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Water availability ranking for 225 urban areas in the United States

For method details, see
Padowski, J. C., and J. W. Jawitz, 2012. Water availability and vulnerability of 225 large cities in the United States, Water Resources Research, 48, W12529, doi:10.1029/2012WR012335.

Urban areas of population greater than 100,000 are ranked by fresh water availability based on liters per person per day. Absolute water availabilities have been normalized by scaling to the maximum value in the set. Vulnerability accounts for both mean water availability and variability about the mean (for example, drought frequency).

This method incorporates not only renewable water flows, but also the extracted, imported, and stored water that urban systems access through constructed infrastructure. These constructed sources represent important components of urban water supply, yet are typically excluded from water scarcity assessments. In this analysis, water availability is measured as the sum of the mean annual volume of water available to cities from both naturally-occurring and constructed sources. Natural availability is also constrained here by environmental limits on withdrawals. Urban water vulnerability is expressed as the susceptibility of those urban supplies under low-flow (drought-like) conditions.

High-ranking cities tend to be adjacent to very large lakes, such as the Great Lakes, and large rivers, such as the Mississippi or Columbia. For example, the highest-availability city (Duluth, MN) is the only US city on Lake Superior, the third-largest freshwater body in the world (by volume). The other Great Lakes have smaller volumes and are shared by more (and larger) cities. Low-ranking cities are often found in arid regions (for example Los Angeles and Las Vegas), have low storage per capita (for example Miami and Atlanta) or share sources with multiple other cities (for example Chicago and Tallahassee). This national, cross-cutting assessment required several assumptions for cases where limited data regarding source characterization or allocation exist (for example cities sharing the Great Lakes or large aquifers). Therefore, the current vulnerability assessments for an individual city should be considered in the context of the data available for each city. Population data in the table below are from the 2000 US Census.

Rank	Urban Area	Normalized availability	Vulnerability	Population
1	Duluth, MN--WI	100.0	Low	118,265
2	Evansville, IN--KY	71.9	Low	211,989
3	Baton Rouge, LA	63.5	Low	479,019
4	Kennewick--Richland, WA	45.3	Low	153,851
5	Huntington, WV--KY--OH	44.9	Low	177,550
6	Fort Smith, AR--OK	34.2	Low	106,470
7	Memphis, TN--MS--AR	33.5	Low	972,091
8	New Orleans, LA	30.1	Low	1,009,283
9	Clarksville, TN--KY	21.5	Low	121,775
10	Aberdeen--Havre de Grace--Bel Air, MD	21.1	Low	174,598
11	York, PA	18.1	Low	192,903
12	Fairfield, CA	15.2	Low	112,446
13	Sioux City, IA--NE--SD	14.5	Low	106,119
14	Saginaw, MI	13.5	Low	140,985
15	Louisville, KY--IN	13.1	Low	863,582
16	Little Rock, AR	12.7	Low	360,331
17	Huntsville, AL	12.3	Low	213,253
18	Davenport, IA--IL	11.9	Low	270,626
19	Salem, OR	11.4	Low	207,229
20	Lancaster, PA	10.8	Low	323,554
21	Vallejo, CA	10.7	Low	158,967
22	Mobile, AL	10.0	Low	317,605
23	Montgomery, AL	10.0	Low	196,892
24	Tuscaloosa, AL	9.50	Low	116,888
25	Poughkeepsie--Newburgh, NY	9.28	Low	351,982
26	Harrisburg, PA	8.99	Low	362,782
27	Frederick, MD	7.75	Low	119,144
28	Cincinnati, OH--KY--IN	6.95	Low	1,503,262
29	Chattanooga, TN--GA	6.93	Low	343,509
30	Portland, OR--WA	6.67	Low	1,583,138
31	Flint, MI	6.45	Low	365,096
32	Marysville, WA	6.33	Low	114,372
33	Charleston, WV	6.26	Low	182,991

34	St. Louis, MO--IL	5.94	Low	2,077,662
35	Muskegon, MI	5.89	Medium	154,729
36	Redding, CA	5.88	Low	105,267
37	Billings, MT	5.65	Low	100,317
38	Myrtle Beach, SC	5.46	Low	122,984
39	Kenosha, WI	5.43	Medium	110,942
40	Hagerstown, MD--WV--PA	5.11	Low	120,326
41	Lafayette, IN	5.09	Low	125,738
42	Green Bay, WI	4.94	Medium	187,316
43	Beaumont, TX	4.75	Low	139,304
44	Racine, WI	4.65	Medium	129,545
45	College Station--Bryan, TX	4.52	Low	132,500
46	Jackson, MS	4.30	Low	292,637
47	Topeka, KS	4.07	Low	142,411
48	Binghamton, NY--PA	4.00	Low	158,884
49	Eugene, OR	3.90	Low	224,049
50	Concord, NC	3.70	Low	115,057
51	Scranton, PA	3.63	Low	385,237
52	Trenton, NJ	3.61	Low	268,472
53	Springfield, MO	3.50	Low	215,004
54	Manchester, NH	3.27	Low	143,549
55	Savannah, GA	3.15	Low	208,886
56	Fort Collins, CO	3.10	Low	206,633
57	New Haven, CT	3.02	Low	531,314
58	Waterloo, IA	2.98	Low	108,298
59	Round Lake Beach--McHenry--Grayslake, IL--WI	2.94	Medium	226,848
60	Omaha, NE--IA	2.90	Low	626,623
61	Hickory, NC	2.72	Low	187,808
62	Deltona, FL	2.65	Low	147,713
63	Yakima, WA	2.55	Low	112,816
64	Boulder, CO	2.54	Low	112,299
65	North Port--Punta Gorda, FL	2.36	Low	122,421
66	Columbus, GA--AL	2.36	Low	242,324
67	Cedar Rapids, IA	2.32	Low	155,334
68	Antioch, CA	2.21	Low	217,591
69	Lake Charles, LA	2.18	Low	132,977
70	Nashville-Davidson, TN	2.15	Low	749,935
71	Knoxville, TN	2.14	Low	419,830
72	Albany, NY	2.07	Low	558,947
73	Springfield, MA--CT	2.07	Low	573,610
74	Odessa, TX	2.06	Medium	111,395
75	Hartford, CT	2.06	Low	851,535
76	Boise City, ID	2.04	Medium	272,625
77	Syracuse, NY	2.03	Low	402,267
78	Brownsville, TX	1.98	Medium	165,776
79	Murfreesboro, TN	1.96	Medium	135,855
80	Pensacola, FL--AL	1.91	Low	323,783
81	Fort Walton Beach, FL	1.91	Low	152,741
82	Spokane, WA--ID	1.90	Low	334,858
83	Ocala, FL	1.89	Low	106,542
84	Augusta-Richmond County, GA--SC	1.84	Low	335,630
85	Springfield, IL	1.79	Medium	153,516
86	Appleton, WI	1.77	Low	187,683
87	Pittsburgh, PA	1.76	Low	1,753,136
88	Fayetteville, NC	1.74	Low	276,368
89	Las Vegas, NV	1.74	Low	1,314,357
90	Danbury, CT--NY	1.72	Low	154,455
91	Grand Rapids, MI	1.67	Medium	539,080
92	Medford, OR	1.63	Low	128,780
93	Tulsa, OK	1.58	Low	558,329

94	Des Moines, IA	1.53	Low	370,505
95	Modesto, CA	1.52	Low	310,945
96	Jacksonville, FL	1.45	Medium	882,295
97	Vero Beach--Sebastian, FL	1.42	Low	120,962
98	Rockford, IL	1.37	Low	270,414
99	Burlington, VT	1.36	Low	105,365
100	Toledo, OH--MI	1.33	Low	503,008
101	Allentown--Bethlehem, PA--NJ	1.32	Low	576,408
102	Waterbury, CT	1.31	Low	189,026
103	Winter Haven, FL	1.29	Low	153,924
104	Harlingen, TX	1.25	Low	110,770
105	Tallahassee, FL	1.22	Medium	204,260
106	Cape Coral, FL	1.22	Medium	329,757
107	Merced, CA	1.18	Low	110,483
108	Greensboro, NC	1.14	Low	267,884
109	Rochester, NY	1.07	Low	694,396
110	Gainesville, FL	1.07	Medium	159,508
111	Sacramento, CA	1.05	Low	1,393,498
112	Johnson City, TN	1.05	Low	102,456
113	Birmingham, AL	1.01	Medium	663,615
114	Port St. Lucie, FL	0.99	Medium	270,774
115	Lakeland, FL	0.99	Medium	199,487
116	Kissimmee, FL	0.96	Low	186,667
117	Boston, MA--NH--RI	0.91	Low	4,032,484
118	Denton--Lewisville, TX	0.91	Medium	299,823
119	Charlotte, NC--SC	0.90	Low	758,927
120	Fayetteville--Springdale, AR	0.87	Medium	172,585
121	Abilene, TX	0.85	Medium	107,041
122	Richmond, VA	0.84	Low	818,836
123	Asheville, NC	0.79	Low	221,570
124	Spartanburg, SC	0.79	Low	145,058
125	Palm Bay--Melbourne, FL	0.79	Low	393,289
126	Reading, PA	0.78	Low	240,264
127	Bonita Springs--Naples, FL	0.78	Low	221,251
128	Laredo, TX	0.78	Low	175,586
129	Olympia--Lacey, WA	0.73	Low	143,826
130	Wilmington, NC	0.72	Low	161,149
131	Stockton, CA	0.72	Low	313,392
132	Reno, NV	0.71	Low	303,689
133	Utica, NY	0.70	Low	113,409
134	Pueblo, CO	0.70	Low	123,351
135	New Bedford, MA	0.69	Medium	146,730
136	Daytona Beach--Port Orange, FL	0.68	Low	255,353
137	Winston-Salem, NC	0.63	Low	299,290
138	Madison, WI	0.62	Low	329,533
139	Hemet, CA	0.60	Low	117,200
140	Detroit, MI	0.60	Low	3,903,377
141	Santa Rosa, CA	0.59	Medium	285,408
142	Lorain--Elyria, OH	0.58	Medium	193,586
143	Buffalo, NY	0.58	Medium	976,703
144	Bridgeport--Stamford, CT--NY	0.55	Medium	888,890
145	Fargo, ND--MN	0.55	Medium	142,477
146	Fresno, CA	0.54	Medium	554,923
147	Tyler, TX	0.54	Medium	101,494
148	Gastonia, NC	0.52	Low	141,407
149	Sarasota--Bradenton, FL	0.52	Medium	559,229
150	Milwaukee, WI	0.52	Medium	1,308,913
151	Corpus Christi, TX	0.51	Medium	293,925
152	Houston, TX	0.49	Low	3,822,509
153	Amarillo, TX	0.49	Low	179,312
154	Greenville, SC	0.49	Low	302,194

155	Seaside--Monterey--Marina, CA	0.47	Medium	125,503
156	Roanoke, VA	0.47	Low	197,442
157	Minneapolis--St. Paul, MN	0.45	Low	2,388,593
158	Simi Valley, CA	0.44	Low	112,345
159	Lubbock, TX	0.43	Low	202,225
160	South Lyon--Howell--Brighton, MI	0.41	Low	106,139
161	Athens-Clarke County, GA	0.40	Low	106,482
162	Santa Maria, CA	0.39	Low	120,297
163	Denver--Aurora, CO	0.39	Medium	1,984,887
164	High Point, NC	0.38	Low	132,844
165	Atlanta, GA	0.37	Medium	3,499,840
166	Thousand Oaks, CA	0.35	Low	210,990
167	Erie, PA	0.35	Medium	194,804
168	Gulfport--Biloxi, MS	0.34	Medium	205,754
169	Dayton, OH	0.34	Low	703,444
170	Salinas, CA	0.33	Medium	179,173
171	Lansing, MI	0.33	Low	300,032
172	Raleigh, NC	0.33	Medium	541,527
173	Bakersfield, CA	0.32	Medium	396,125
174	Visalia, CA	0.32	Medium	120,044
175	Santa Barbara, CA	0.30	Low	196,263
176	Killeen, TX	0.30	Medium	167,976
177	Providence, RI--MA	0.30	Low	1,174,548
178	Santa Clarita, CA	0.29	Low	170,481
179	Austin, TX	0.28	Medium	901,920
180	Seattle, WA	0.27	Low	2,712,205
181	Indio--Cathedral City--Palm Springs, CA	0.27	Low	254,856
182	McAllen, TX	0.27	Low	523,144
183	Wichita, KS	0.27	Medium	422,301
184	Champaign, IL	0.27	Medium	123,938
185	Oklahoma City, OK	0.26	Low	747,003
186	Orlando, FL	0.26	Medium	1,157,431
187	Baltimore, MD	0.26	Medium	2,076,354
188	Canton, OH	0.26	Low	266,595
189	Indianapolis, IN	0.25	Medium	1,218,919
190	Victorville--Hesperia--Apple Valley, CA	0.25	Low	200,436
191	Washington, DC--VA--MD	0.23	Low	3,933,920
192	Columbus, OH	0.22	Low	1,133,193
193	Youngstown, OH--PA	0.21	Low	417,437
194	Ogden--Layton, UT	0.21	Medium	417,933
195	Lafayette, LA	0.21	Low	178,079
196	Virginia Beach, VA	0.21	Low	1,394,439
197	Albuquerque, NM	0.21	Medium	598,191
198	Panama City, FL	0.20	Low	132,419
199	Temecula--Murrieta, CA	0.20	Low	229,810
200	Philadelphia, PA--NJ--DE--MD	0.19	Low	5,149,079
201	Dallas--Fort Worth--Arlington, TX	0.18	Medium	4,145,659
202	Phoenix--Mesa, AZ	0.18	Medium	2,907,049
203	Colorado Springs, CO	0.18	Medium	466,122
204	Akron, OH	0.18	Low	570,215
205	New York--Newark, NY--NJ--CT	0.17	Medium	17,799,861
206	Tampa--St. Petersburg, FL	0.17	Medium	2,062,339
207	Lancaster--Palmdale, CA	0.16	Low	263,532
208	Oxnard, CA	0.15	Medium	337,591
209	Ann Arbor, MI	0.14	Low	283,904
210	Tucson, AZ	0.13	Medium	720,425
211	Chicago, IL--IN	0.12	Medium	8,307,904
212	Concord, CA	0.12	Medium	552,624
213	Charleston--North Charleston, SC	0.12	Medium	423,410
214	Las Cruces, NM	0.12	Medium	104,186

215	Cleveland, OH	0.10	Medium	1,786,647
216	El Paso, TX--NM	0.07	High	674,801
217	Mission Viejo, CA	0.06	High	533,015
218	Riverside--San Bernardino, CA	0.06	High	1,506,816
219	Salt Lake City, UT	0.05	High	887,650
220	Los Angeles--Long Beach--Santa Ana, CA	0.05	High	11,789,487
221	San Diego, CA	0.05	High	2,674,436
222	San Jose, CA	0.04	High	1,538,312
223	Lincoln, NE	0.04	High	226,582
224	Miami, FL	0.04	High	4,919,036
225	San Antonio, TX	0.04	High	1,327,554

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