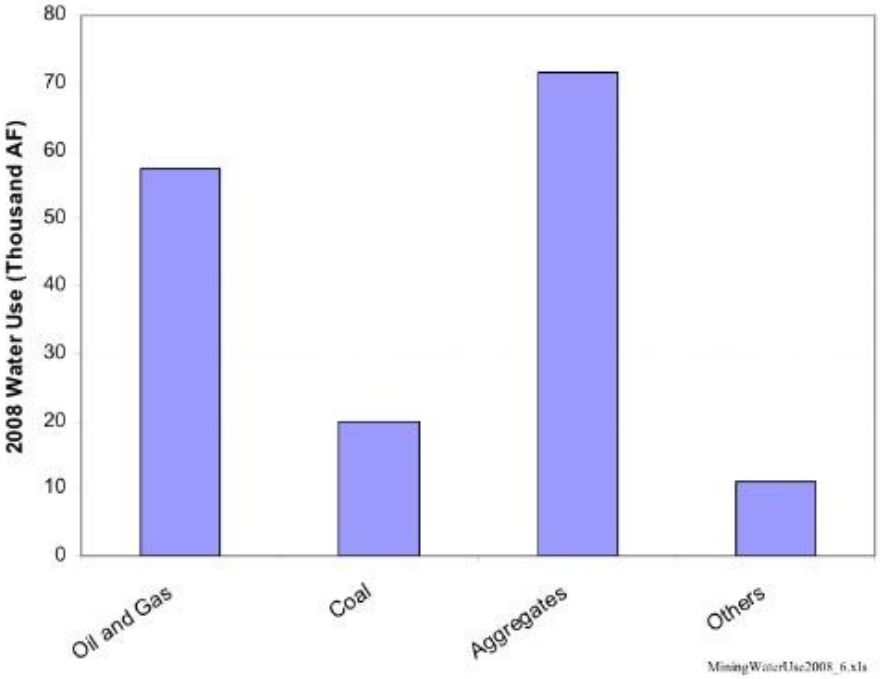


Figure 114. Summary of water use by mining industry segment (2008)

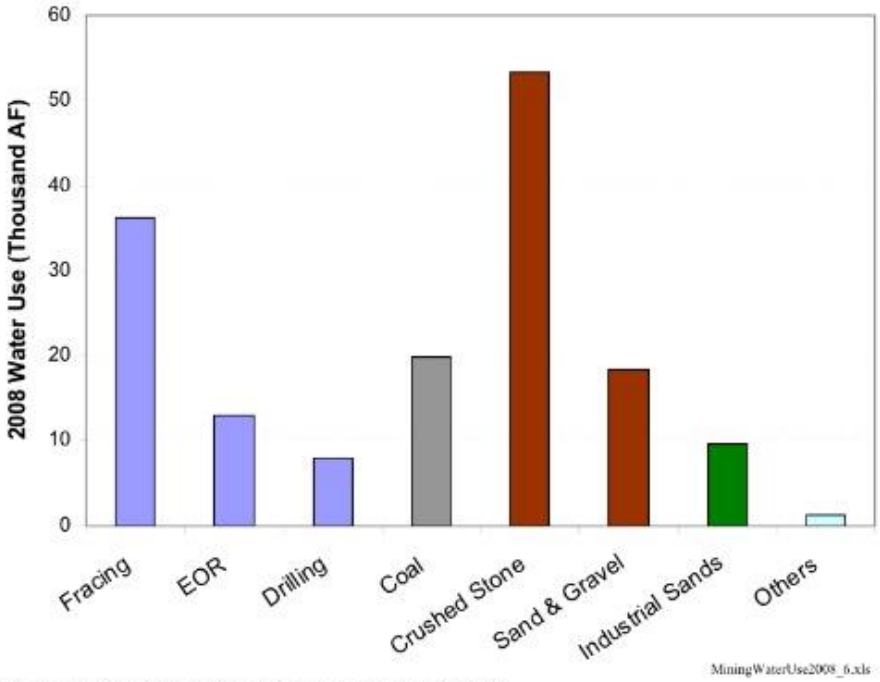
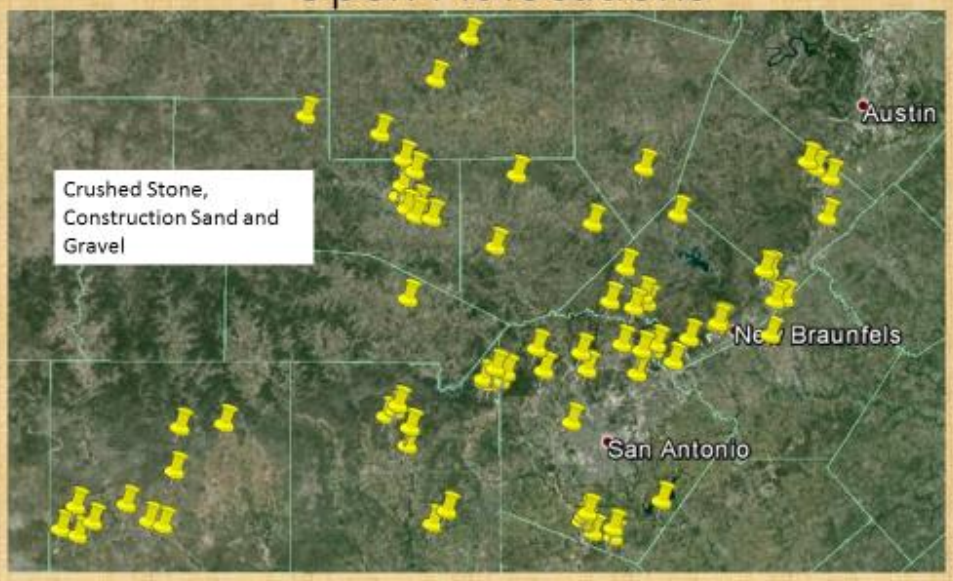


Figure 115. Summary of water use by category (2008)

5.4 Aggregates

Key parameters for future aggregate water use relating population and aggregate production are presented in Table 66, Figure 128, and Figure 129. We assumed that crushed stone and construction sand and gravel will follow a trajectory similar to that of the past 2 decades. The production trajectory considered deviates from strict linear extrapolation of historical data and is somewhat flattened. The increased gap between crushed-stone and sand and gravel operations (Figure 129) is consistent with the societal trend of having large operations at one location for a long period of time, rather than having dispersed generally smaller sand and gravel operations. However, both categories are expected to grow in the future. The overall growth rate is 1.5%–2% (Table 66). Some analysts have projected an annual growth in the industry of 3%–5% (Walden and Baier, 2010). Although industry has been significantly impacted by the current economic recession, it is anticipated that demand for aggregate products will continue to grow with the population and the need for roadway and other building materials. It is not clear, however, how a 3% annual growth (translating into a production of ~1,200 million tons/yr in 2060) can be sustained in terms of water use without increasing water recycling or developing dry processes. The aggregate water use projections presented in this report can therefore be construed as either modest annual growth with no change from current practices or higher annual growth with concomitant decrease in water use intensity. In addition, although most mining facilities are operated for at least 20 years, and although some larger operations have 100 years or more of reserves, small "mom & pop" quarries may be operated for as little as 5 years and are often associated with specific development projects or other short-term, localized demands. This observation carries the understanding that many small facilities could appear in counties not listed in Table 68, which shows sand and gravel water-use projections. Table 67 does the same for crushed stone. Table 69 summarizes projections displayed at the county level in Figure 130, Figure 131, and Figure 132. Overall aggregate will increase from ~75 thousand AF/yr in 2010 to ~140 thousand AF/yr in 2060.

Open Pit locations



Water Demands

- Databases (MSHA, TCEQ, USGS, GCD) do not contain commodity production or water use
- Water comes from groundwater, surface water, stormwater

Table 37. Estimated county-level crushed-stone and sand and gravel water use for 2008 (other counties are assumed to have zero water use) – Units are thousands of AF

County	CS	S&G	County	CS	S&G	County	CS	S&G
Atascosa		0.350	Guadalupe		0.186	Nueces		0.445
Bastrop		0.063	Harris		2.494	Oldham	0.374	0.002
Bee	0.310		Hays	0.639		Orange		0.136
Bell	1.075	0.346	Henderson		0.115	Parker	1.041	0.253
Bexar	5.097	1.028	Hidalgo	0.898	0.603	Potter	0.388	0.308
Bosque	1.185	0.013	Hill	0.244		Reeves		0.008
Bosque			Hood	0.476		Sabine	0.282	
Brazoria		0.565	Hudspeth	0.438		San Patricio	0.188	0.055
Brazos		0.230	Hutchinson		0.023	San Saba	0.497	
Brown	0.857		Jack	0.778		Smith		0.106
Burnet	3.265	0.031	Jefferson		0.131	Somervell		0.398
Callahan	0.130		Johnson	0.314	0.075	Starr	0.180	0.142
Coke		0.003	Johnson			Tarrant		1.093
Colorado		1.540	Jones	0.103	0.010	Taylor	0.292	
Comal	6.593	0.099	Kaufman		0.195	Titus	0.178	
Cooke	0.146	0.026	Kerr		0.059	Tom Green	0.883	
Coryell	0.213		Lampasas	0.143	0.012	Travis	1.895	0.718
Dallas		1.574	Liberty		0.108	Upton	0.330	
Denton		1.262	Limestone	2.330		Uvalde	2.994	
Duval	0.150	0.604	Lubbock	0.123	0.415	Val Verde		0.031
Eastland	0.203		Marion	0.131		Van Zandt	0.195	
Ector	0.380		Maverick	0.000		Victoria		0.000
El Paso	2.402	0.581	McCulloch	1.131		Ward		0.016
Falls	0.187		McLennan	0.731	1.025	Washington		0.018
Fannin		0.006	Medina	1.406	0.063	Webb	0.100	0.005
Fayette		0.082	Midland	0.325		Wheeler	0.102	
Floyd	0.302		Mitchell	0.226		Williamson	3.759	
Fort Bend		0.000	Montague	0.321	0.010	Wise	5.477	0.229
Galveston		0.282	Montgomery		0.028			
Glasscock	0.326		Motley	0.123				
Grayson		0.041	Navarro	0.594	0.062	Total	53.3	18.3

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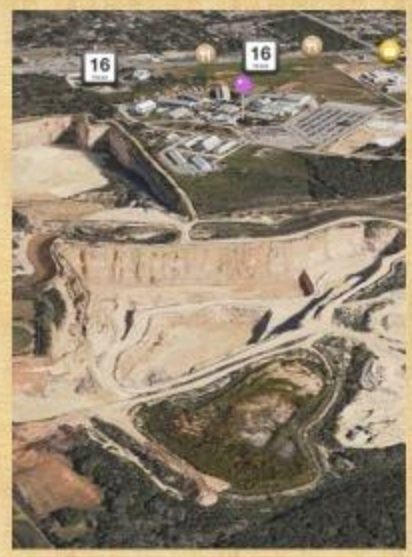
A Growing Metropolis



Edwards Aquifer Authority

Hydrologic Data Report for 2012
Report No. 13-01
December 2013

- Plotting contaminants exceeding the Maximum Contaminant Levels
  - antimony (6.78 detected, 6.0 safe),
  - arsenic (37.4 detected, 5.0 safe),
  - iron (3830 detected, 300 safe),
  - thallium (17.5 detected, 2 safe),
  - vanadium (6.9 detected, 1.7 safe),
  - maximum nitrate concentrations, pesticides, SVOCs, PPCPs, tetrachloroethylene, 2-chlorotoline, benzene, bromodichloromethane, boroform, carbon disulfate, carbon tetrachloride, chlorobenzene, chloroform, chloromethane, dibromochloromethane, di-n-butyl phthalate, diethyl phthalate, DHEP, 2 4-D, 4 4'-DDE.

"the presence of these compounds in samples is a concern, and is a positive indicator of human made compounds in the aquifer system

4. Failure to properly conduct the 90 day exceedance investigation following the 5/24/13 TSS exceedances at outfalls 001, 002, and 005 (notable exceedance of 13,600 mg/L at outfall 005 on 5/24/13). The Pollution Prevention Team states in the required 90 day follow up investigation of the exceedances, "the BMPs at outfalls 001, 002, and 005 were determined to be inadequate. The BMPs were reconstructed and samples will be taken at the next rain event." It is not clear what BMPs were reconstructed, why (the cause) they were failing, and why additional BMPs were not installed if the current BMPs were inadequate at outfalls 001, 002, and 005. It was noted during the investigation that outfall 001 had a sock tube filter installed in front of the outfall. This BMP cannot be reconstructed. Furthermore, it is not clear whether the sock tube filter had been installed before or after the 5/24/13 TSS exceedance.

Additionally, the Oil & Grease samples in 2013 were approximately 400% more from the previous year.

5/24/13 - outfall 002 oil grease: 25.6 mg/L; outfall 005 oil and grease: 60.3 mg/L.
5/15/12 - outfall 002 oil and grease: <5.0 mg/L; outfall 005 oil and grease <5 mg/L.
No discussion was provided as to why these values increased so much. PH levels showed roughly around 7 for the other outfalls, but outfall 002 showed over 8.2 for two consecutive years (2012 and 2013) without an explanation of why or that the Pollution Prevention Team investigated this matter. Outfall 002 is located approximately 40

Neighborhoods in NE Bexar County,

Over proposed VR Pipeline:

Seismic Activity

- Limestone is extracted by blasting it away from rock wall
- Engineered Process
- Uncontrolled- Neighborhoods feel vibrations
- Caves under neighborhoods
- If left uncontrolled, cave collapse is inevitable

Table 44. Estimates of groundwater–surface water split with estimates of withdrawal vs. consumption.

Mining Category	Total Withdrawal	Consumption	Withdrawal Groundwater	Withdrawal Surface Water	Consumption Surface Water	Consumption Surface Water
Barnett Shale	25,446	25,446	10,178	15,268	10,178	15,268
Haynesville and Bossier Shales	106	106	74	32	74	32
Eagle Ford Shale	68	68	68	0	68	0
PB and other Sh.	89	89	89	0	89	0
Anadarko B.	2,224	2,224	1,334	890	1,334	890
East Texas B.	4,258	4,258	2,555	1,703	2,555	1,703
Permian B. +C.B. Fm.	3,253	3,253	1,952	1,301	1,952	1,301
Gulf Coast B.	604	604	362	242	362	242
Total Fracing	***36,042***	***36,042***	***16,612***	***19,436***	***16,612***	***19,436***
Waterflood	12,951	12,951	10,361	2,590	12,951	12,951
Drilling	8,000	8,000	7,200	800	8,000	8,000
Total Oil&Gas						
Coal*	**19,895**	**2,560**	**18,449**	**1,452**	**1,116**	**1,447**
Crushed Rock	53,328	33,010	26,184	6,879	26,184	6,879
Sand&Gravel	18,293	13,720	4,573	6,860	4,573	6,860
Total Aggregate**	**71,621**	**46,730**	**30,757**	**13,739**	**30,757**	**13,739**
Other	**11,000**	**6,809**	**5,401**	**1,419**	**5,401**	**1,419**
Total Mining	**159,509**	**113,092**	**88,780**	**39,436**	**74,837**	**56,992**
		70.9% of Total Withdrawal	**55.7% of Total Withdrawal**		**62.7% of Total Consumption**	

Note: * a large fraction of withdrawal is for depressurization
** difference between withdrawal and consumption is "storm water"

Data have been obtained for the quarrying and processing of 570,000 tons and 250,000 tons of limestone, respectively. The average gross energy required to produce one ton of limestone is 0.808 million BTUs. Table 1 shows the breakdown of this gross energy per ton of limestone product produced. Table 2 displays the water required for the same production. Table 3 and 4 display the life-cycle inputs and outputs for both the quarrying and stone processing operations, as well as their accumulated totals. Table 5 gives the additional ancillary inputs required for the quarrying and stone processing operations, and Table 6 gives the ancillary outputs for these same processes. (Note that Tables 5 and 6 may be incomplete as level of detail reported for ancillary materials was quite varied.) Each of these tables are available in an excel spreadsheet for your convenience on the Natural Stone Council website.

Note that the abbreviations found in Tables 1-4 imply the following:

- W = Withheld to avoid disclosure of company proprietary information
- N/A = Not applicable due to a lack of data
- NR = Not reported by any facility (i.e., all surveys left this survey question blank)

Table 1. Gross energy to produce one ton of limestone products. [1]

Energy Type	*Energy Consumption (Btu/ton)*		
	Quarrying	*Processing*	*Total*
Electricity	2.03E+04	1.18E+05	1.38E+05
Natural Gas	1.50E-03	4.15E+05	4.15E+05
Propane	2.30E+02	3.22E+04	3.24E+04
Diesel	2.50E+05	4.77E+04	2.98E+05
Gasoline	7.31E+03	2.43E+04	3.16E+04
Other Fuel	NR	UA	UA
TOTAL	*2.78E+05*	*6.37E+05*	**9.14E+05**

[1] These values represent the total energy consumption at the quarry and processing sites only. See Table 3 for the complete LCI energy data.

Table 2. Water consumption for limestone quarrying and processing. [2]

Energy Type	*Water Consumption (gal/ton)*		
	Quarrying	*Processing*	*Total*
Groundwater	2.00E+01	2.43E+03	2.45E+03
Surface water	6.23E+02	7.23E+03	7.85E+03
Public supply	7.10E-02	9.66E+03	9.66E+03
TOTAL	*6.43E+02*	*1.93E+04*	**2.00E+04**

[2] These values represent the total water consumption at the quarry and processing sites only. See Table 3 for the complete LCI water data.

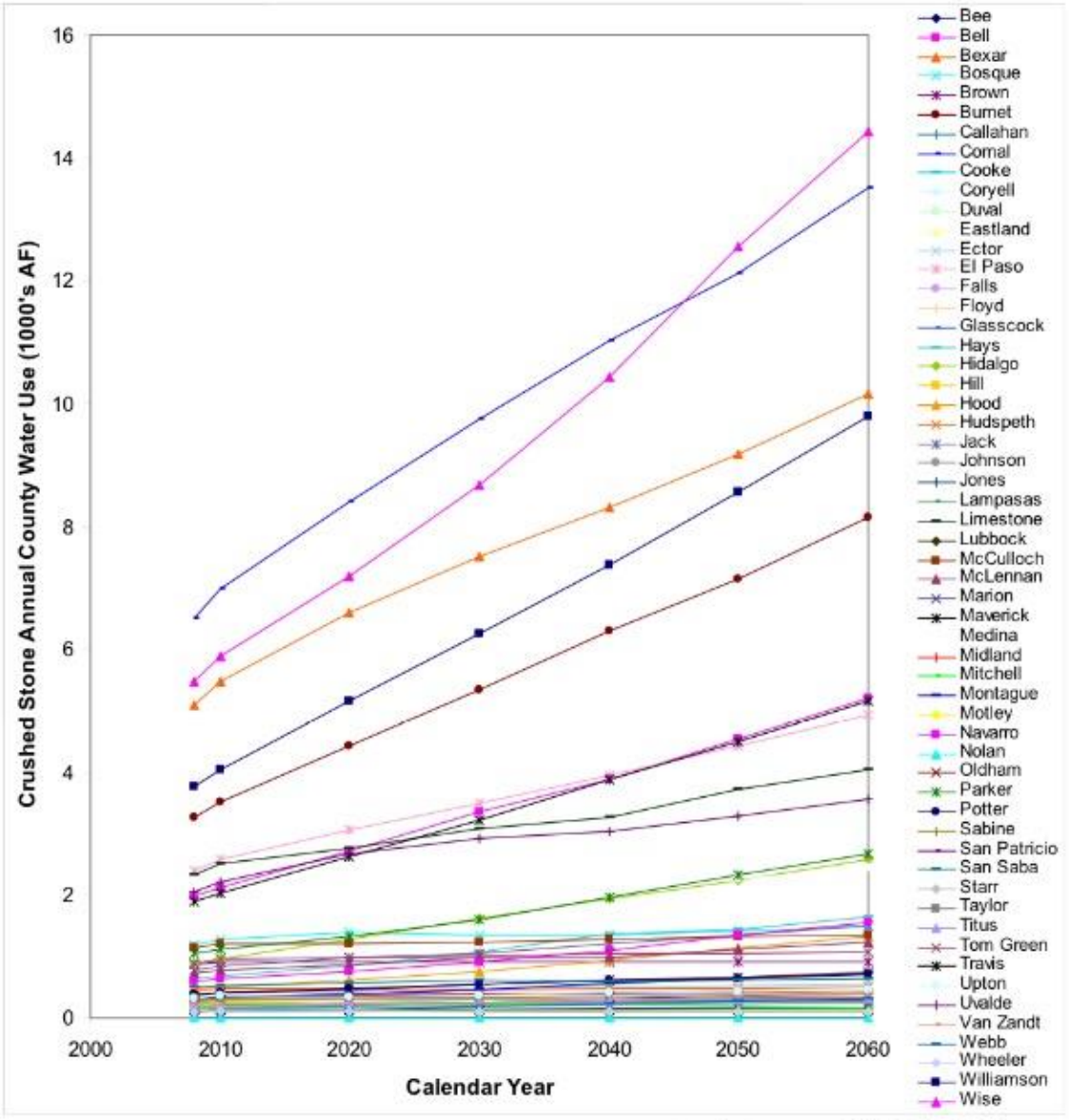


Figure 130. Crushed-stone water-use projections per county through 2060

Year	(million tons)	(million tons)	Population	Population Change
1990	55	42	16,986,510	
[illegible]	[illegible]	74	20,851,820	+386,531
[illegible]	[illegible]	105	25,388,403	+453,658
[illegible]	[illegible]	124	29,650,388	+426,199
[illegible]	[illegible]	144	33,712,020	+406,163
2040	268	165	37,734,422	+402,240
2050	307	187	41,924,167	+418,975
2060	346	210	46,323,725	+439,956

Table 67. Crushed-stone water use projections per county through 2060 (thousand AF)

County	2008	2010	2020	2030	2040	2050	2060
Bee	0.310	0.334	0.345	0.346	0.348	0.319	0.312
Bell	1.975	2.123	2.719	3.358	3.889	4.549	5.198
Bexar	5.097	5.479	6.587	7.507	8.300	9.171	10.166
Bosque	1.185	1.274	1.386	1.344	1.343	1.420	1.478
Brown	0.857	0.922	0.909	0.915	0.920	0.923	0.921
Burnet	3.265	3.510	4.436	5.344	6.295	7.150	8.138
Callahan	0.130	0.140	0.140	0.140	0.135	0.131	0.128
Comal	6.503	6.991	8.411	9.744	11.024	12.119	13.505
Cooke	0.146	0.157	0.200	0.240	0.284	0.347	0.402
Coryell	0.213	0.229	0.272	0.305	0.333	0.363	0.398
Duval	0.150	0.162	0.165	0.165	0.148	0.129	0.118
Eastland	0.203	0.218	0.227	0.239	0.285	0.289	0.307
Ector	0.380	0.409	0.440	0.474	0.491	0.518	0.547
El Paso	2.402	2.582	3.055	3.496	3.945	4.425	4.939
Falls	0.187	0.201	0.225	0.246	0.259	0.286	0.307
Floyd	0.302	0.325	0.338	0.346	0.358	0.370	0.382
Glasscock	0.326	0.351	0.366	0.383	0.390	0.404	0.419
Hays	0.639	0.687	0.845	1.075	1.361	1.445	1.654
Hidalgo	0.898	0.965	1.270	1.623	1.937	2.246	2.587
Hill	0.244	0.263	0.291	0.321	0.353	0.390	0.422
Hood	0.476	0.512	0.615	0.753	0.935	1.138	1.315
Hudspeth	0.438	0.471	0.479	0.451	0.468	0.483	0.492
Jack	0.778	0.836	0.980	1.052	1.199	1.353	1.512
Johnson	0.314	0.338	0.385	0.453	0.546	0.658	0.750
Jones	0.103	0.110	0.107	0.104	0.099	0.093	0.088
Lampasas	0.143	0.153	0.181	0.202	0.220	0.238	0.261
Limestone	2.330	2.504	2.759	3.085	3.253	3.709	4.043
Lubbock	0.123	0.133	0.137	0.140	0.148	0.156	0.162

Table 68. Sand and gravel water-use projections per county through 2060 (thousand AF)

County	2008	2010	2020	2030	2040	2050	2060
Atascosa	0.350	0.420	0.526	0.615	0.698	0.755	0.846
Bastrop	0.063	0.076	0.113	0.162	0.225	0.310	0.387
Bell	0.346	0.415	0.523	0.622	0.710	0.800	0.907
Bexar	1.028	1.233	1.233	1.233	1.233	1.233	1.233
Borden	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Bosque	0.013	0.015	0.018	0.018	0.019	0.021	0.023
Brazoria	0.565	0.678	0.866	1.064	1.289	1.533	1.790
Brazos	0.230	0.276	0.347	0.403	0.495	0.474	0.521

County	2008	2010	2020	2030	2040	2050	2060
Burnet	0.031	0.037	0.050	0.064	0.079	0.100	0.120
Coke	0.003	0.004	0.004	0.005	0.005	0.006	0.006
Colorado	1.540	1.848	2.033	2.190	2.372	2.440	2.543
Comal	0.099	0.119	0.180	0.242	0.305	0.382	0.464
Cooke	0.026	0.031	0.040	0.048	0.066	0.073	0.085
Dallas	1.574	1.889	1.889	1.889	1.889	1.889	1.889
Denton	1.262	1.514	2.106	2.678	3.332	4.293	5.191
Duval	0.604	0.725	0.796	0.846	0.810	0.748	0.713
El Paso	0.581	0.697	0.880	1.063	1.266	1.482	1.721
Fannin	0.006	0.007	0.011	0.016	0.023	0.027	0.033
Fayette	0.082	0.098	0.123	0.145	0.183	0.241	0.287
Fort Bend	0.000	0.000	0.000	0.000	0.001	0.001	0.001
Galveston	0.282	0.339	0.375	0.402	0.444	0.480	0.514
Grayson	0.041	0.049	0.061	0.073	0.089	0.106	0.125
Guadalupe	0.186	0.224	0.318	0.422	0.541	0.674	0.816
Harris	2.494	2.993	2.993	2.993	2.993	2.993	2.993
Henderson	0.115	0.138	0.181	0.235	0.304	0.395	0.477
Hidalgo	0.603	0.723	1.045	1.444	1.850	2.272	2.750
Hutchinson	0.023	0.027	0.028	0.027	0.026	0.027	0.026
Jefferson	0.131	0.157	0.180	0.202	0.230	0.280	0.315

TABLE 2
CRUSHED STONE SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY STATE[1]

(Thousand metric tons and thousand dollars)

State	2014						2015	
	Quantity					Value	Quantity	Percent
	1st qtr.	2d qtr.	3d qtr.	4th qtr.	1st–4th qtr.[2]	1st–4th qtr.[2]	1st qtr.	change[3]
Alabama	6,760	8,790	9,350	7,440	32,300	308,000	6,220	-8.0
Alaska	(4)	(4)	(4)	(4)	1,063	13,558	(4)	(4)
Arizona	2,380	2,080	2,200	1,880	8,540	77,800	2,440	2.9
Arkansas	5,150	7,060	7,080	6,800	26,100	211,000	5,840	13.4
California	7,430	9,540	10,600	8,810	36,400	353,000	8,890	19.6
Colorado	2,540	3,300	3,310	2,570	11,700	99,700	2,320	-8.6
Connecticut	424	2,550	3,120	2,460	8,550	132,000	358	-15.5
Delaware	W	W	W	W	W	W	W	W
Florida	14,400	14,500	13,000	12,400	54,300	670,000	13,400	-6.6
Georgia	9,540	12,400	12,500	10,600	45,100	568,000	9,870	3.4
Hawaii	(4)	(4)	(4)	(4)	5,180	92,300	(4)	(4)
Idaho	255	1,250	2,200	1,200	4,910	31,900	405	59.2
Illinois	3,910	14,700	21,700	17,200	57,500	608,000	5,710	46.1
Indiana	4,480	11,900	14,500	12,500	43,400	331,000	5,820	29.8
Iowa	2,720	9,830	11,500	8,470	32,500	311,000	3,610	32.7
Kansas	2,370	4,940	5,640	3,670	16,600	146,000	3,040	28.4
Kentucky	7,040	13,500	16,000	13,300	49,900	503,000	8,190	16.4
Louisiana	W	W	W	W	W	W	W	W
Maine	193	1,120	1,680	945	3,940	33,900	135	-30.1
Maryland	2,830	6,360	7,150	5,930	22,300	215,000	3,190	12.7
Massachusetts	759	3,470	4,110	3,620	12,000	159,000	676	-10.9
Michigan	1,610	7,670	12,200	8,470	30,000	223,000	2,440	51.9
Minnesota	410	2,690	4,400	2,170	9,660	116,000	729	77.8
Mississippi	384	594	700	551	2,230	62,500	356	-7.3
Missouri	11,800	18,800	20,100	14,300	64,900	584,000	12,600	6.7
Montana	(4)	(4)	(4)	(4)	2,650	32,700	(4)	(4)
Nebraska	1,150	1,900	2,230	1,660	6,940	83,600	1,430	23.5
Nevada	1,520	1,780	2,030	1,720	7,050	73,800	1,490	-1.9
New Hampshire	370	1,500	2,160	1,450	5,480	50,000	369	-0.2
New Jersey	2,040	5,080	5,210	4,730	17,100	147,000	1,910	-6.5
New Mexico	956	1,070	2,030	1,320	5,380	45,700	1,040	8.8
New York	2,560	8,680	13,800	8,970	34,000	357,000	2,870	12.2
North Carolina	8,280	13,700	13,700	12,200	47,900	755,000	9,080	9.7
North Dakota	(4)	(4)	(4)	(4)	1,300	8,980	(4)	(4)
Ohio	5,160	15,100	19,700	15,700	55,700	469,000	6,010	16.4
Oklahoma	9,970	11,700	9,860	8,770	40,300	316,000	8,360	-16.2
Oregon	2,530	4,280	6,080	4,110	17,000	138,000	3,050	20.8
Pennsylvania	9,480	23,700	29,000	21,800	84,000	974,000	10,800	13.8
Rhode Island	115	735	568	623	2,040	22,600	150	30.0
South Carolina	3,790	5,450	5,440	5,390	20,100	213,000	4,650	22.5
South Dakota	500	2,520	3,070	1,860	7,950	63,400	824	64.6
Tennessee	7,530	11,300	12,500	10,300	41,600	532,000	7,720	2.6
Texas	36,500	39,900	44,100	40,300	161,000	1,340,000	39,500	8.1
Utah	1,350	2,320	3,110	2,210	8,990	75,600	1,750	29.8
Vermont	166	2,020	3,100	1,490	6,770	68,900	162	-2.1
Virginia	6,910	12,900	13,300	11,100	44,200	685,000	7,670	11.0
Washington	3,480	4,060	4,580	3,500	15,600	209,000	3,590	3.1
West Virginia	2,950	4,110	4,930	4,310	16,300	167,000	2,690	-8.7
Wisconsin	5,650	4,140	4,670	3,220	17,700	117,000	4,360	-22.8
Wyoming	1,310	2,850	2,890	1,740	8,790	37,900	1,290	-2.0

W Withheld to avoid disclosing company proprietary data.

[1]Quarterly totals shown are estimates based on a sample survey. Estimated quantities for prior quarters have been recalculated.

[2]Data may not add to totals shown because of independent rounding and differences between projected totals by States and divisions.

[3]Compared with the same period of preceding year; all percentages are calculated using unrounded totals.

[4]State not included in quarterly survey.