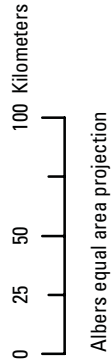
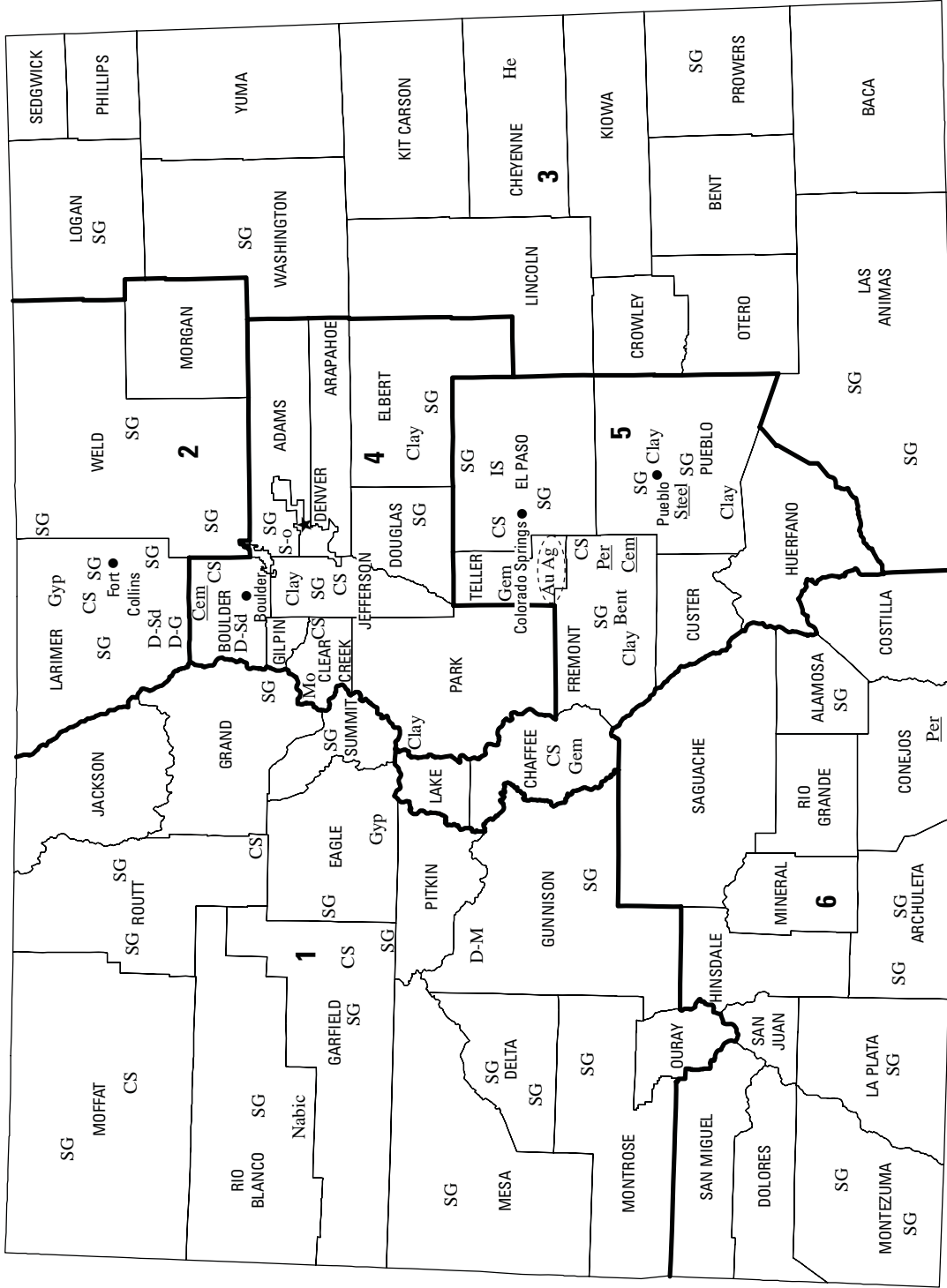




2006 Minerals Yearbook

COLORADO

COLORADO



LEGEND

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

**MINERAL SYMBOLS
(Major producing areas)**

- Ag Silver
- Au Gold
- Bent Bentonite
- Cem Cement plant
- Clay Common clay
- CS Crushed stone
- D-G Dimension granite
- D-M Dimension marble
- D-Sd Dimension sandstone
- Gem Gemstones
- Gyp Gypsum
- He Helium
- IS Industrial sand
- Mo Molybdenum
- Nabic Sodium bicarbonate
- Per Perlite plant
- S-o Sulfur (oil)
- SG Construction sand and gravel
- Sh Shale
- Steel Steel plant
- Concentration of mineral operations

THE MINERAL INDUSTRY OF COLORADO

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

In 2006, Colorado's nonfuel raw mineral production¹ was valued at \$1.68 billion, based upon annual U.S. Geological Survey (USGS) data. This was a 4% decrease from the State's total nonfuel mineral production value of 2005, following a 73% increase from 2004 to 2005. Colorado was 13th in rank (10th in 2005) among the 50 States in nonfuel mineral production value, while accounting for about 2.5% of the U.S. total value in 2006.

The State's two leading nonfuel mineral commodities in 2006, by value, were molybdenum concentrates and construction sand and gravel, followed by cement (portland and masonry), gold, and crushed stone. These five commodities accounted for more than 98% of Colorado's total nonfuel raw mineral production value. The largest increases in value took place in construction sand and gravel, gold, and portland cement. A 7% increase in construction sand and gravel production led to a \$47 million, or 17%, increase in the commodity's value of production. Although a small decrease took place in gold production, a significant increase in its unit value resulted in a more than \$30 million rise in its production value. The production of portland cement was also down slightly, but an increase in its unit value resulted in a significant increase in the commodity's value (data withheld—company proprietary data). Smaller yet significant increases also took place in the values of produced Grade-A helium, lime, and crushed stone (table 1). The only substantial decrease in a nonfuel mineral commodity value was in the production value of molybdenum concentrates. Although molybdenum production increased by about 10% as compared with that of 2005, the total production value of molybdenum concentrates decreased by more than \$150 million, owing to a drop in its unit value.

Approximately 62% of Colorado's nonfuel mineral production value in 2006 resulted from the production of metals—molybdenum concentrates, gold, and silver—in descending order of value; this was down somewhat from the recent high of 65% in 2005, following a 52% share in 2004, 30% in 2003, and 23% in 2002. Although gold, especially, also shared in the increased percentage of metals value, the largest share of the increases from 2003-06 (as compared with recent years past) mainly resulted from the significantly higher increases in the average annual prices of molybdenum concentrates.

In 2006, Colorado continued to be second in the quantity of molybdenum in concentrates produced among seven producing States and fourth of 11 gold-producing States. The State rose to seventh from ninth in construction sand and gravel production and continued to produce significant quantities (in descending

¹The 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 2006 USGS mineral production data published in this chapter are those available as of March 2008. 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>.
COLORADO—2006

order of value) of portland cement, crushed stone, crude gypsum, common clays, and gemstones (gemstones based upon value).

The following narrative information was provided by the Colorado Geological Survey² (CGS) and much of the data are based on its own surveys, estimates, and information gathered from company annual reports.

Exploration and Development Activities

Mineral exploration and development activity increased in 2006. New mining claims filed pertaining to mineral resources on Federal land in the State totaled 5,693. While many of these claims were likely aimed at uranium resources, interest in other mineral resources was evident.

Copper.—Constellation Copper Corporation, Lakewood, continued its interest in developing the Cashin deposit, a sandstone-hosted copper prospect in Montrose County near the Colorado-Utah border. If developed, Cashin would be a satellite operation to Constellation's Lisbon Valley Mine, located 24 kilometers (km) southwest in Utah. The Lisbon Valley Mine and processing facilities began copper production in 2006. The Cashin deposit could add several years of copper production to the Lisbon Valley operation. Constellation's consultants have estimated that Cashin contains 5.2 million metric tons (Mt) of probable ore reserves grading 0.547% copper. Copper was originally discovered in the Cashin area in 1896 and was mined from 1899 to the 1950s. Mineralization consists primarily of malachite and azurite, with chalcocite, chrysocolla, and neotocite also present. Native copper (and some native silver) was occasionally found in high-grade portions of the historic mine. Copper mineralization at Cashin is hosted by the Wingate Sandstone of Triassic age (Constellation Copper Corporation, 2006, p. 11).

Gold and Silver.—Wits Basin Precious Minerals Inc., Minneapolis, MN, continued development of the Bates-Hunter Mine in Gilpin County. Wits Basin controls the mine and mill and holds active mining and water discharge permits that would enable 64,000 metric tons per year (t/yr) of gold ore to be processed. The Bates-Hunter Mine had been a gold producing mine during the period from the 1860s to the 1930s and had been worked to the 245-meter (m) level. Many mines in the district near Bates-Hunter were producing gold mines at levels greater than 600 m. Wits Basin conducted additional drilling tests during the year and began a defined program to dewater existing mine shafts.

Calais Resources, Inc. focused on defining the mineral deposit at its Caribou Consolidated Project near Nederland, Boulder

²James A. Cappa, Geologist and Chief, James Burnell, Geologist, Mineral Resources and Mapping, Colorado Geological Survey, authored the text of the State mineral industry information provided by that agency.

County. The deposit is located on a property that consists of an assemblage of various patented and unpatented claims and operational rights that extend more than 890 hectares (ha). Results of nearly 43,000 m of core drilling have indicated that an estimated 12,400 kilograms (kg) (400,000 troy ounces) of gold and 390,000 kg (12.5 million troy ounces) of silver are contained in the Caribou Consolidated property.

Minerex Corporation, Shawneetown, IL, received State and county permits to begin mining gold in the small underground Little Hope Mine north of Cripple Creek. The company had applied for permits from the State of Colorado and Teller County in 2004. It was anticipated that any gold ore mined at Little Hope would be processed at a custom mill located elsewhere. No mining was carried out in 2006.

Molybdenum.—Plans for operation of the Lucky Jack Mine (formerly known as Mount Emmons) were begun during the year. The mine consists of 25 patented and 520 unpatented mining claims covering about 2,200 ha, 8 km northwest of Crested Butte in Gunnison County. This significant molybdenum property was first discovered by Amax Inc. in 1974 on leases owned by U.S. Energy Corporation. Amax delineated a large ore body at the site reportedly containing approximately 140 Mt of mineralization averaging 0.44% molybdenite. Amax progressed toward mine development by completing nearly 61,000 m of core drilling, developing a 1,300-m drift, and constructing a water treatment plant on the property. In 2006 the property was re-acquired by U.S. Energy Corporation and Crested Corporation, at which time it was renamed the Lucky Jack Project. The companies initiated an operations plan for the mine that included using a longhole stoping mining method and a paced backfill system to minimize surface and visual impacts resulting from extraction of the ore. The goal was to have the operations plan completed in 2007, a feasibility study completed in 2008, and an environmental impact statement received in 2010. Mill construction would then begin in 2011 with operation of the mine and mill expected to begin in 2013.

Phelps Dodge Corporation, prompted by the sustained high price of molybdenum, announced plans to conduct a feasibility study on the reopening of the Climax Molybdenum Mine. The mine, located on the continental divide at Fremont Pass between Leadville and Copper Mountain, had been on care-and-maintenance status since 1995. A prefeasibility study showed that the mine would likely produce from 9,100 to 13,600 t/yr of molybdenum and employ 300 workers (Keller, Carroll, and Widmann, 2006). The Climax deposit is estimated to still contain 142 Mt of ore grading 0.19% molybdenite. Phelps Dodge planned to demolish the original facilities at the mine and replace them with new structures, including a mill to process about 27,000 metric tons per day of ore. Production at the Climax Mine has been targeted to be about 10,900 t/yr of molybdenum.

In November, Freeport-McMoRan Copper & Gold Inc. agreed to acquire Phelps Dodge for about \$26 billion. The merger was recommended by each company's board of directors and was to be presented for shareholder approval in the first quarter of 2007 (Metal Bulletin, 2006).

Commodity Review

Industrial Minerals

Cement.—Cemex, Inc. produced portland and masonry cement at its Boulder County cement plant. Holcim (US), Inc. continued to operate its portland cement plant near Florence in Fremont County. GCC Rio Grande, Inc. (a subsidiary of Grupo Cementos de Chihuahua) continued the planning and permitting process for a new cement plant in Pueblo. The plant is scheduled to open in 2008 and produce about 0.9 million metric tons per year of cement.

Clay and Shale.—Production of clay in 2006 decreased by 17% compared with that of 2005. Most of the clay mined in the State was common clay, used mainly to produce bricks and tiles or in the manufacture of cement and lightweight aggregate. Common clay was mined principally in eastern Colorado, especially near the Front Range in Elbert, El Paso, Douglas, Fremont, Jefferson, and Pueblo Counties. The clay was recovered mainly from the Laramie Formation (Upper Cretaceous), the Dakota Sandstone (Lower Cretaceous), and the Dawson Formation (Upper Cretaceous to Tertiary). Principal producers of clay products were Robinson Brick Co., Denver Brick Co., Summit Brick and Tile Co., and TXI Operations (Texas Industries).

Gypsum.—Producers of gypsum during the year were American Gypsum in Eagle County and Colorado Lein in Larimer County. American Gypsum operated a wallboard manufacturing plant in Gypsum, adjacent to its mine. The gypsum was excavated from evaporite deposits using a surface grinding method. Colorado Lein produced gypsum from the Permian Lykins Formation for use within the State in the cement industry.

Soda Ash.—Natural Soda, Inc. used solution mining to recover naturally occurring sodium bicarbonate from nahcolite on leases in the Piceance Basin of Rio Blanco County.

Stone, Crushed, and Sand and Gravel.—An estimated 60 Mt of construction aggregate was produced in 2006, up 4% compared with that of 2005. The value of the aggregate produced was estimated to have increased by 12% compared with that of 2005, reflecting an overall increase in the price of aggregate materials. Statewide, sand and gravel represented 80% of the total aggregate production. Aggregate Industries and Lafarge West, Inc. operated a significant portion of the aggregate production facilities within the State.

Stone, Dimension.—Granite, marble, rhyolite and sandstone (flagstone) were the principal varieties of dimension stone produced in 2006. Approximately 18,000 metric tons of dimension and decorative stones were produced during the year, with a value of \$2.4 million. The Yule Marble quarry in Gunnison County has produced a pure, white marble that has been used at the Lincoln Memorial, Washington, DC, and the Tomb of the Unknowns, Arlington National Cemetery. Red granite from the Red Rose quarry, alabaster from the Lykins formation, and Lyons sandstone each were produced in Larimer County. Colorado Quarries produced decorative and landscape stone from facilities in Chaffee, Custer, Fremont, and Teller Counties.

Metals

Gold and Silver.—Cripple Creek and Victor Gold Mining Co., (CC&V) (a subsidiary of AngloGold Ashanti, Ltd. of South Africa) operated the Cresson Mine in Teller County, the leading producer of precious metals in the State. The company processed about 5.4 Mt of ore during the year, from a reserve estimated to be about 129 Mt, containing 72,000 kg (2.33 million troy ounces) of recoverable gold. Silver also was produced as a byproduct of the gold mining.

Two smaller underground mines also produced gold in 2006. The Golden Wonder Mine in Hinsdale County mined high-grade ore from the rocks of the San Juan volcanic field. Since 2000, the Golden Wonder Mine has produced an average of 675 kg (21,750 troy ounces) per year of gold from ore grading 0.55 kg (17.9 troy ounces) per metric ton. The Cash Mine in Boulder County began producing from the Gold Hill District west of the city of Boulder at yearend. The Cash property consists of 18 former gold producing mines covering an area of about 195 ha.

Molybdenum.—Colorado remained the second leading molybdenum producing State in 2006, with more than one-

fourth of the United States production derived from the Henderson Mine in Clear Creek County, operated by the Climax Molybdenum Company. Ore from the Henderson Mine was transported beneath the Continental Divide to the company's mill in Grand County by a 24-km-long conveyer. The Henderson Mine has yielded more than 150 Mt of ore that have resulted in the production of about 0.38 Mt of molybdenum. Reserves are estimated to be more than 136 Mt, containing approximately 0.23 Mt of recoverable molybdenum.

References Cited

- Constellation Copper Corporation, 2006, Technical report—Cashin copper deposit: Lakewood, CO, Constellation Copper Corporation, 76 p. (Accessed July 30, 2008, at <http://constellationcopper.com/art/lisbon/Constellation.Cashin.43-101.162302.KG.pdf>.)
- Keller, J., Carroll, C. and Widmann, B., 2006, Mining Engineering Annual Review 2005: Colorado, v. 58, no. 5, p. 75.
- Metal Bulletin, 2006, Freeport McMoRan to buy Phelps Dodge for \$25.9 BN: Metal Bulletin, no. 8972, November 27, p. 14.

TABLE 1
NONFUEL RAW MINERAL PRODUCTION IN COLORADO^{1, 2}

(Thousand metric tons and thousand dollars)

Mineral	2004		2005		2006	
	Quantity	Value	Quantity	Value	Quantity	Value
Clays:						
Bentonite	5	W	W	W	W	40
Common	249	1,510	255	1,610	211	1,300
Gemstones, natural ³	NA	360	NA	358	NA	261
Lime	26	2,570	29	3,900	50	5,750
Sand and gravel:						
Construction	40,900	235,000	44,700	280,000	48,000	327,000
Industrial	W	3,300	W	W	W	W
Stone:						
Crushed	11,100	68,300	13,200 ^r	90,500 ^r	12,100	88,800
Dimension	16	1,980	18	2,400	18	2,400
Combined values of cement, gold, gypsum (crude), helium (Grade-A), molybdenum concentrates, silver, soda ash (2004), and values indicated by the symbol W	XX	699,000	XX	1,380,000	XX	1,250,000
Total	XX	1,010,000	XX	1,750,000	XX	1,680,000

^rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data. Withheld values included in "Combined value" data.

XX Not applicable.

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

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

³Includes production of freshwater shell.

TABLE 2
 COLORADO: CRUSHED STONE SOLD OR USED, BY KIND¹

Kind	2005			2006		
	Number of quarries	Quantity (thousand metric tons)	Value (thousands)	Number of quarries	Quantity (thousand metric tons)	Value (thousands)
Limestone	6	1,540	\$11,300	7	1,380	\$13,200
Dolomite	1	42	290	1	22	209
Marble	2 ^r	W	W	1	W	W
Granite	10	6,240	42,400	10	5,630	38,900
Traprock	1	W	W	1	W	W
Sandstone and quartzite	8 ^r	4,440 ^r	30,500 ^r	8	3,990	29,200
Volcanic cinder and scoria	3	159	1,080	3	151	975
Miscellaneous stone	8 ^r	624 ^r	3,910 ^r	16	890	6,040
Total	XX	13,200 ^r	90,500 ^r	XX	12,100	88,800

^rRevised. W Withheld to avoid disclosing company proprietary data; included in "Total." XX Not applicable.

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

TABLE 3
 COLORADO: CRUSHED STONE SOLD OR USED BY PRODUCERS
 IN 2006, BY USE¹

(Thousand metric tons and thousand dollars)

Use	Quantity	Value
Construction:		
Coarse aggregate (+1½ inch):		
Riprap and jetty stone	507	6,370
Filter stone	192	1,890
Other coarse aggregate	118	513
Total	817	8,780
Coarse aggregate, graded:		
Concrete aggregate, coarse	W	W
Bituminous aggregate, coarse	1,060	8,950
Bituminous surface-treatment aggregate	W	W
Railroad ballast	W	W
Total	1,130	9,780
Fine aggregate (-¾ inch):		
Stone sand, bituminous mix or seal	(2)	(2)
Screening, undesignated	(2)	(2)
Other fine aggregate	129	1,530
Coarse and fine aggregates:		
Graded road base or subbase	472	1,980
Unpaved road surfacing	W	W
Terrazzo and exposed aggregate	W	W
Crusher run or fill or waste	145	251
Other coarse and fine aggregates	51	277
Total	707	2,800
Other construction materials	12	85
Chemical and metallurgical:		
Cement manufacture	(2)	(2)
Sulfur oxide removal	(2)	(2)
Special, mine dusting or acid water treatment	(2)	(2)
Unspecified: ³		
Reported	707	4,810
Estimated	7,500	56,000
Total	8,240	61,200
Grand total	12,100	88,800

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

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

²Withheld to avoid disclosing company proprietary data; included in "Grand total."

³Reported and estimated production without a breakdown by end use.

TABLE 4
 COLORADO: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 2006, BY USE AND DISTRICT^{1,2}

(Thousand metric tons and thousand dollars)

Use	Districts 1, 4 and 5 ³		District 2		District 6	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction:						
Coarse aggregate (+1½ inch) ⁴	799	8,650	--	--	18	130
Coarse aggregate, graded ⁵	1,130	9,780	--	--	--	--
Fine aggregate (-¾ inch) ⁶	W	W	--	--	--	--
Coarse and fine aggregates ⁷	703	2,770	--	--	4	26
Other construction materials	12	85	--	--	--	--
Chemical and metallurgical ⁸	W	W	--	--	--	--
Special ⁹	W	W	--	--	--	--
Unspecified: ¹⁰						
Reported	623	4,230	--	--	6	42
Estimated	7,400	56,000	103	706	--	--
Total	11,900	87,300	103	706	28	198
Unspecified districts						
	Quantity	Value				
Construction:						
Coarse aggregate (+1½ inch) ⁴	--	--				
Coarse aggregate, graded ⁵	--	--				
Fine aggregate (-¾ inch) ⁶	--	--				
Coarse and fine aggregates ⁷	--	--				
Other construction materials	--	--				
Chemical and metallurgical ⁸	--	--				
Special ⁹	--	--				
Unspecified: ¹⁰						
Reported	78	537				
Estimated	--	--				
Total	78	537				

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

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

²No production for District 3.

³Districts 1, 4 and 5 are combined to avoid disclosing company proprietary data.

⁴Includes filter stone, riprap and jetty stone, and other coarse aggregate.

⁵Includes bituminous aggregate (coarse), bituminous surface-treatment aggregate, concrete aggregate (coarse), and railroad ballast.

⁶Includes stone sand (bituminous mix or seal), screening (undesignated), and other fine aggregate.

⁷Includes crusher run or fill or waste, graded road base or subbase, terrazzo and exposed aggregate, unpaved road surfacing, and other coarse and fine aggregates.

⁸Includes cement manufacture and sulfur oxide removal.

⁹Includes mine dusting or acid water treatment.

¹⁰Reported and estimated production without a breakdown by end use.

TABLE 5
 COLORADO: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2006,
 BY MAJOR USE CATEGORY¹

Use	Quantity		
	(thousand metric tons)	Value (thousands)	Unit value
Concrete aggregate (including concrete sand)	8,630	\$62,700	\$7.27
Plaster and gunite sands	48	470	9.74
Concrete products (blocks, bricks, pipe, decorative, etc.)	422	3,050	7.23
Asphaltic concrete aggregates and other bituminous mixtures	2,360	19,000	8.06
Road base and coverings	7,130	42,100	5.90
Road and other stabilization (cement)	90	353	3.95
Fill	1,540	7,080	4.61
Snow and ice control	179	3,060	17.07
Filtration	7	54	7.65
Other miscellaneous uses	369	2,540	6.90
Unspecified: ²			
Reported	3,720	27,000	7.27
Estimated	23,500	159,000	6.78
Total or average	48,000	327,000	6.81

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

²Reported and estimated production without a breakdown by end use.

TABLE 6
 COLORADO: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2006, BY USE AND DISTRICT¹

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate and concrete products ²	952	9,950	2,180	18,400	76	735
Asphaltic concrete aggregates and road base materials ³	2,020	14,900	1,460	10,300	1,540	8,670
Fill	125	525	462	1,970	--	--
Other miscellaneous uses ⁴	143	1,380	176	1,260	--	--
Unspecified: ⁵						
Reported	803	11,100	898	6,030	--	--
Estimated	4,710	31,700	9,820	66,600	1,250	8,500
Total or average	8,760	69,600	15,000	104,000	2,870	17,900
Use	District 4		District 5		District 6	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate and concrete products ²	3,070	19,900	2,490	14,300	331	2,950
Asphaltic concrete aggregates and road base materials ³	946	4,580	1,130	4,930	2,480	18,100
Fill	671	3,480	128	421	151	694
Other miscellaneous uses ⁴	155	2,270	70	594	10	163
Unspecified: ⁵						
Reported	41	371	178	448	1,220	7,930
Estimated	3,890	26,400	2,800	19,200	1,010	6,850
Total or average	8,770	56,900	6,790	39,900	5,200	36,700
Use	Unspecified districts					
	Quantity	Value				
Concrete aggregate and concrete products ²	--	--				
Asphaltic concrete aggregates and road base materials ³	--	--				
Fill	--	--				
Other miscellaneous uses ⁴	--	--				
Unspecified: ⁵						
Reported	584	1,130				
Estimated	--	--				
Total or average	584	1,130				

-- Zero.

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

²Includes plaster and gunite sands.

³Includes road and other stabilization (cement).

⁴Includes snow and ice control and filtration.

⁵Reported and estimated production without a breakdown by end use.