
WY09C-472	Beaver Creek	O/S	-108.334137	42.664816	Wind River	
WY09C-473	Wind River	O/S	-109.870119	43.628939	Wind River	

WY09C-474	North Popo Agie River	O/S	-109.005045	42.831642	Wind River	
WY09C-475	Beaver Creek	O/S	-108.342111	42.771919	Wind River	
WY09C-476	Muskrat Creek	O/S	-107.987406	43.043926	Wind River	
WY09C-477	Sage Creek	O/S	-108.616447	44.979736	Yellowstone Shoshone	
WY09C-478	Shoshone River	O/S	-108.750830	44.703561	Yellowstone Shoshone	
WY09C-479	Trout Creek	O/S	-109.435823	44.571367	Yellowstone Shoshone	
WY09C-480	Rock Creek	O/S	-109.377083	44.299220	Yellowstone Shoshone	
WY09C-481	Whistle Creek	O/S	-108.566682	44.746433	Yellowstone Shoshone	
WY09C-482	Shoshone River	O/S	-108.945678	44.612284	Yellowstone Shoshone	
WY09C-483	Little Sunlight Creek	O/S	-109.615096	44.719926	Yellowstone Shoshone	
WY09C-484	Elk Fork	O/S	-109.675102	44.400447	Yellowstone Shoshone	
WY09C-485	Shoshone River	O/S	-108.261751	44.865396	Yellowstone Shoshone	
WY09C-486	Trail Creek	O/S	-109.184510	44.572446	Yellowstone Shoshone	
WY09C-487	Clarks Fork Yellowstone River	O/S	-109.427909	44.809202	Yellowstone Shoshone	
WY09C-488	Marquette Creek	O/S	-109.226492	44.430809	Yellowstone Shoshone	
WY09C-489	Blaine Creek	O/S	-109.218352	44.745414	Yellowstone Shoshone	
WY09C-490	Sage Creek	O/S	-109.048590	44.364679	Yellowstone Shoshone	
WY09C-491	Gunbarrel Creek	O/S	-109.791374	44.458983	Yellowstone Shoshone	
WY09C-492	Squaw Creek	O/S	-109.714591	44.897038	Yellowstone Shoshone	
WY09C-493	Sand Draw	O/S	-108.359350	44.826515	Yellowstone Shoshone	
WY09C-494	Sulphur Creek	O/S	-109.094506	44.485776	Yellowstone Shoshone	
WY09C-495	Clarks Fork Yellowstone River	O/S	-109.486478	44.850969	Yellowstone Shoshone	
WY09C-496	North Fork Shoshone River	O/S	-109.487993	44.472296	Yellowstone Shoshone	
WY09C-497	Unnamed tributary	O/S	-109.042152	44.941573	Yellowstone Shoshone	
WY09C-498	Pat O'Hara Creek	O/S	-109.257974	44.696458	Yellowstone Shoshone	
WY09C-499	Ishawooa Creek	O/S	-109.540847	44.258428	Yellowstone Shoshone	
WY09C-500	Clarks Fork Yellowstone River	O/S	-109.130682	44.970601	Yellowstone Shoshone	

Appendix 5 – Statewide probabilistic (random) survey stations

Survey ID	Stream	Type	Longitude	Latitude	HUC	Crew
WYS08706-047	Horseshoe Creek	Oversample	-105.203903	42.425864	10180008	Cheyenne
WYS08706-051	Laramie River	Oversample	-105.701731	41.716625	10180010	Cheyenne
WYS08706-053	Trout Creek	Oversample	-109.487552	44.579807	10080012	Sheridan
WYS08706-054	West Fork Big Goose Creek	Oversample	-107.280378	44.630844	10090101	Sheridan
WYS08706-055	North Platte River	Oversample	-106.532412	42.736710	10180007	Cheyenne
WYS08706-056	Green River	Oversample	-109.979710	41.970835	14040103	Lander
WYS08706-058	Savery Creek	Oversample	-107.412644	41.048978	14050003	Cheyenne
WYS08706-059	Deer Creek	Oversample	-106.030575	42.567193	10180007	Cheyenne
WYS08706-060	Antelope Creek	Oversample	-110.921616	41.901074	16010101	Lander
WYS08706-061	Little Bighorn River	Oversample	-107.678582	44.945405	10080016	Sheridan
WYS08706-062	North Platte River	Oversample	-106.551483	41.213843	10180002	Cheyenne
WYS08706-063	Smiths Fork	Oversample	-110.202397	41.378328	14040107	Lander
WYS08706-064	Sand Creek	Oversample	-104.109424	44.493341	10120203	Sheridan
WYS08706-065	Hoback River	Oversample	-110.705326	43.318890	17040103	Lander
WYS08706-066	Little Missouri River	Oversample	-104.890992	44.792823	10110201	Sheridan
WYS08706-067	Laramie River	Oversample	-105.610847	41.294987	10180010	Cheyenne
WYS08706-068	Henrys Fork	Oversample	-109.667273	41.004119	14040106	Lander
WYS08706-069	North Fork Fish Creek	Oversample	-110.099194	43.694133	17040102	Lander
WYS08706-070	Middle Fork Powder River	Oversample	-107.060100	43.585971	10090201	Sheridan
WYS08706-071	Bates Creek	Oversample	-106.437348	42.632715	10180007	Cheyenne
WYS08706-072	North Piney Creek	Oversample	-110.177840	42.597411	14040101	Lander
WYS08706-073	Meeteetse Creek	Oversample	-109.229070	44.259028	10080009	Lander
WYS08706-074	Shell Creek	Oversample	-107.968780	44.527543	10080010	Sheridan
WYS08706-075	Duck Creek	Oversample	-105.448529	42.008485	10180011	Cheyenne
WYS08706-076	Salt River	Oversample	-110.976681	42.722259	17040105	Lander
WYS08706-077	North Alkali Creek	Oversample	-108.876094	44.738827	10080014	Sheridan
WYS08706-078	Pass Creek	Oversample	-106.565721	41.581972	10180002	Cheyenne
WYS08706-079	Little Cow Creek	Oversample	-104.847034	43.247410	10120104	Cheyenne
WYS08706-080	Belle Fourche River	Oversample	-104.383293	44.899152	10120202	Sheridan

WYS08706-081	Fall River	Oversample	-111.034019	44.118191	17040203	Lander
WYS08706-082	Miller Creek	Oversample	-104.636791	44.482015	10120201	Sheridan
WYS08706-083	South Chugwater Creek	Oversample	-105.409458	41.513677	10180011	Cheyenne
WYS08706-084	Killpecker Creek	Oversample	-110.246300	42.807128	14040101	Lander
WYS08706-085	Elk Fork	Oversample	-109.633591	44.456531	10080012	Sheridan
WYS08706-086	Gloom Creek	Oversample	-107.322537	44.720173	10090101	Sheridan
WYS08706-087	Conant Creek	Oversample	-108.060349	42.832451	10080004	Lander
WYS08706-088	La Barge Creek	Oversample	-110.561522	42.407272	14040101	Lander
WYS08706-089	Buffalo Fork	Oversample	-110.405106	43.838724	17040101	Lander
WYS08706-090	Muddy Creek	Oversample	-107.439772	41.434298	14050004	Cheyenne
WYS08706-091	Elkhorn Creek	Oversample	-106.283109	42.808101	10180007	Cheyenne
WYS08706-092	Muddy Creek	Oversample	-110.552827	41.929546	14040107	Lander
WYS08706-093	Crazy Woman Creek	Oversample	-106.429236	44.254465	10090205	Sheridan
WYS08706-094	Spring Creek	Oversample	-106.476814	41.078231	10180002	Cheyenne
WYS08706-095	Blacks Fork	Oversample	-110.568902	41.065300	14040107	Lander
WYS08706-096	East Mule Creek	Oversample	-104.163370	43.288092	10120106	Cheyenne
WYS08706-098	Antelope Creek	Oversample	-105.364128	43.482992	10120101	Cheyenne
WYS08706-099	Canyon Creek	Oversample	-105.021437	41.741456	10180011	Cheyenne
WYS08706-100	Salt Wells Creek	Oversample	-108.936207	41.409542	14040105	Lander

Appendix 6 – WDEQ/USGS Non-CBM Fixed Station Monitoring Network for 2010

USGS Station Number	Station Name	Constituents	Frequency	Basis
06259000	Wind River below Boysen Reservoir	Field, CBM, nutrients	12/yr	monthly
06264700	Bighorn River at Lucerne	Field, Bacteria, Nutrients, Sediment	4/yr	quarterly
06274300	Bighorn River at Basin	Field, Bacteria, Nutrients, Sediment	4/yr	quarterly
06276500	Greybull River near Meeteetse	Field, Bacteria, Nutrients, Sediment	4/yr	quarterly
06279500	Bighorn River at Kane	Field, Bacteria, Nutrients, Sediment	4/yr	quarterly
06284500	Bitter Creek near Garland	Field, Bacteria, Nutrients	4/yr	quarterly
06285100	Shoshone River at Lovell	Field, Bacteria, Nutrients, Sediment	4/yr	quarterly
06630000	North Platte River above Seminoe, near Sinclair	Field, Bacteria, Nutrients, Sediment	4/yr	quarterly
06639000	Sweetwater River near Alcova	Field, Common Ions, Nutrients, Sediment	4/yr	quarterly
06645000	North Platte River below Casper	Field, Bacteria, Nutrients, Common Ions, Trace metals	4/yr	quarterly
06652000	North Platte River near Orin	Field, Bacteria, Nutrients, Sediment	4/yr	quarterly
06659050	Wheatland Creek below Wheatland	Field, Bacteria, Nutrients	4/yr	quarterly
06670500	Laramie River at Fort Laramie	Field, Bacteria, Nutrients, Sediment	4/yr	quarterly
06674500	North Platte River at WY-NE State line	Field, Bacteria, Nutrients, Sediment	4/yr	quarterly
06756060	Crow Creek near Archer	Field, Bacteria, Nutrients, Major ions, Trace metals	4/yr	quarterly
09209400	Green River nr La Barge	Field, CBM, Nutrients, Sediment	4/yr	quarterly
09224050	Hams Fork River near Diamondville	Field, Bacteria, Nutrients, Sediment	4/yr	quarterly
09224700	Blacks Fork nr Little America	Field, Bacteria, Nutrients, Sediment	4/yr	quarterly
09259050	Little Snake River below Baggs	Field, Common ions, Sediment	4/yr	hydrograph

Appendix 7– WDEQ/USGS CBM Fixed Station Monitoring Network for 2010

Station	Name	Code	Freq
06299980	Tongue R at Monarch	CBM	12/yr
06304500	Little Goose Cr at Sheridan	CBM	12/yr
06305500	Goose Cr bel Sheridan	CBM	12/yr
06306020	Tongue R bel Youngs Cr nr Acme	CBM, FIL Se, FIL Hg	12/yr
06306200	Prairie Dog Cr at Wakely Siding nr Sheridan	CBM	24/yr
06306250	Prairie Dog Cr nr Acme	CBM	24/yr
06313400	Salt Cr nr Sussex	CBM and FIL Se	12/yr
06313500	Powder R at Sussex	CBM and FIL Se	24/yr
06313605	Powder R bel Burger Draw nr Buffalo	CBM	12/yr
06316400	Crazy Woman Cr at Upper Station nr Arvada	CBM Sediment	24/yr
06317000	Powder R at Arvada	CBM Nutrients	24/yr
06320210	Clear Cr ab Kumor Draw nr Buffalo	CBM	12/yr
06324000	Clear Cr nr Arvada	CBM	24/yr
06324970	Little Powder R ab Dry Cr nr Weston	CBM Nutrients	12/yr
06369500	Cheyenne R nr Dull Center	CBM	12/yr
06386500	Cheyenne R nr Spencer	CBM	12/yr
06425900	Caballo Cr at mouth nr Piney	CBM Nutrients	12/yr
06426400	Donkey Cr nr Moorcroft	CBM	12/yr
06426500	Belle Fourche R bel Moorcroft	CBM Nutrients	12/yr
06428050	Belle Fourche R bel Hulett	CBM	12/yr
06635000	Medicine Bow R ab Seminole Res nr Hanna	CBM Nutrients Sediment	12/yr
06636000	N Platte R ab Pathfinder Res	CBM Sediment	12/yr
09258980	Muddy Cr bel Young Draw nr Baggs	CBM Sediment	12/yr
06313590	Powder R ab Burger Draw nr Buffalo	CBM	12/yr
06313540	Willow Cr nr mouth nr Sussex	Cations	12/yr
06313560	Pumpkin Cr nr mouth nr Sussex	Cations	12/yr
06313585	Beaver Cr at mouth nr Sussex	Cations	12/yr
06313604	Burger Draw at mouth nr Buffalo	Cations	12/yr
06313633	Van Houten Draw at mouth nr Buffalo	Cations	12/yr
06313750	Barber Cr at mouth nr Buffalo	Cations	12/yr
06316900	Cottonwood Cr at mouth nr Arvada	Cations	12/yr
06317030	Wild Horse Cr at mouth at Arvada	Cations	12/yr
06317095	Spotted Horse Cr at mouth nr Arvada	Cations	12/yr
06317100	Powder R ab Clear Cr nr Arvada	Cations	12/yr
06323550	Clear Cr ab Double Crossing Cr nr Clearmont	Cations	12/yr
06324200	L X Bar Cr at mouth nr Moorhead MT	Cations	12/yr
06324300	S A Cr at mouth nr Moorhead MT	Cations	12/yr
06324785	Dry Fk Little Powder R at mouth nr Gillette	Cations	12/yr
06324870	Rawhide Cr at mouth nr Gillette	Cations	12/yr
06324940	Horse Cr at mouth nr Weston	Cations	12/yr
06324950	Little Powder R bel Elk Cr nr Weston	Cations	12/yr
06324965	Olmstead Cr at mouth nr Weston	Cations	12/yr
06425720	Belle Fourche R bel Rattlesnake Cr nr Piney	Cations	12/yr

1. CBM parameters: common ions, select filtered trace metals, arsenic