



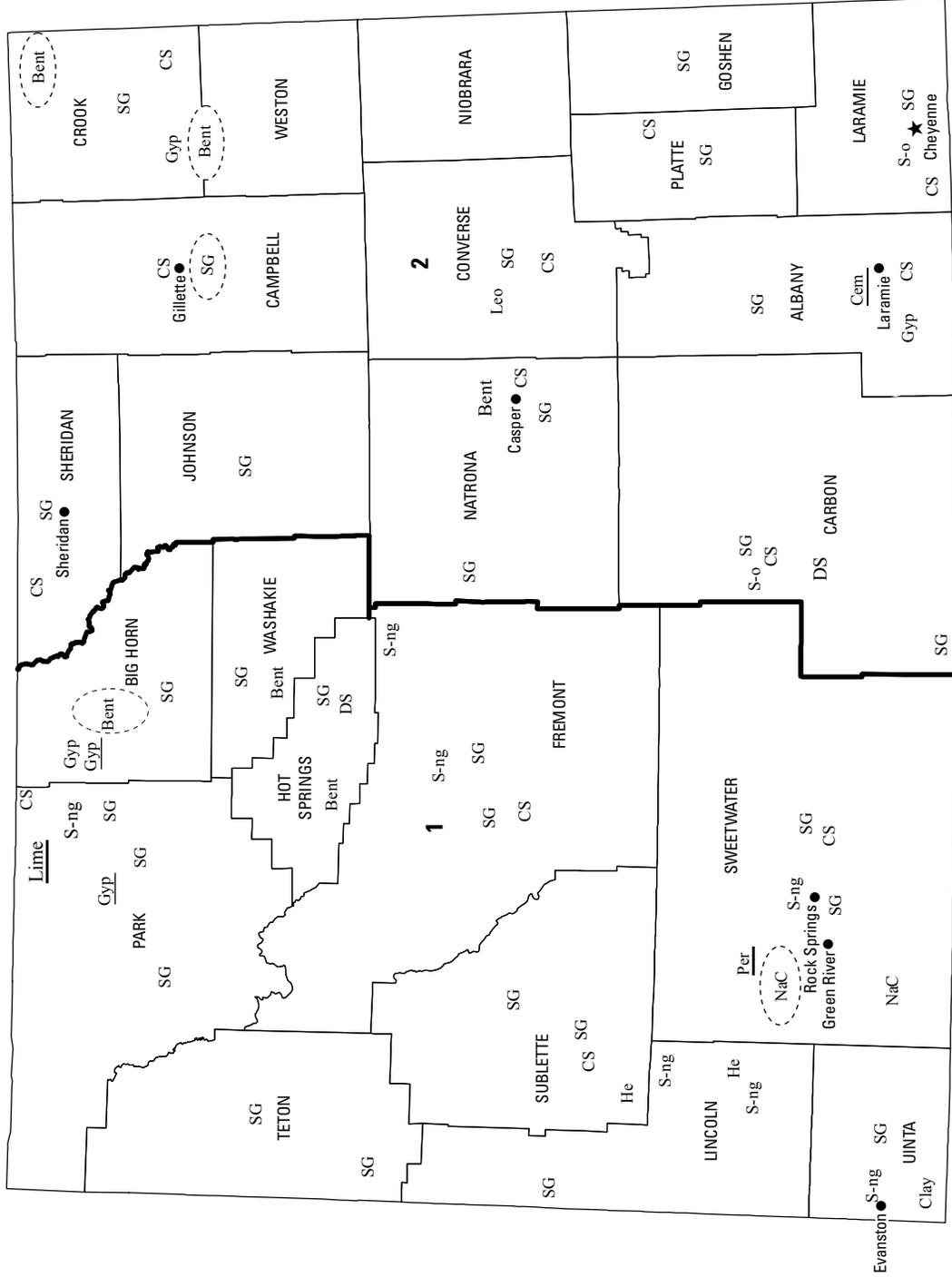
# 2008 Minerals Yearbook

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## WYOMING

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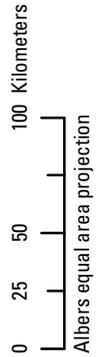


**LEGEND**

- County boundary
- Capital
- City
- Crushed stone/sand and gravel district boundary

**MINERAL SYMBOLS (Principal producing areas)**

- Bent
- Cem
- Clay
- CS
- DS
- Gyp
- Gyp
- He
- Leo
- Lime
- NaC
- Per
- SG
- S-ng
- S-o
- Concentration of mineral operations



# THE MINERAL INDUSTRY OF WYOMING

This chapter has been prepared under a Memorandum of Understanding between the U.S. Geological Survey and the Wyoming State Geological Survey for collecting information on all nonfuel minerals.

In 2008, Wyoming's nonfuel raw mineral production<sup>1</sup> was valued at just over \$2 billion, based upon annual U.S. Geological Survey (USGS) data. This was a \$260 million, or an almost 15%, increase from the State's total nonfuel mineral production value for 2007, which was up \$170 million, or more than 10%, from that of 2006. The State rose in rank to 11th from 14th among the 50 States in total nonfuel raw mineral production value; Wyoming ranked 14th from 2005–2007. In 2008 Wyoming accounted for 2.8% of the U.S. total value. For the third consecutive year, the State ranked second in the Nation for the per capita production value of its nonfuel mineral industry. With a population of 533,000, the production value was about \$3,780 per person.

Soda ash remained Wyoming's leading nonfuel mineral, by production value, followed by bentonite clay, Grade-A helium, construction sand and gravel, portland cement, and crushed stone. Together, these six mineral commodities have accounted for approximately 99% of the State's total nonfuel raw mineral production value since 2005.

The largest increases in mineral commodity production values, in descending order of total value, took place with soda ash, Grade-A helium, and construction sand and gravel. Production of soda ash was up only slightly (1.7%) compared to 2007 but the production value still rose by almost 19%. Grade-A helium production was up almost 9% in 2008 from 2007 but the production value rose by 45%. Conversely, production of construction sand and gravel was down 10% from that of 2007, but the production value rose by more than \$4 million, or almost 5%. In descending order of total production value, the unit values of Grade-A helium, soda ash, crude gypsum, and construction sand and gravel saw the largest increases in 2008. Between 2006 and 2008, the unit value of soda ash had risen just over 26%, Grade-A helium, 68%, and construction sand and gravel, 35%.

The largest decrease in production value took place in bentonite clay, which was down almost \$13 million, although production was up 6%. Smaller total production value decreases were seen with crushed stone, lime, and portland cement.

Since at least 1986,<sup>2</sup> Wyoming continued to be ranked first in soda ash and bentonite clay production, and since at least 1987, second in Grade-A helium production. Since 2005, Wyoming has been one of only two soda ash-producing States, with California producing a significantly smaller amount. In 2008, the United States continued to be the world's leading

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<sup>1</sup>The terms "nonfuel mineral production" and related "values" encompass variations in meaning, depending upon the mineral products. Production may be measured by mine shipments, mineral commodity sales, or marketable production (including consumption by producers) as is applicable to the individual mineral commodity.

All 2008 USGS mineral production data published in this chapter are those available as of July 2010. All USGS Mineral Industry Surveys and USGS Minerals Yearbook chapters—mineral commodity, State, and country—can be retrieved over the Internet at URL <http://minerals.usgs.gov/minerals>.

<sup>2</sup>The U.S. Bureau of Mines began to publish detailed commodity rankings among States in the 1986 edition of the Minerals Yearbook.

producer of soda ash from natural sources and the second leading producer, after China, of natural and synthetic soda ash. Sweetwater County hosts the world's largest known deposit of trona, the major ore for soda ash production.

The Wyoming State Geological Survey<sup>3</sup> (WSGS) provided the following narrative information. Production data in the text that follows are reported by the WSGS and are based on the agency's own surveys and estimates. They may differ from production figures reported to the USGS.

## Exploration and Development

With the strong economy in the early portion of the year, Wyoming saw rising interest in finding new, economically recoverable deposits of both metals and industrial minerals, such as construction aggregates, dimension stone, and phosphates, among others. However, following the price decline in metals near yearend, metals exploration projects ended for the immediate future, with the notable exceptions of certain gold and rare earth elements projects. It was unknown at yearend to what extent the downturn's effect had on sustaining the interests in industrial mineral commodities beyond 2008.

## Industrial Minerals

**Diamond.**—Most of Wyoming is underlain by the Wyoming Craton, which is part of the more than 2.5 billion-year-old core of the North American continent. Diamond-bearing intrusives are known on the margins of the Craton in southern Wyoming and northern Colorado (Hausel, 1998, p. 9–11). Two companies proposed diamond exploration activities in southeastern Wyoming during the first part of the year.

The first 9 months of 2008, however, were dominated by exploration from DiamonEx USA, a subsidiary of DiamonEx Ltd. (Brisbane, Australia). Its exploration targeted areas including the Bighorn Basin in the north-central portion of the State, as well as in southern Wyoming. In the Bighorn Basin, in the Fifteen Mile Creek area west of Worland, purple garnets concentrated in ant hills on a gravel terrace on top of Tertiary sediments have been known for many years and were suspected to be of kimberlitic origins. DiamonEx USA, through MCC Geoscience Inc. (Vancouver, British Columbia, Canada) determined that these garnets were crustal in origin and not derived from any kimberlitic or lamproitic source. In southern Wyoming, in the Medicine Bow Mountains, the company did not find any kimberlite indicator minerals in its sampling program in the Cortex and Douglas Creek areas. Rough diamond prices plunged between 30–50% in late 2008,

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<sup>3</sup>Wayne M. Sutherland, Geologist (gemstones, metals, and economic geology specialist), and Robert Gregory, Geologist (uranium and minerals specialist) of the Wyoming State Geological Survey, coauthored the text of the State mineral industry information.

with finished stone prices falling between 10–20% (Irving, 2008, 2009). DiamondEx suspended all exploration activities in Wyoming, in addition to work on its Sloan kimberlite in Colorado, following this decline and the general economic downturn. At yearend, the company was focused on further developing its funding strategy (ABN Newswire, 2009).

**Gemstones.**—Commercial exploration activity focused on diamond and kimberlite exploration, but more interest was seen from amateurs for a wide variety of lapidary materials, including crystals, mineral specimens, and precious and semiprecious gemstones. The first part of the year saw some commercial exploration for iolite, opal, and rubies. Interest in gemstones by amateur collectors increased in 2008 and amateur activity continued well into the fourth quarter, unhindered by the economic problems facing professional exploration and development companies.

**Sand, Industrial.**—There was considerable interest in silica sand by one company, U.S. Silica Co. (Frederick, MD), on the Cassa deposit in Platte County. The WSGS performed a study of the Cassa deposit in 1988 (Harris, 1988). The company drilled and cored several holes and was evaluating sandstone from the lower Cretaceous Cloverly Formation for potential use in glass manufacturing. No quarrying had taken place as of yearend.

## **Metals**

**Overview.**—Interest in gold, copper, platinum, and other metals remained high in the first three financial quarters of 2008, reflected by overall high prices. The fourth quarter, however, had steep decreases in the price of metals—the prices of gold, lead, platinum, nickel, and copper fell 17%, 19%, 22%, 29%, and 37%, respectively (Fiscor, 2008). Most exploration projects in Wyoming were subsequently halted.

**Copper and Precious Metals.**—Overall interest in Wyoming copper, accompanied by high prices, remained solid until October when prices began to decline, settling at around \$1.50 per pound for the remainder of the year and effectively terminating copper exploration activity within the State.

Black Range Minerals Ltd. (Perth, Australia), based on encouraging results from the 2007 drill program, planned to continue drilling in the Sierra Madre at the Ferris-Haggerty deposit in 2008 (Black Range Minerals, 2008a). However, early in 2008, an ownership dispute over the deposit and the imprisonment of one of the claimants created an environment in which Black Range Minerals could not determine or “maintain a reasonable business association with” the rightful owner. The company withdrew from the project without proceeding with any drilling (Black Range Minerals, 2008b). The Ferris-Haggerty deposit was last examined in 1988, with a projected estimate of 3,600 kg (117,000 troy ounces) of gold and a significant quantity of copper (U.S. Geological Survey, 2010).

**Gold.**—Gold prices did not follow the downward trend established by other precious metals. Gold stayed near or above \$850 per troy ounce through the first 8 months of 2008, reaching a peak of more than \$1,000 per troy ounce in March, dropping to near \$700 per troy ounce in November, then climbing to over \$870 per troy ounce at the end of the year. Unlike other precious metals, the lowest gold price per troy ounce seen in 2008 was still above the September 2007 price. Gold’s strong performance at yearend,

even with most other sectors of the economy headed downward, showed promise for continued gold exploration in Wyoming.

As in previous years, numerous individual prospectors and small companies explored across the State, including in the Medicine Bow, Sierra Madre, and Laramie Mountains, the northwestern Bighorn Basin, as well as the South Pass area and Oregon Buttes-Dickie Springs paleoplacer deposits near Lander.

Evolving Gold Corp. (Vancouver, British Columbia, Canada) confirmed the coexistence of high-grade gold zones surrounded by a large halo of low-grade gold mineralization at the Rattlesnake Hills project west of Casper in Natrona County. The company cored a cumulative total of approximately 6,500 meters (m) (over 21,000 feet) in 15 holes. The results of the drill hole assays showed two holes in the high-grade zone, 65 m (about 210 feet) apart, grading 2.9 grams per metric ton (g/t) over a vertical interval of about 145 m (almost 480 feet) and 2.7 g/t over roughly 130 m (almost 430 feet). Surrounding low-grade drill holes graded at about 0.8 g/t over an almost 310 m vertical interval, 0.65 g/t over about 270 m, and 0.55 g/t over almost 270 m. With higher grades reported at smaller intercepts, the company planned to maintain or increase exploration activities in 2009 (Evolving Gold, 2008).

Golden Predator Mines Inc. (Winnemucca, NV) maintained interest in gold properties in the Lewiston district, approximately 19 kilometers (km; 12 miles) southeast of the South Pass area. They planned further evaluation of their Lewiston project during 2009.

Northwest of the town of Sundance in the Bear Lodge Mountains, the Sundance exploration project reported encouraging results from their 2008 sampling activities and related metallurgical leach tests. The exploration project was a joint venture primarily operated by Newmont North America Exploration Ltd. (a subsidiary of Newmont Mining Corp.), with the unpatented mineral claims being held by Paso Rico (USA) Inc. (a wholly owned subsidiary of Rare Element Resources Ltd.). The total area of the joint venture was more than 2,300 hectares (ha) (9 square miles) (Rare Element Resources, Ltd., 2008). Rare Element Resources had prepared a draft environmental assessment to continue exploration beyond 2008 in May 2007, with a decision from the Black Hills National Forest anticipated for early 2009.

**Iron Ore.**—Iron ore prices more than doubled during the year, with a sharp rise in April, resulting in inquiries regarding the historic iron deposits. No significant exploration projects began, however, before the price decline in the fourth quarter.

**Platinum-Group Metals.**—Platinum exploration followed a similar trend to that of copper. With record high prices above \$2,000 per troy ounce during the first half of the year declining to under \$800 by yearend, exploration excitement was tempered. However, south of Albany in the Medicine Bow National Forest, mining claims near Lake Owen were maintained out of long-term optimism.

**Rare Earths.**—In the Bear Lodge Mountains, near their Sundance gold exploration project, Rare Element Resources Ltd. continued exploration and completed all four planned drill holes by yearend. At yearend the company continued to work towards completing its first National Instrument (NI) 43-101-compliant mineral resource report, estimated for completion in early 2009 (Rare Element Resources, 2009).

## Commodity Review

### Industrial Minerals

**Limestone.**—Pete Lien & Sons, Inc. (Rapid City, SD) remained in the permitting process for the new high-purity limestone quarry 16 km north of Laramie. The limestone is part of the Casper Formation, which crops out extensively along the western flank of the Laramie Mountains. Construction of the quarry and plant, expected to employ at least 50 workers, was planned to begin in late 2009.

**Soda Ash.**—Soda ash [also known as sodium carbonate ( $\text{Na}_2\text{CO}_3$ )] is refined from trona. In southwestern Wyoming, trona is found as an evaporate mineral in the Wilkins Peak Member of the Eocene Green River Formation. The Wilkins Peak Member consists of trona beds up to about 12 m (40 feet) thick separated intermittently by shale-like sediments, sandstone, and carbonate rocks at depths between roughly 180–610 m (about 600–2,000 feet). Approximately 1.8 metric tons (t) of trona, which is roughly 70% sodium carbonate, are required to produce 1 t of refined soda ash. Wyoming hosts the world's largest trona deposits with an estimated resource of more than 115 billion t (127 billion short tons) (Leigh, 1998). Four companies operate five plants in the Green River Basin in southwestern Wyoming—primarily Sweetwater County—and accounted for the vast majority of the approximately 11.3 million metric tons (Mt) of all soda ash produced in the United States in 2008. Total U.S. production in 2008 was valued over \$1.5 billion. This is up slightly from the total U.S. production of 11.1 Mt, valued at almost \$1.3 billion, in 2007.

In 2008, the soda ash industry attempted to introduce two increases in the list and off-list price for bulk soda ash—a \$50-per-short-ton increase in May and a \$40-per-short-ton increase in August due to increases in energy and transportation costs. Glass (49%), chemicals (30%), and soap and detergents (8%) accounted for an estimated 87% of the end uses for soda ash in 2008 (Kostick, 2009). The effect of the dramatic drop in the price of oil and the economic downturn at the end of 2008 on the soda ash industry remained unknown at yearend.

**Stone, Dimension.**—From domestic and foreign companies alike, interest in potential sources for decorative stone continued through most of 2008 with little impact from the economic downturn. Strid Marble & Granite Co. (Cheyenne) continued to produce “Wyoming Gray Sandstone” and was in the exploration stages for a suitable granite product. The State has a wide variety of known dimensional and decorative stone deposits, notably granite, sandstones, quartzite, marble, gneiss, limestone, and some volcanic rocks. WSGS has published several information circulars on decorative stone over the past two decades (Harris, 1991; Harris, 2003).

**Zeolites.**—Water Remediation Technologies Inc. continued to control the only commercial zeolite deposit in Sweetwater County but no production has been reported from the quarry in the last several years.

## Government Activities

The WSGS continued to be an active participant in the STATEMAP program. STATEMAP is a component of the congressionally mandated National Cooperative Geologic Mapping Program (NCGMP), through which the USGS distributes Federal funds to support geologic mapping efforts through a competitive funding process. The NCGMP has three primary components: (1) FEDMAP, which funds Federal geologic mapping projects, (2) STATEMAP, which is a matching-funds grant program with State geological surveys, and (3) EDMAP, a matching-funds grant program with universities that has a goal to train the next generation of geologic mappers. In 2008, WSGS, in cooperation with the STATEMAP program, continued work on the 30' x 60' Pinedale, Lander, Rock Springs, Firehole Canyon, Kinney Rim, and Rawlins quadrangles, as well as on 1:24,000-scale maps of the Laramie and Pilot Hills areas.

For additional information on the State's minerals and minerals production, geologic maps, recently printed and digital publications, and further information on the geology of Wyoming, visit the WSGS home page at <http://www.wsgs.uwyo.edu/>.

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TABLE 1  
 NONFUEL RAW MINERAL PRODUCTION IN WYOMING<sup>1,2</sup>

(Thousand metric tons and thousand dollars)

Mineral	2006		2007		2008	
	Quantity	Value	Quantity	Value	Quantity	Value
Clays:						
Bentonite	4,360	209,000	4,250	227,000	4,520	214,000
Common	53	206	59	226	37	89
Gemstones, natural	NA	14	NA	15	NA	14
Sand and gravel, construction	17,200	74,600	19,100	95,800	17,100	100,000
Stone, crushed	12,500	70,700 <sup>r</sup>	12,500 <sup>r</sup>	61,400 <sup>r</sup>	12,100	57,100
Combined values of cement (portland), gypsum (crude), helium (Grade-A), lime, soda ash, stone [dimension (2008)], zeolites (2006–07)	XX	1,240,000	XX	1,370,000	XX	1,640,000
Total	XX	1,590,000	XX	1,760,000 <sup>r</sup>	XX	2,020,000

<sup>r</sup>Revised. NA Not available. XX Not applicable.

<sup>1</sup>Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

TABLE 2  
 WYOMING: CRUSHED STONE SOLD OR USED, BY TYPE<sup>1</sup>

Type	2007			2008		
	Number of quarries	Quantity (thousand metric tons)	Value (thousands)	Number of quarries	Quantity (thousand metric tons)	Value (thousands)
Limestone <sup>2</sup>	17 <sup>r</sup>	3,470 <sup>r</sup>	\$21,400 <sup>r</sup>	16	5,460	\$32,700
Volcanic cinder and scoria	11 <sup>r</sup>	4,050 <sup>r</sup>	23,500 <sup>r</sup>	12	1,630	8,530
Miscellaneous stone	4	4,950	16,500	4	5,010	15,900
Total	XX	12,500 <sup>r</sup>	61,400 <sup>r</sup>	XX	12,100	57,100

<sup>r</sup>Revised. XX Not applicable.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Includes limestone-dolomite reported with no distinction between the two.

TABLE 3  
WYOMING: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 2008, BY USE<sup>1</sup>

(Thousand metric tons and thousand dollars)

Use	Quantity	Value
Construction:		
Coarse aggregate (+ 1½ inch), riprap and jetty stone	W	W
Coarse and fine aggregates:		
Graded road base or subbase	W	W
Unpaved road surfacing	W	W
Other coarse and fine aggregates	53	126
Other construction materials	4	27
Chemical and metallurgical, cement manufacture	W	W
Unspecified, reported <sup>2</sup>	10,900	49,700
Total	12,100	57,100

W Withheld to avoid disclosing company proprietary data; included in "Total."

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Reported production without a breakdown by end use.

TABLE 4  
WYOMING: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 2008, BY USE AND DISTRICT<sup>1</sup>

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		Unspecified districts	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction:						
Coarse aggregate (+ 1½ inch) <sup>2</sup>	W	W	--	--	--	--
Coarse and fine aggregate <sup>3</sup>	W	W	W	W	--	--
Other construction materials	--	--	4	27	--	--
Chemical and metallurgical <sup>4</sup>	--	--	W	W	--	--
Unspecified, reported <sup>5</sup>	147	863	8,210	48,200	2,510	661
Total	202	996	9,400	55,400	2,510	661

W Withheld to avoid disclosing company proprietary data; included in "Total." -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Includes riprap and jetty stone.

<sup>3</sup>Includes graded road base or subbase, unpaved road surfacing, and other coarse and fine aggregates.

<sup>4</sup>Includes cement manufacture.

<sup>5</sup>Reported production without a breakdown by end use.

TABLE 5  
WYOMING: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2008,  
BY MAJOR USE CATEGORY<sup>1</sup>

Use	Quantity (thousand metric tons)	Value (thousands)	Unit value
Concrete aggregate (including concrete sand) <sup>2</sup>	946	\$10,700	\$11.28
Plaster and gunite sands	50	607	12.14
Asphaltic concrete aggregates and other bituminous mixtures	591	6,700	11.34
Road base and coverings	5,430	32,900	6.06
Road stabilization (lime)	42	597	14.21
Fill	996	4,200	4.21
Snow and ice control	45	752	16.71
Railroad ballast	55	480	8.73
Filtration	1	4	4.00
Other miscellaneous uses	54	226	4.19
Unspecified: <sup>3</sup>			
Reported	7,210	33,600	4.66
Estimated	1,630	9,610	5.90
Total or average	17,100	100,000	5.89

<sup>1</sup>Data are rounded to no more than three significant digits, except unit value; may not add to totals shown.

<sup>2</sup>Includes plaster and gunite sands.

<sup>3</sup>Reported and estimated production without a breakdown by end use.

TABLE 6  
WYOMING: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2008,  
BY USE AND DISTRICT<sup>1</sup>

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		Unspecified districts	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregates (including concrete sand) <sup>2</sup>	456	6,500	295	2,060	245	2,720
Asphaltic concrete aggregates and other bituminous mixtures	178	2,130	107	1,100	306	3,470
Road base and coverings	1,770	12,700	2,500	12,800	1,160	7,500
Road stabilization (lime)	--	--	42	597	--	--
Fill	772	3,090	112	611	112	492
Filtration	1	4	--	--	--	--
Other miscellaneous uses <sup>3</sup>	45	449	82	721	27	289
Unspecified: <sup>4</sup>						
Reported	1,570	8,840	1,120	7,150	4,520	17,600
Estimated	665	3,920	965	5,690	--	--
Total	5,450	37,600	5,220	30,700	6,380	32,100

-- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Includes plaster and gunite sands.

<sup>3</sup>Includes railroad ballast, and snow and ice control.

<sup>4</sup>Reported and estimated production without a breakdown by end use.