

April 1, 2003

Technical Memorandum Wind/Big Horn Basin Plan

Subject: Industrial and Mining Water Use

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This Technical Memorandum discusses the existing industrial and mining use in the basin. The document fulfills the reporting requirements of Task 2, industrial water use.

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Section 1 - Introduction

The counties considered herein are Big Horn, Fremont, Hot Springs, Park, and Washakie. It should be noted that a small area in northwest Natrona County lies within the WBHB watershed, while a portion of the southeast corner of Fremont County lies outside it, in the Green River drainage. Both these areas are very thinly populated. The people in the Fremont County are outside the basin are included in the demography of the Wind/Big Horn Basin Plan, though water use/demand is not. In the case of the Natrona County section, its population is not incorporated in the WBHB demographic analysis. Two or three small, generally intermittent streams that head in Natrona County flow into Washakie and Fremont counties.

There are also portions of Teton County within the watershed, but they are virtually uninhabited mountain areas. Much of Yellowstone Park lies physically within the Basin (mostly in Park County) but since its management is almost entirely a federal prerogative, an analysis of Yellowstone's water demand differs somewhat, of necessity, from that of the rest of the Basin. Although water is certainly consumed within the Park, and is accounted for in the WBHB Plan, consumption is limited to domestic use (approximately 1 acre foot per year) and evaporative losses. Agricultural or industrial development is precluded in the Park, and therefore is not considered in this memorandum.

Projections of industrial water needs at low, medium, and high growth rates over the planning period are discussed in Chapter 4. Most industrial water users in the Wind/Big Horn Basin (WBHB) are comparatively small companies, with relatively low water needs. In most cases, these companies draw their water from municipal systems, or from their own wells. In many cases the water used from wells for industrial purposes is not suited for other uses due to poor water quality. For those industries utilizing water from municipal sources, that consumptive use is included in the basin as municipal use.

Section 2 - Industry in the WBHB

The Basin’s economy, like Wyoming’s as a whole, has long depended on a triad of industries: mining (especially coal, bentonite, oil and gas), tourism, and agriculture. Mining’s annual payroll in Wyoming nearly doubles that of retail trade, the nearest competing sector. In terms of numbers of jobs it trails only retail trade and accommodation, and food services (U.S. Census Bureau, 1997 Economic Census). Other economic sectors, such as manufacturing, are, of course, significantly impacted by events in the minerals industries. Another energy-producing industry, hydroelectric power production, needs to be considered. Virtually all such power is currently produced by the U.S. Bureau of Reclamation at its reservoirs. Although there may be more potential in the power generation industry. Wyoming’s electricity costs are well below the national average, and this might prove useful in attracting new manufacturing plants.

Note: Power generation potential is discussed in a separate report “Power Generation Potential in the Wind River, Clarks Fork, and Big Horn Basins of Wyoming”, BRS, MWH, et al, 2003.

Discussions of manufacturing, power production, and mining, and oil and gas follow.

2.1 Manufacturing

Large manufacturing companies are rare in the WBHB, as they are in the state as a whole. In the WBHB there are about two-dozen manufacturing companies that consistently maintain a workforce of twenty-five or more [Phillip Christopherson, Andy Rose, MAMTEC, Riverton and Powell]. Most of the larger companies’ products are related to Wyoming’s overall character – products derived from minerals, products for agriculture, products for camping, hunting and fishing. Machinery, electronic goods, and fabricated metal products are also manufactured in the Basin. Manufacturing companies include:

Industry	Location
Sugar Beet Refinery	Worland, Powell
Bottling, Water and Beverages	Worland
Aluminum Can Manufacturing	Worland

Light Manufacturing (Brunton Factory)	Riverton
Bentonite Plants	Greybull, Lovell, Worland, Lucerne
Sulphur Plants	Rural Fremont County

2.2 Power Production

Hydroelectric power is produced by water-driven turbines at thirteen Bureau of Reclamation sites in Wyoming, six of which are in the WBHB. Collectively the six WBHB plants have a production capacity of 47,100 kW. Clearly the Wind/Big Horn system is capable of producing considerably more power. A 1993 study for the U.S. Department of Energy listed sites with potential for hydropower production on the Big Horn River at Kane and Thermopolis, as well as on the Clarks Fork, Popo Agie and Shoshone Rivers. Other listed sites were on Shell, Sunlight, Sunshine, and Tensleep Creeks [James E. Francfort, Idaho National Engineering Laboratory, "U.S. Hydropower Resource Assessment for Wyoming," U. S. Department of Energy, December, 1993.]

The questions are whether or not there is a ready market for increased amounts of electric power, and whether or not the power can be transmitted to market. The possibility of the deregulation of the electric power industry exists, creating many uncertainties in the industry. Historically the industry has been vertically integrated, with power generation, transmission, and distribution linked within corporations. Legislation mandating separation of these functions has been enacted in Oregon, Arizona, and Texas, and suspended in California after having been enacted. In Wyoming, restructure has been studied, but there are currently no active efforts to legislate deregulatory action [Energy Information Administration, U.S. Department of Energy, <http://www.eia.doe.gov/>, September, 2002.] Although the potential to produce more power in the WBHB exists, at this time the transmission capacity necessary to export that power is lacking. The future of the State's electric power industry remains uncertain, since "transmission issues cloud investment in generation" [Wyoming Energy Commission Progress Report, Section VI., Electric Transmission Working Group, www.wyomingenergy.org/minerals/energy_commission/index.cfm]. Development of additional generation capacity, for export outside the state, appears to hinge on further development of markets and transmission capacity. Power production for local consumption and/or peak demand is more promising.

Currently there are no commercial fossil fuel power generation facilities in the basin. Small gas-fire, gas-cooled, turbine generating stations are utilized in the oil and gas industry for internal use such as powering gas pumping stations. Historically there has been both coal mining and coal fired power production in the basin, however, reported coal production ceased in the Wing River and Big Horn basins in 1966 and 1994, respectively (Bob Lyman, WGS, May, 2002). However, as discussed in the report "Power Generation Potential in the Wind River, Clarks Fork, and Big Horn Basins of Wyoming", BRS, MWH, et al, 2003, there are sufficient coal and natural gas reserves in the Wind River and Big Horn Basins to support at least modest power production.

Promising new developments in combined-cycle gas turbines, using gas-fired, gas-cooled, turbines in combination with waste heat/gas-fired, conventional steam turbines may make natural gas electric power production more competitive. William Liggett of the Energy Information Agency, points out that “Technological improvements in gas turbines have changed the economics of power production. No longer is it necessary to build a 1,000- megawatt generating plant to exploit economies of scale. Combined-cycle gas turbines reach maximum efficiency at 400 megawatts, while aero-derivative gas turbines can be efficient at scales as small as 10 megawatts” [http://www.eia.doe.gov/cneaf/electricity/chg_stru_update/update2000.html].

2.3 Mining: oil & gas, coal, uranium, bentonite and gypsum

Over the years the WBHB, as well as the state generally, benefitted from repeated mining booms: there has been oil and gas, bentonite and industrial minerals, and coal production in the Basin for many decades. However, several of Wyoming’s currently healthy mineral products, coal, coalbed methane, uranium and trona, are not produced in the WBHB. In fact, the availability of jobs in the Powder River Basin, and in southwest Wyoming, where some of these minerals are being produced, certainly draws some working-age people from the WBHB, further limiting its labor force and hurting its economy.

In Wyoming the peak years for oil production were 1959 to 1976, while gas production began a steep upward climb about 1976, and is still rising. Coal experienced three major production booms – from the late 1880s until the early 1920s, during World War II, and an ongoing boom that began about 1969 [University of Wyoming, “Economic Trends in Wyoming’s Mineral Sector”].

Oil and gas remain important to the WBHB economy, with gas plants in all counties except Hot Springs, but it seems unlikely that the future will offer many more jobs in the industry. There appears to be more potential in the Wind River Basin Province than in the Big Horn Basin Province [Fox, James E., and Dolton, Gordon L., 1995, *Wind River Basin Province and Bighorn Basin Province*, USGS National Oil and Gas Assessment].

Uranium mining began in Wyoming in the 1950s, primarily in the Wind River Basin. The industry peaked, producing uranium for the Atomic Energy Commission (AEC), around 1960. As AEC stockpiling slowed to a halt about 1964, the industry “crashed.” From 1964 to 1972 a transition occurred as private sector demand, mostly for power plants, developed. Increasing oil prices, spurred by the embargo of 1974, helped uranium markets rise to another peak around 1978-80. Oversupply, compounded by the aftermath of the Three-Mile Island event, brought on another crash in uranium markets from 1982 to 1984.

The future for uranium mining appears to be in-situ development, in which wells, rather than open-pit mines, produce the ores. Non-potable ground water is re-injected into ore seams as part of a reverse osmosis process, resulting in a net consumptive loss of only 5% or so. Uranium production via in-situ methods is active in the Powder River Basin, making Wyoming one of the largest uranium producing localities in the United States. One potential future in-situ uranium mine (Power Resource Inc.) is permitted but not in production in the Gas Hills Uranium District,

Fremont County. Additional uranium reserves in the District, held by other interests, could support a second in-situ operation or enhance the longevity of the currently planned development.

Wyoming leads the nation in bentonite production, and it is mined at several locations in the WBHB. The outlook for bentonite production seems to be a continuance of the status quo. No large increases or decreases in productions seem likely. [Larry Madsen, Black Hills Bentonite, 9 September, 2002; Rick Magstaff, WyoBen Corporation, 10 September, 2002, personal communications].

Bentonite processing plants are located in Big Horn (Greybull and Lovell) and Washakie (Worland) Counties. The Black Hills Bentonite plant in Worland uses about 500,000 gallons per month, purchasing it from the City of Worland. Near Greybull, WyoBen's water is pumped from the Big Horn River, and used mainly for dust control on haul roads. Lovell's American Colloid plant uses Bentonite to produce drilling mud, and uses very little water. The future of that operation is closely tied to that of oil and gas drilling [Jay Bischoff, American Colloid Corporation, personal communication, 10 September, 2002.]

There are gypsum plants in Park and Big Horn Counties, producing wallboard. Well water is used in the process, and recycling is practiced in all plants.

Despite the vicissitudes of minerals production, mining in the WBHB has generally offered better-paid jobs than most other industries. It remains fundamental to the Basin's economic foundation. Absent the development in the WBHB of major new industries, such as light manufacturing or agriculturally related industry, the size and makeup of both the economy and population will continue to be strongly related to the economics of mineral production.

Section 3 - Summary of Consumptive Use

3.1 Current Water Rights/Usage

Appendix A contains a listing of all industrial and mining water rights, surface and ground water, in the Wind River/Big Horn River Basins, from Division III, State Engineer's Office, tabulation, 1999. In summary, the permitted water rights for mining and industrial uses in the basin are:

Oil & Gas, including pipelines	73,792 acre-ft/year
Mining, dust control and mine pit waters	2,741 acre-ft/year
Manufacturing and Miscellaneous Industrial	15,708 acre-ft/year
Total Permitted Water Use - Industrial and Mining	92,241 acre-ft/year

3.2 Steam Power Plant Water Usage

Although there are currently no fossil fuels power plants in the Basin, there is a potential reserve base for either coal or natural gas fired electric power production. It is estimated that a nominal

200 MW coal-fired steam turbine facility would require approximately 4,000 acre-ft/year of water and a 500 MW gas-fired combination turbine facility would require approximately 5,000 acre-ft/year of water.

APPENDIX A

**Industrial and Mining Water Rights
Surface and Ground Water
Wind River/Big Horn River Basins
Division III, State Engineer's Office, 1999**

Industrial and Mining Water Rights for the Wind River/Bighorn River Basins

Surface Water

						All Listed	Industrial Use
Diversion	Ditch	Permit No.	Priority Date	Appropriator	Use	Amount (c.f.s.)	Total cfs
Clark's Fork River	Clark Fork-Elk Basin Pipe Line	19819	15973	Ohio Oil Company	D,Ind.,Oil	2.00	2
Big Horn River	Thorpe Res	2091R	4066	Big Horn Collieries Co.	D,Min.,Steam Power	0.18 a.f	
Big Horn River	Thorpe Pipe Line	10504	4066	Big Horn Collieries Co.	D,Min.,Steam Power	1.00	1
Big Horn River	Holly Pipe Line	19292	14621	Holly Sugar Corp.	Ind.	12.00	12
Big Horn River	Boysen Res	5576R	16732	USDI, Bureau of Rec.	D,I,Ind,Min,Mun,Power,S	757,851.00 a.f.	
Big Horn River	River Dome Pipe Line	20163	17715	Texas Gulf Sulphur Co.	Ind.	80.00	80
Big Horn River	Enl. River Dome Pipe Line	5599E	19015	Montana-Dakota Utilities Co.	Ind.	0.10	0.1
Big Horn River	Greybull Big Horn River Pump Station	22539	22696	Town of Greybull	Ind.,Mun.	2.00	2
Big Horn River	Holly Wastelime Retention Res	9336R	30995	Holly Sugar Corp.	Ind.,PC		0
Porcupine Creek	Fortunatus Pipe Line	315	-2709	The Fortunatus Mining and Milling Co.	Mil,Min		0
Shoshone River	Byron Water Line	18654	13184	Ohio Oil Company	D,Ind	0.33	0.33
Shoshone River	Garland Unit Water Line	18802	13807	Ohio Oil Company	D,Drl,Ind	0.33	0.33
Shoshone River	Lovell Fuel Oil Plant Water Line	18803	13807	Ohio Oil Company	D,Ind,Ref	1.00	1
Shoshone River	Husky Refinery Diversion	22055	21832	Husky Oil Co.	D,Ind,Mfg	4.50	4.5
Shoshone River	Byron Wastewater Lagoon	9575R	32678	Town of Byron	Ind.,PC		0
Sage Creek	Frannie Sewage Treatment	9362R	31945	Town of Frannie	Ind.,PC		0
Frazier Draw	Frazier Res.	9196R	29851	Cody Concrete Company	Ind.	6.70 a.f.	
Frazier Draw	Frazier Diversion	29524	30819	Cody Concrete Company	Ind.	2.50	2.5
Sage Creek	C. Thomsen Res	4152R	10475	Carl Thomsen	D,Ind,S	80.01 a.f.	
South Fork Shoshone River	Enl. Cody Canal	188E	-1377	Eli Jernberg	D,I,Mfg,Min	0.24	0.24
Drainage Big Horn River	Greybull Sewage Treatment Lagoon	9647R	33074	Town of Greybull	Ind.	152.00 a.f.	
Spring Creek	Haley Water Wheel Power Source	25271	27820	John R. Haley Jr.	Ind.	2.00	2
Spring Creek	Haley Water Wheel Power Source	25271	27820	John R. Haley Jr.	Ind.	2.00	2
Greybull River	Upper Sunshine Res	4604R	10294	Greybull Valley Irr. District	Ind.	3,892.77 a.f.	
Greybull River	Enl. Upper Sunshine Res	5474R	14704	Greybull Valley Irr. District	I,Ind.	3,529.20 a.f.	
Greybull River	Enl. Rocky	6326E	25235	Helen M. Barling	Ind.	1.25	1.25
Meeteetse Creek	Meeteetse Creek Pipe Line	20125	17558	Texas Company	D,Drl,Ind	0.50	0.5
Sunshine Creek	Enl. Upper Sunshine Res	5474R	14704	Greybull Valley Irr. District	I,Ind.	3529.20	
Nowood River	Big Horn Plant Water Line	21296	19680	Mobile Producing Co.	Ind.	1.00	1
Madden Draw	Honor farm Waste Water Lagoons	9307R	31971	Wyoming State Prison Honor Farm	Ind.		0
Dry Creek	Union 2-inch Pipe Line	16613	8531	Union Oil Co. of California	D,Ind,S	0.11	0.11
Spring No. 1	Three Springs Pipe Line	19241	14516	Northern Utilities, Inc.	D,Ind	0.01	0.01
Clark Spring	Clark	18097	11577	F.H. Clark, et al	D,Min	0.10	0.1
Clark Spring No. 2	Spring Gulch	18098	11577	F.H. Clark, et al	D,Min	0.10	0.1
Meadow Gulch	Dickerson Ditches Nos.1	1883	-2684	Eli Dickerson	Min	0.50	0.5
Big Fork Popo Agie	Town of Hudson Wastewater Lagoon	9437R	32272	Town of Hudson	Ind.		0
Little Popo Agie	Christina Res	Terr.	-4137	Timba-Bah Mining Co.	Mil,Min	1,200.00 a.f.	
Drainage Big Fork Popo Agie	Lander Wastewater Treatment	10571R	34478	Town of Lander	Ind.	394.70 a.f.	
						Total	113.57
						1 cfs ~ 724 af/yr	82,225
						acre feet/yr	

Ground Water

District	Well	U.W. No.	Priority Date	Appropriator	Use	Amount (g.p.m.)	
District No. 1-Fremont County	Northern Arapahoe No. 1	P3989	25468	North Apapahoe Tribe of Indians	Com,Ind	500.00	500
District No. 1-Fremont County	Madison Tank Battery No. 1	P15614	26512	Amoco Production Company	Ind.	425.00 A.S.	425
District No. 1-Fremont County	Empire Tank Battery No.1	P15615	26512	Amoco Production Company	Ind.	65.00	65
District No. 1-Fremont County	Indian Tank Battery No. 1	P15616	26512	Amoco Production Company	Ind.	30.00 A.S.	30

District No. 1-Fremont County	Lease 276 Tank Battery No. 1	P15617	26512	Amoco Production Company	Ind.	125.00 A.S.	125
District No. 3-Fremont County	RCC 1	P2	21251	Koch Sulfur Products Company	Ind.	150.00	150
District No. 3-Fremont County	Rossman No. 1	P28764	27373	Wind River Ready Mix	Ind.	25.00	25
District No. 6-Washakie County	Cottonwood Creek Unit Water No. 4	P331	22019	Amoco Production Company	Ind.	700.00	700
District No. 6-Washakie County	Cottonwood Creek Unit Battery No. 1	P15423	26543	Amoco Production Company	Ind.	175.00 A.S.	175
District No. 6-Washakie County	Cottonwood Creek Unit Battery No. 7	P15426	26543	Amoco Production Company	Ind.	5.00 A.S.	5
District No. 6-Washakie County	Cottonwood Creek Unit Battery No. 5	P15427	26543	Amoco Production Company	Ind.	10.00 A.S.	10

District	Well	U.W. No.	Priority Date	Appropriator	Use	Amount (g.p.m.)	
District No. 6-Washakie County	Cottonwood Creek Unit Battery No. 2	P15428	26543	Amoco Production Company	Ind.	5.00 A.S.	5
District No. 6-Washakie County	Cottonwood Creek Unit Battery No. 4	P15421	26543	Amoco Production Company	Ind.	10.00	10
District No. 6-Washakie County	Cottonwood Creek Unit Battery No. 3	P15422	26543	Amoco Production Company	Ind.	50.00 A.S.	50
District No. 6-Washakie County	Cottonwood Creek Field Extension No. 1	P29172	27432	Gulf Oil Corporation	Ind.	50.00	50
District No. 11-Fremont County	Luck MC No. 8	P3	21258	USDI, Bureau of Land Management	Ind.	80.00	80
District No. 11-Fremont County	Federal Water No. 5	P151	21716	Federal-American Partners	Ind.	100.00	100
District No. 11-Fremont County	Federal Water No. 6	P152	21716	Federal-American Partners	Ind.	100.00 A.S.	100
District No. 11-Fremont County	Federal Water No. 8	P154	21716	Federal-American Partners	Ind.	100.00 A.S.	100
District No. 11-Fremont County	Federal Water No. 13	P648	22200	Federal-American Partners	Ind.	125.00 A.S.	125
District No. 11-Fremont County	Luck MC No. 11	P2395	25178	Pathfinder Mines Corp.	Ind.	100.00	100
District No. 11-Fremont County	Montana-Dakota No. 1	P9184	26074	Montana-Dakota Utilities Co.	Ind.	1.00	1
District No. 11-Fremont County	Tablestakes No. 1	P23625	26847	Federal-American Partners	Ind.	225.00 A.S.	225
District No. 13-Park County	Little Buffalo Tensleep Battery No. 1	P15626	26568	Amoco Production Company	Ind.	1300.00	1300
District No. 13-Park County	Little Buffalo Tensleep Battery No. 2	P15627	26568	Amoco Production Company	Ind.	500.00 A.S.	500
District No. 13-Park County	Little Buffalo Tensleep Battery No. 1	P15628	26568	Amoco Production Company	Ind.	250.00 A.S.	250
District No. 15-Big Horn County	Himes No.1	P5878	25737	Georgia-Pacific Corp.	Ind.	80.00	80
District No. 15-Big Horn County	Byron Water Supply Well No. 1	P61913	30190	Marathon Oil Co.	Ind.	35.00	35
District No. 15-Big Horn County	Byron Water Supply Well No. 3	P62570	30273	Marathon Oil Co.	Ind.	20.00	20
District No. 15-Big Horn County	Georgia Pacific No. 2	P68485	30930	Georgia-Pacific Corp.	Ind.,Misc	120.00 A.S.	120
District No. 15-Park County	Elk Basin Frontier Battery No. 1	P16054	26560	Amoco Production Company	Ind.	200.00 A.S.	200
District No. 15-Park County	Elk Basin Frontier Battery No. 5	P16055	26560	Amoco Production Company	Ind.	9.00 A.S.	9
District No. 15-Park County	Elk Basin Frontier Battery No. 18	P16057	26560	Amoco Production Company	Ind.	150.00 A.S.	150
District No. 15-Park County	Elk Basin Madison Battery No. 10	P16058	26560	Amoco Production Company	Ind.	40.00 A.S.	40
District No. 15-Park County	Elk Basin Madison Battery No. 11	P16059	26560	Amoco Production Company	Ind.	650.00 A.S.	650
District No. 15-Park County	Elk Basin Jefferson Battery No. 14	P16060	26560	Amoco Production Company	Ind.	175.00 A.S.	175
District No. 15-Park County	Elk Basin Jefferson Battery No. 16	P16061	26560	Amoco Production Company	Ind.	300.00 A.S.	300
District No. 15-Park County	Elk Basin Tensleep Battery No. 5	P31042	27413	Amoco Production Company	Ind.	91.00	91
						Total	7076
					1 gom ~ 1.61 af/yr	acre feet/yr	11,392