PROJECT PROPOSAL

Assessment of Aquatic Communities in Northeastern Wyoming and Southeastern Montana

Environmental Problem Description: Interest in aquatic communities of streams in northeastern Wyoming is largely driven by coalbed natural gas (CBNG) development, but oil and gas development and coal mining also occur. More than 10,000 CBNG wells have been drilled in northeastern Wyoming as of 2004, primarily in the Powder River and Tongue River basins. Up to 40,000 CBNG wells are expected at the peak of development, in areas including the Cheyenne River and Belle Fourche River basins. Southeastern Montana also has been identified as an area of current and future CBNG production. Development of the resource has accelerated at a rapid pace in Wyoming, precluding the possibility of designing a regional monitoring plan that would have been useful to establish a baseline of pre-CBNG development conditions. Although it is too late to establish a true baseline, the data collection identified in this proposal still will be of value in light of the increased activity planned for future years.

A common theme to the development is discharge of ground water that: (1) often is too saline or otherwise unsuitable to use for crop irrigation, and (2) has unknown effects to the aquatic communities inhabiting streams that receive the water. Discharge to the streams occurs through pumping to perennial streams and intermittent and ephemeral streams that discharge to perennial streams, and in the long-term, discharge of ground water from seepage under surface impoundments of discharge water.

Goals of the Project: The goals are to: (1) assess condition of algal, invertebrate, and fish communities and habitat conditions in streams of northeastern Wyoming and southeastern Montana; (2) compare invertebrate and algal communities in 2005 to historical data; and (3) publish results of the study in a manner useful to regulatory agencies, resource managers, industry, citizen groups, and individuals.

Approach: This proposal was prepared as a complement to the biological monitoring plan prepared by the Aquatic Task Group (ATG) in June 2004. Funding for sampling under the ATG plan has been requested to begin in 2006 (Larry Gerard, Bureau of Land Management, written commun., Nov. 2004). Implementation of this proposal will allow sampling to start in 2005 and provide for analysis of historical data from the study area. A total of 41 sites (fig. 1) are targeted for sampling during 2005. Sampling at 27 of the sites is funded through Wyoming entities (table 1) and 14 are funded through Montana entities (table 2).

Sampling and measurement techniques described below are drawn from the USEPA Environmental Monitoring and Assessment Program (EMAP) protocols for habitat and fish community (with some modifications) and the USGS National Water-Quality Assessment (NAWQA) Program protocols for algae and invertebrates.

The reach length is defined as 40 wetted channel widths (Peck and others, 2003), ranging from a minimum of 200 meters to a maximum of 1,000 meters for all sites on streams other than the main stem of the Powder River. Eleven transects will be established for measurement of variables such as bank and streambed substrate, embeddedness, bank angle, canopy cover, and fish cover. Photopoints will be established at each transect to document channel, bank, and riparian conditions. At Wyoming sites (table 1), a longitudinal profile of the streambed, water surface, bankfull stage and low terraces, if any, will be surveyed as described by Harrelson (1994). Two to four cross sections in the reach will be monumented with rebar and surveyed to one or more local reference marks. A 100-particle pebble count will be completed in at least one riffle cross section and at least one pool cross section. At Montana sites (table 2), two to four cross sections will be monumented, but longitudinal profiles and pebble counts will be omitted.

The habitat measurement methods described above are designed for small wadeable streams, and not as well suited to the homogenous, shifting sand habitats of the larger Powder River. The Wyoming Game and Fish Department (WGFD) established seven 2.0 mile study reaches on the main stem Powder River in 2004. The WGFD will sample each of the sites in 2005 using the protocol described in Appendix A. In order to coordinate efforts, USGS will also conduct sampling at the 7 WGFD sites on the Powder

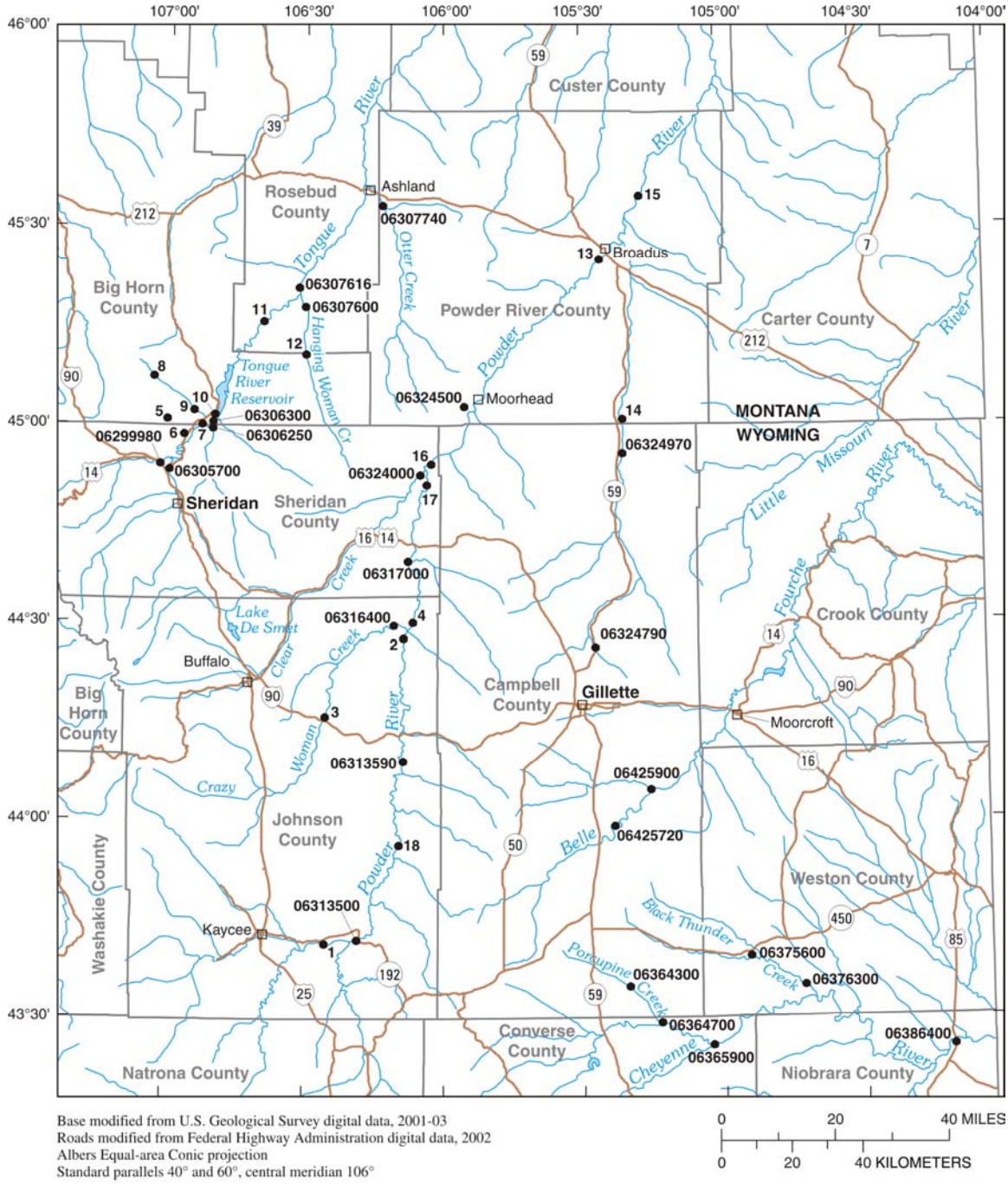

Figure 1. Location of proposed sampling sites for aquatic ecology in northeastern Wyoming and southeastern Montana (sites are listed in tables 1 and 2).

River. Two additional sites will be added on the Powder River in 2005 (at Arvada and above Burger Draw). WGFD and USGS personnel will coordinate field schedules and sample all nine sites on the mainstem Powder on the same days in 2005. Fish community and mesohabitat sampling will be conducted in the spring of the year (pre-runoff) and during low-flow conditions in July. WGFD personnel will collect the fish samples and conduct the Warmwater Stream Assessment during both sampling periods for sites on the main stem of the Powder River in Wyoming and USGS personnel will provide high-resolution GPS mapping of habitat types (riffle, shallow run, deep run, pool, and backwater) for both periods. A modified version of the EMAP and Harrelson protocols for habitat will be performed by USGS personnel, along with algae and invertebrate sampling, during the low-flow sampling of Powder River sites in Wyoming. Habitat features will be recorded at a total of ten transects, by constructing one transect through each of the 10 habitat types sampled by the WGFD, at each Powder River site. The WGFD protocol is proposed for use at sites on the Powder River in Montana, but without the GPS habitat mapping.

Fish communities at all other sites will be sampled once, near the time of the invertebrate and algae sampling. The primary fish collection techniques will be seining and electrofishing; hoop nets and other types of collection gear may be used depending on conditions at the time of sampling. Shocking or seining should be stopped after each habitat unit is sampled at sites on the Powder River and all fish identified and the habitat-type recorded before the next habitat unit is sampled. Incidental observations of amphibians encountered while sampling will be recorded on forms designed by WGFD. A quality assurance plan for fish taxonomy will be prepared, and voucher specimens for taxonomic confirmation will be curated at a museum or equivalent repository (Walsh and Meador, 1998).

Each Wyoming site will be sampled once for invertebrates, algae, and field parameters. Algae and invertebrate samples will be collected and processed as described by Moulton and others (2002). At sites where riffles are available in the stream reach, the riffles will be sampled as the richest targeted habitat (RTH). The invertebrate sample from riffles will be a composite, semi-quantitative sample from 1.25 square meters area, collected

with a Slack sampler equipped with 500-micron mesh. The algae sample from riffles will be a composite sample of 25 collections of periphyton scraped from the rocks, or other hard substrates such as submerged logs if rocks are not available, with the area documented in the field. A qualitative multi-habitat (QMH) sample of invertebrates will be collected at all sites and will function as the primary sample at sites where no riffles are present. The algae sample at sites where hard substrates are absent will be collected from depositional habitat in the euphotic zone of pools. Parameters measured in the field will include dissolved oxygen, pH, specific conductance, water temperature, turbidity, and quantum light profiles. At Montana sites, invertebrates and field parameters will be sampled as described above, but algae samples will be omitted.

The invertebrate samples will be sent to Utah State University for taxonomic identification under the BLM contract. Algae samples will be sent to a contractor for taxonomic analysis following NAWQA protocols (Charles and others, 2002). A sub-sample of the algal collection from sites with riffles will be preserved on dry ice and sent to the USGS National Water-Quality Laboratory for fluorometric analysis of chlorophyll following EPA method 445.0 and analysis of ash-free dry mass following Standard Methods. Quality-control samples, at a rate of one replicate or split sample per 10 environmental samples will be collected and sent to the appropriate laboratories.

Timing of the sample collection for algae and invertebrates will vary according to flow conditions; generally, streams originating in the plains will be sampled during early summer, whereas streams originating in the mountains will be sampled during mid- to late summer of 2005. Procedures for sampling and measurement of habitat, algae, and invertebrates will be modified as appropriate to accommodate the longer reach lengths established for sites on the Powder River.

Most of the sites chosen for ecological sampling also are part of the current water-chemistry monitoring network, and many have historical biological data (table 1). Use of NAWQA protocols in this study provides some comparability with algae and invertebrate samples previously collected in the study area under the USEPA CFP in 2002 and under the Yellowstone River basin NAWQA program during 1998-2004. Invertebrate and algae samples collected during 1980-81 followed USGS protocols existing at that time

and provide some insight into seasonal fluctuation in communities. Aquatic biological samples and habitat measurements were collected under the EMAP investigation during 2000-2004 at a few sites in the study area. Although none of the EMAP sites are proposed for re-sampling, the available data will be included in the analysis of historical data cited in tables 1 and 2.

Data analysis will include computation of indices of community structure such as proportion of EPT (Ephemeroptera, Plecoptera, and Trichoptera), percent dominant taxon, examination of functional-feeding groups, and pollution tolerance. Metrics to be used in invertebrate data analysis will be chosen from those described by Barbour and others (1999), the State regulations of Wyoming and Montana, and other sources as appropriate. Metrics to be used in the algal data analysis will be chosen from the State of Montana regulations, Van Dam and others (1994), and other sources. Multivariate analysis of community and environmental data will be conducted where applicable.

Outputs and Progress Reports: The primary output will be a USGS SIR, in printed form and available on the USGS web site in 2006 or 2007. Timing of the report is dependent on the turnaround time of samples from the taxonomic laboratories. Preliminary results will be presented at one or two meetings of interested parties in the interim between sample collection and publication.

Table 1. Proposed sampling sites and availability of selected ancillary data at sites funded by Wyoming entities [CFP, USEPA consolidated funding program; BST, bed sediment and fish tissue].

Site number (fig. 1)	Site Name	CFP Eco samples 2002	YELL NAWQA ecol site	YELL NAWQA BST site	Current (FY05) water chem site	Eco samples 1980-81
	Tongue River Basin					
06299980	Tongue R at Monarch				x	
06305700	Goose C nr Acme			x	x	
06306250	Prairie Dog C nr Acme				x	
06306300	Tongue R at State line	x		x	x	
	Powder River Basin					
1	Powder R ab Salt C					
06313500	Powder R at Sussex				x	
18	Powder R ab Pumpkin C					
06313590	Powder R ab Burger Draw				x	
2	Powder R ab Crazy Woman C					
3	Crazy Woman C nr I-90					
06316400	Crazy Woman C at upper sta.			x	x	
4	Powder R bl Crazy Woman C					
06317000	Powder R at Arvada	x			x	
17	Powder R ab Clear C					
06324000	Clear C nr Arvada	x			x	
16	Powder R bl Clear C					
06324500	Powder R at Moorhead	x			x	
06324790	Little Powder R at Hwy 59					x
06324970	Little Powder R ab Dry C		x	x	x	x
	Cheyenne River Basin					
06364300	Porcupine C nr Teckla				x	
06364700	Antelope C nr Teckla				x	
06365900	Cheyenne R nr Dull Center				x	x
06375600	Little Thunder C nr Hampshire				x	x
06376300	Black Thunder C nr Hampshire				x	
06386400	Cheyenne R at Riverview	x			x	
	Belle Fourche River Basin					
06425720	Belle Fourche R bl Rattlesnake C				x	x
06425900	Caballo C at mouth				x	

Table 2. Proposed sampling sites funded by Montana entities.

Site number (fig. 1)	Site Name
	Tongue River Basin
5	Upper Youngs Creek
6	Lower Youngs Creek
7	Tongue R upstream of dam, us of outfalls
8	Upper Squirrel Creek
9	Lower Squirrel Creek
10	Tongue R upstream of dam, ds of outfalls
11	Tongue R downstream of dam
12	Middle Hanging Woman C
06307600	Hanging Woman C nr Birney
06307616	Tongue R near Birney Day School
06307740	Otter C near Ashland, MT
	Powder River Basin
13	Powder R near Broadus
14	Little Powder R at State Line
15	Powder R ds of mouth of L Powder

References

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Peck, D.V., Lazorchak, J.M., and Klemm, D.J., (eds.), 2003, Environmental Monitoring and Assessment Program – surface waters: Western Pilot Study field operations manual for wadeable streams: Washington, D.C., U.S. Environmental Protection Agency, 258 p.

Walsh, S.J., and Meador, M.R., 1998, Guidelines for quality assurance and quality control of fish taxonomic data collected as part of the National Water-Quality Assessment Program: U.S. Geological Survey Water-Resources Investigations Report 98-4239, 33 p.

Budget:

Category	FY05	FY06	Total	Tasks
Salaries & benefits	$323,085.42	160,130.00	483,215.42	Sampling, data analysis, report preparation
Travel	76,612.00	0	76,612.00	Per diem and vehicle costs
Equipment and supplies	7,880.00	0	7,880.00	Sampling equipment, shipping, preservatives
Contractual services	6,150.00	21,730.00	27,880.00	Algal and fish taxonomy, chlorophyll analysis
Printing/ Outreach	0	10,600.00	10,600.00	Printing and Internet posting of report
Totals	413,727.42	192,460.00	606,187.42	

Funding sources:

Agency	FY05	FY06	Total
BLM	$200,000.00	20,000.00*	220,000.00
WDEQ	102,390.00	100,000.00	202,390.00
USGS (coop)	100,000.00	72,460.00	172,460.00
USGS (DOI matching)	11,337.42	0	11,337.42
Total	413,727.42	192,460.00	606,187.42

* - Possible funding from USEPA