

US EPA ARCHIVE DOCUMENT



Bibliometric Analysis

for the U.S. Environmental Protection Agency/Office of Research and Development's Drinking Water Research Program

This is a bibliometric analysis of the papers prepared by intramural and extramural researchers of the U.S. Environmental Protection Agency's (EPA) Drinking Water Research Program. For this analysis, 910 papers were reviewed, and they were published from 1996 to 2006. These publications were cited 13,632 times in the journals covered by Thomson's *Web of Science*¹ and Scopus². Of these 910 publications, 783 (86.04%) have been cited at least once in a journal.

Searches of Thomson Scientific's *Web of Science* and Elsevier's Scopus were conducted to obtain times cited data for the drinking water journal publications. The analysis was completed using Thomson's *Essential Science Indicators (ESI)* and *Journal Citation Reports (JCR)* as benchmarks. *ESI* provides access to a unique and comprehensive compilation of essential science performance statistics and science trends data derived from Thomson's databases. For this analysis, the *ESI* highly cited papers thresholds as well as the hot papers thresholds were used to assess the influence and impact of the drinking water papers. *JCR* is a recognized authority for evaluating journals. It presents quantifiable statistical data that provide a systematic, objective way to evaluate the world's leading journals and their impact and influence in the global research community. The two key measures used in this analysis to assess the journals in which the EPA drinking water papers are published are the Impact Factor and Immediacy Index. The Impact Factor is a measure of the frequency with which the "average article" in a journal has been cited in a particular year. The Impact Factor helps evaluate a journal's relative importance, especially when compared to other journals in the same field. The Immediacy Index is a measure of how quickly the "average article" in a journal is cited. This index indicates how often articles published in a journal are cited within the same year and it is useful in comparing how quickly journals are cited.

The report includes a summary of the results of the bibliometric analysis, an analysis of the 910 drinking water research papers analyzed by *ESI* field (e.g., chemistry, microbiology, pharmacology & toxicology), an analysis of the journals in which the drinking water papers were published, a table of the highly cited researchers in the Drinking Water Research Program, and a list of patents and patent applications that have resulted from the program.

¹ Thomson Scientific's *Web of Science* provides access to current and retrospective multidisciplinary information from approximately 8,830 of the most prestigious, high impact research journals in the world. *Web of Science* also provides cited reference searching.

² Scopus is a large abstract and citation database of research literature and quality Web sources designed to support the literature research process. Scopus offers access to 15,000 titles from 4,000 different publishers, more than 12,850 academic journals (including coverage of 535 Open Access journals, 750 conference proceedings, and 600 trade publications), 27 million abstracts, 245 million references, 200 million scientific Web pages, and 13 million patent records.

SUMMARY OF RESULTS

1. More than one-fifth of the drinking water publications are highly cited papers. 193 (21.21%) of the drinking water papers qualify as highly cited when using the *ESI* criteria for the top 10% of highly cited publications. This is 2.12 times the 10% of papers expected to be highly cited. 26 (2.86%) of the drinking water papers qualify as highly cited when using the *ESI* criteria for the top 1%, which is 2.86 times the number expected. 1 (0.11%) of these papers qualify as very highly cited when using the criteria for the top 0.1%, which is exactly the number anticipated. None of the papers actually meet the 0.01% threshold for the most highly cited papers, which is not surprising given that the number of papers expected to meet this threshold for this program is 0.09.
2. The drinking water papers are more highly cited than the average paper. Using the *ESI* average citation rates for papers published by field as the benchmark, in 14 of the 19 fields in which the 910 EPA drinking water papers were published, the ratio of actual to expected cites is greater than 1, indicating that the drinking water papers are more highly cited than the average papers in those fields. For all 19 fields combined, the ratio of total number of cites to the total number of expected cites (13,632 to 8,944.60) is 1.52, indicating that the drinking water papers are more highly cited than the average paper.
3. More than one-third of the drinking water papers are published in high impact journals. 411 of the 910 papers were published in the top 10% of journals ranked by *JCR* Impact Factor, representing 45.16% of EPA's drinking water papers. This number is 4.52 times higher than the expected 91 papers. 278 of the 910 papers appear in the top 10% of journals ranked by *JCR* Immediacy Index, representing 30.55% of EPA's drinking water papers. This number is 3.06 times higher than the expected 91 papers.
4. Fourteen of the drinking water papers qualify as hot papers. Using the hot paper thresholds established by *ESI* as a benchmark, 14 hot papers, representing 1.54% of the drinking water papers, were identified in the analysis. Hot papers are papers that were highly cited shortly after they were published. The number of drinking water hot papers identified is 15.4 times higher than the expected 0.91 hot papers.
5. The authors of the drinking water papers cite themselves much less than the average author. 661 of the 13,632 cites are author self-cites. This 4.85% author self-citation rate is well below the accepted range of 10-30% author self-citation rate.
6. Twenty of the authors of the drinking water papers are included in *ISI HighlyCited.com*, which is a database of the world's most influential researchers who have made key contributions to science and technology during the period from 1981 to 1999.
7. There was 1 patent issued to an investigator from 1996 to 2006 for research that was conducted under EPA's Drinking Water Research Program. This patent was cited by another patent.

Highly Cited Drinking water Publications

All of the journals covered by *ESI* are assigned a field, and to compensate for varying citation rates across scientific fields, different thresholds are applied to each field. Thresholds are set to select highly cited papers to be listed in *ESI*. Different thresholds are set for both field and year of publication. Setting different thresholds for each year allows comparable representation for older and younger papers for each field.

The 910 drinking water research papers reviewed for this analysis were published in journals that were assigned to 19 of the 22 *ESI* fields. The distribution of the papers among these 19 fields and the number of citations by field are presented in Table 1.

Table 1. Drinking Water Papers by *ESI* Fields

<i>ESI</i> Field	No. of Citations	No. of DW Papers	Average Cites/Paper
Agricultural Sciences	130	18	7.22
Biology & Biochemistry	354	27	13.11
Chemistry	1,360	73	18.63
Clinical Medicine	1,575	104	15.14
Computer Science	6	1	6.00
Economics & Business	57	4	14.25
Engineering	442	55	8.04
Environment/Ecology	2,800	267	10.49
Geosciences	9	5	1.80
Immunology	569	26	21.88
Materials Science	0	1	0.00
Microbiology	2,212	106	20.87
Molecular Biology & Genetics	712	44	16.18
Multidisciplinary	199	4	49.75
Neuroscience & Behavior	204	14	14.57
Pharmacology & Toxicology	2,835	142	19.96
Physics	27	2	13.50
Plant & Animal Science	33	8	4.12
Social Sciences, general	108	9	12.00
	Total = 13,632	Total = 910	14.98

There are 193 (21.21% of the papers analyzed) highly cited EPA drinking water papers in 15 of the 19 fields—Agricultural Sciences, Biology & Biochemistry, Chemistry, Clinical Medicine, Economics & Business, Engineering, Environment/Ecology, Geosciences, Immunology, Microbiology, Multidisciplinary, Neuroscience & Behavior, Pharmacology & Toxicology, Physics, and Social Sciences—when using the *ESI* criteria for the **top 10% of papers**. Table 2 shows the number of drinking water papers in those 15 fields that meet the **top 10% threshold in *ESI***. Twenty-six (2.86%) of the papers analyzed qualify as highly cited when using the *ESI* criteria for the **top 1% of papers**. These papers cover 7 fields—Chemistry, Clinical Medicine, Engineering, Environment/Ecology, Microbiology, Multidisciplinary, and Pharmacology & Toxicology. Table 3 shows the 26 papers by field that meet the **top 1% threshold in *ESI***. The citations for these 26 papers are provided in Tables 4 through 10. There was 1 (0.11%) very highly cited drinking water paper in the field of Multidisciplinary. The paper, which met the **top 0.1% threshold in *ESI***, is listed in Table 11. None of the drinking water papers met the **top 0.01% threshold in *ESI***, which is not surprising given that the expected number of papers that should meet this threshold for this analysis is 0.09.

Table 2. Number of Highly Cited Drinking Water Papers by Field (top 10%)

<i>ESI</i> Field	No. of Citations	No. of Papers	Average Cites/Paper	% of Papers in Field
Agricultural Sciences	73	4	18.25	22.22%
Biology & Biochemistry	156	4	39.00	14.81%
Chemistry	942	28	33.64	38.36%
Clinical Medicine	736	16	46.00	15.38%
Economics & Business	48	2	24.00	50.00%
Engineering	319	19	16.79	34.55%
Environment/Ecology	1,579	66	23.92	24.72%
Geosciences	2	1	2.00	20.00%
Immunology	193	2	96.50	7.69%
Microbiology	1,266	18	70.33	16.98%
Multidisciplinary	199	2	99.50	50.00%
Neuroscience & Behavior	57	1	57.00	7.14%
Pharmacology & Toxicology	1,638	24	68.25	16.90%
Physics	27	1	27.00	50.00%
Social Sciences, general	100	5	20.00	55.56%
	Total = 7,335	Total = 193	38.00	21.21%

Table 3. Number of Highly Cited Drinking Water Papers by Field (top 1%)

<i>ESI</i> Field	No. of Citations	No. of Papers	Average Cites/Paper	% of EPA Papers in Field
Chemistry	43	2	21.50	2.74%
Clinical Medicine	87	1	87.00	0.96%
Engineering	95	3	31.67	5.45%
Environment/Ecology	232	11	21.09	4.12%
Microbiology	318	2	159.00	1.89%
Multidisciplinary	199	2	99.50	50.00%
Pharmacology & Toxicology	761	5	152.20	3.52%
	Total = 1,735	Total = 26	66.73	2.86%

Table 4. Highly Cited Drinking Water Papers in the Field of Chemistry (top 1%)

No. of Cites	First Author	Paper
20	Tufenkji N	Breakdown of colloid filtration theory: Role of the secondary energy minimum and surface charge heterogeneities. <i>Langmuir</i> 2005;21(3):841-852.
23	Richardson SD	Water analysis: emerging contaminants and current issues. <i>Analytical Chemistry</i> 2005;77(12):3807-3838.

Table 5. Highly Cited Drinking Water Paper in the Field of Clinical Medicine (top 1%)

No. of Cites	First Author	Paper
87	Lindesmith L	Human susceptibility and resistance to Norwalk virus infection. <i>Nature Medicine</i> 2003;9(5):548-553.

Table 6. Highly Cited Drinking Water Papers in the Field of Engineering (top 1%)

No. of Cites	First Author	Paper
57	Rice EW	Evaluating plant performance with endospores. <i>Journal American Water Works Association</i> 1996;88(9):122-130.
23	Xu JL	Microbial degradation of perchlorate: principles and applications. <i>Environmental Engineering Science</i> 2003;20(5):405-422.

No. of Cites	First Author	Paper
15	Budde WL	Analytical mass spectrometry of herbicides. <i>Mass Spectrometry Reviews</i> 2004;23(1):1-24.

Table 7. Highly Cited Drinking Water Papers in the Field of Environment/Ecology (top 1%)

No. of Cites	First Author	Paper
59	Styblo M	The role of biomethylation in toxicity and carcinogenicity of arsenic: a research update. <i>Environmental Health Perspectives</i> 2002;110(Suppl 5):767-771.
59	Simpson JM	Microbial source tracking: state of the science. <i>Environmental Science & Technology</i> 2002;36(24):5279-5288.
51	Metcalf CD	Distribution of acidic and neutral drugs in surface waters near sewage treatment plants in the lower Great Lakes, Canada. <i>Environmental Toxicology and Chemistry</i> 2003;22(12):2881-2889.
26	Glassmeyer SD	Transport of chemical and microbial compounds from known wastewater discharges: potential for use as indicators of human fecal contamination. <i>Environmental Science & Technology</i> 2005;39(14):5157-5169.
4	Chiu WA	Issues in the pharmacokinetics of trichloroethylene and its metabolites. <i>Environmental Health Perspectives</i> 2006;114(9):1450-1456.
4	Craun GF	Observational epidemiologic studies of endemic waterborne risks: Cohort, case-control, time-series, and ecologic studies. <i>Journal of Water and Health</i> 2006;4(Suppl 2):101-120.
5	Colford J	A review of household drinking water intervention trials and an approach to the estimation of endemic waterborne gastroenteritis in the United States. <i>Journal of Water and Health</i> 2006;4(Suppl 2):71-88.
5	Craun GF	Assessing waterborne risks: an introduction. <i>Journal of Water and Health</i> 2006;4(Suppl 2):3-18.
5	Calderon RL	Estimates of endemic waterborne risks from community-intervention studies. <i>Journal of Water and Health</i> 2006;4(Suppl 2):89-100.
6	Craun MF	Waterborne outbreaks reported in the United States. <i>Journal of Water and Health</i> 2006;4(Suppl 2):19-30.
8	Groffman P	Ecological thresholds: the key to successful environmental management or an important concept with no practical application? <i>Ecosystems</i> 2006;9(1):1-13.

Table 8. Highly Cited Drinking Water Papers in the Field of Microbiology (top 1%)

No. of Cites	First Author	Paper
208	Fayer R	Epidemiology of <i>Cryptosporidium</i> : transmission, detection and identification. <i>International Journal for Parasitology</i> 2000;30(12-13):1305-1322.
110	Morgan-Ryan UM	<i>Cryptosporidium hominis</i> n. sp (Apicomplexa : Cryptosporidiidae) from <i>Homo sapiens</i> . <i>Journal of Eukaryotic Microbiology</i> 2002;49(6):433-440.

Table 9. Highly Cited Drinking Water Papers in the Field of Multidisciplinary (top 1%)

No. of Cites	First Author	Paper
65	Xu P	The genome of <i>Cryptosporidium hominis</i> . <i>Nature</i> 2004;431(7012):1107-1112.
134	Abrahamsen MS	Complete genome sequence of the apicomplexan, <i>Cryptosporidium parvum</i> . <i>Science</i> 2004;304(5669):441-445.

Table 10. Highly Cited Drinking Water Papers in the Field of Pharmacology & Toxicology (top 1%)

No. of Cites	First Author	Paper
183	Styblo M	Comparative toxicity of trivalent and pentavalent inorganic and methylated arsenicals in rat and human cells. <i>Archives of Toxicology</i> 2000;74(6):289-299.
134	Thomas DJ	The cellular metabolism and systemic toxicity of arsenic. <i>Toxicology and Applied Pharmacology</i> 2001;176(2):127-144.
153	Mass MJ	Methylated trivalent arsenic species are genotoxic. <i>Chemical Research in Toxicology</i> 2001;14(4):355-361.
187	Kitchin KT	Recent advances in arsenic carcinogenesis: modes of action, animal model systems, and methylated arsenic metabolites. <i>Toxicology and Applied Pharmacology</i> 2001;172(3):249-261.
104	Hughes MF	Arsenic toxicity and potential mechanisms of action. <i>Toxicology Letters</i> 2002;133(1):1-16.

Table 11. Very Highly Cited Drinking Water Paper (top 0.1%)

<i>ESI</i> Field	No. of Cites	First Author	Paper
Multidisciplinary	134	Abrahamsen MS	Complete genome sequence of the apicomplexan, <i>Cryptosporidium parvum</i> . <i>Science</i> 2004;304(5669):441-445.

Ratio of Actual Cites to Expected Citation Rates

The expected citation rate is the average number of cites that a paper published in the same journal in the same year and of the same document type (article, review, editorial, etc.) has received from the year of publication to the present. Using the *ESI* average citation rates for papers published by field as the benchmark, in 14 of the 19 fields in which the EPA drinking water papers were published, the ratio of actual to expected cites is greater than 1, indicating that the drinking water papers are more highly cited than the average papers in those fields (see Table 12). For all 19 fields combined, the ratio of total number of cites to the total number of expected cites (13,632 to 8,944.60) is 1.52, indicating that the drinking water papers are more highly cited than the average paper.

Table 12. Ratio of Actual Cites to Expected Cites for Drinking Water Papers by Field

<i>ESI</i> Field	Total Cites	Expected Cite Rate	Ratio
Agricultural Sciences	130	95.80	1.36
Biology & Biochemistry	354	323.92	1.09
Chemistry	1,360	668.55	2.03
Clinical Medicine	1,575	1,166.73	1.35
Computer Science	6	4.02	1.49
Economics & Business	57	18.30	3.11
Engineering	442	194.77	2.27
Environment/Ecology	2,800	1,734.88	1.61
Geosciences	9	18.33	0.49
Immunology	569	514.70	1.10
Materials Science	0	0.22	0.00
Microbiology	2,212	1,357.75	1.63
Molecular Biology & Genetics	712	1,135.17	0.63
Multidisciplinary	199	14.06	14.15
Neuroscience & Behavior	204	221.60	0.92
Pharmacology & Toxicology	2,835	1,400.67	2.02

ESI Field	Total Cites	Expected Cite Rate	Ratio
Physics	27	7.80	3.46
Plant & Animal Science	33	38.23	0.86
Social Sciences, general	108	29.10	3.71
TOTAL	13,632	8,944.60	1.52

JCR Benchmarks

Impact Factor. The *JCR* Impact Factor is a well known metric in citation analysis. It is a measure of the frequency with which the “average article” in a journal has been cited in a particular year. The Impact Factor helps evaluate a journal’s relative importance, especially when compared to others in the same field. The Impact Factor is calculated by dividing the number of citations in the current year to articles published in the 2 previous years by the total number of articles published in the 2 previous years.

Table 13 indicates the number of drinking water papers published in the top 10% of journals, based on the *JCR* Impact Factor. Four hundred eleven (411) of 910 papers were published in the top 10% of journals, representing 45.16% of EPA’s drinking water papers. This indicates that nearly one-half of the drinking water papers are published in the highest quality journals as determined by the *JCR* Impact Factor, which is 4.52 times higher than the expected percentage.

Table 13. Drinking Water Papers in Top 10% of Journals by JCR Impact Factor

Drinking Water Papers in that Journal	Journal	Impact Factor (IF)	JCR IF Rank
2	Science	30.927	6
1	Nature	29.273	11
1	Nature Medicine	28.878	12
1	Lancet	23.878	17
1	Nature Biotechnology	22.738	20
1	Chemical Reviews	20.869	23
1	Mass Spectrometry Reviews	13.273	60
1	Genome Biology	9.712	106
1	Drug Discovery Today	7.755	151
1	Nucleic Acids Research	7.552	162
1	FASEB Journal	7.064	181

Drinking Water Papers in that Journal	Journal	Impact Factor (IF)	JCR IF Rank
1	Progress in Nuclear Magnetic Resonance Spectroscopy	6.462	201
1	Molecular Microbiology	6.203	213
1	Bioinformatics	6.019	224
1	Journal of Biological Chemistry	5.854	232
2	AIDS	5.835	234
24	Analytical Chemistry	5.635	242
29	Environmental Health Perspectives	5.342	257
3	Mutation Research—Reviews in Mutation Research	5.333	259
2	Emerging Infectious Diseases	5.308	264
5	Journal of Virology	5.178	278
5	Carcinogenesis	5.108	288
3	American Journal of Epidemiology	5.068	290
1	Critical Reviews in Toxicology	5.000	297
1	Free Radical Biology and Medicine	4.971	303
10	Journal of Infectious Diseases	4.953	307
1	Bioscience	4.708	336
1	Cancer Epidemiology Biomarkers & Prevention	4.460	378
1	Pediatrics	4.272	420
1	Current Opinion in Infectious Diseases	4.258	425
4	TrAC - Trends in Analytical Chemistry	4.088	460
55	Environmental Science & Technology	4.054	467
3	International Journal of Epidemiology	4.045	470
5	Epidemiology	4.043	471
1	Drug Metabolism and Disposition	4.015	481
9	Infection and Immunity	3.933	506
46	Applied and Environmental Microbiology	3.818	544
1	Ecological Applications	3.804	548
1	Current Opinion in Drug Discovery & Development	3.778	555
1	Langmuir	3.705	569

Drinking Water Papers in that Journal	Journal	Impact Factor (IF)	JCR IF Rank
1	Journal of Nutrition	3.689	574
1	Human Reproduction	3.669	581
11	Journal of Analytical Atomic Spectrometry	3.640	591
5	Journal of the American Society for Mass Spectrometry	3.625	594
1	Methods	3.591	610
9	Journal of Clinical Microbiology	3.537	630
2	Ecosystems	3.455	661
3	International Journal for Parasitology	3.346	695
8	Mutation Research-Fundamental and Molecular Mechanisms of Mutagenesis	3.340	697
14	Chemical Research in Toxicology	3.339	700
1	Journal of Economic Geography	3.222	733
1	Microbiology-SGM	3.173	751
1	Archives of Biochemistry and Biophysics	3.152	762
21	Toxicology and Applied Pharmacology	3.148	765
1	Reproduction	3.136	768
7	Journal of Chromatography A	3.096	779
30	Toxicological Sciences	3.088	781
1	Critical Reviews in Environmental Science and Technology	3.080	786
1	Virology	3.080	786
7	Cancer Letters	3.049	801
45	Water Research	3.019	810
8	Analyst	2.858	877
1	Environment International	2.856	879
Total = 411			

Immediacy Index. The JCR Immediacy Index is a measure of how quickly the *average article* in a journal is cited. It indicates how often articles published in a journal are cited within the year they are published. The Immediacy Index is calculated by dividing the number of citations to articles published in a given year by the number of articles published in that year.

Table 14 indicates the number of drinking water papers published in the top 10% of journals, based on the *JCR* Immediacy Index. Two hundred seventy-eight (278) of the 910 papers appear in the top 10% of journals, representing 30.55% of the drinking water papers. This indicates that nearly one-third of the drinking water papers are published in the highest quality journals as determined by the *JCR* Immediacy Index, which is 3.06 times higher than the expected percentage.

Table 14. Drinking Water in Top 10% of Journals by *JCR* Immediacy Index

Drinking Water Papers in that Journal	Journal	Immediacy Index (II)	<i>JCR</i> II Rank
1	Lancet	7.347	5
1	Nature Medicine	6.600	6
2	Science	6.398	7
1	Nature	5.825	11
1	Nature Biotechnology	5.210	16
1	Chemical Reviews	4.523	23
1	Mass Spectrometry Reviews	2.220	76
3	International Journal of Epidemiology	1.791	111
10	Journal of Infectious Diseases	1.547	145
1	Molecular Microbiology	1.402	170
1	Nucleic Acids Research	1.391	173
2	International Journal of Toxicology	1.309	193
5	Epidemiology	1.298	198
1	Journal of Biological Chemistry	1.265	208
1	Genome Biology	1.230	221
1	FASEB Journal	1.181	238
4	Mutation Research-Reviews in Mutation Research	1.143	251
1	Drug Discovery Today	1.125	257
1	Progress in Nuclear Magnetic Resonance Spectroscopy	1.111	266
3	American Journal of Epidemiology	1.099	271
5	Journal of Virology	1.059	284
1	Pediatrics	1.005	309
1	Harmful Algae	0.976	331
29	Environmental Health Perspectives	0.955	346

Drinking Water Papers in that Journal	Journal	Immediacy Index (II)	JCR II Rank
1	Bioinformatics	0.944	354
2	AIDS	0.937	360
5	Carcinogenesis	0.935	362
2	Emerging Infectious Diseases	0.840	440
1	Archives of Biochemistry and Biophysics	0.774	495
1	Drug Metabolism and Disposition	0.733	534
1	Bioscience	0.731	538
6	Science of the Total Environment	0.731	538
14	Chemical Research in Toxicology	0.729	542
1	Methods	0.720	558
24	Analytical Chemistry	0.713	569
1	Free Radical Biology and Medicine	0.696	585
1	Human Reproduction	0.693	596
8	Mutation Research-Fundamental and Molecular Mechanisms of Mutagenesis	0.682	604
4	TrAC - Trends in Analytical Chemistry	0.679	610
1	ATLA-Alternatives to Laboratory Animals	0.676	615
1	Mental Retardation and Developmental Disabilities Research Reviews	0.667	628
1	Virology	0.664	638
1	Current Opinion in Drug Discovery & Development	0.662	642
5	Journal of the American Society for Mass Spectrometry	0.649	660
9	Infection and Immunity	0.648	663
4	Human and Ecological Risk Assessment	0.628	698
30	Toxicological Sciences	0.617	715
1	Langmuir	0.610	723
1	Journal of Nutrition	0.598	741
1	Current Opinion in Infectious Diseases	0.585	767
1	Microbiology-SGM	0.571	800

Drinking Water Papers in that Journal	Journal	Immediacy Index (II)	JCR II Rank
7	Journal of Exposure Analysis and Environmental Epidemiology	0.571	800
8	Analyst	0.546	861
1	Diagnostic Microbiology and Infectious Disease	0.546	861
1	Ecological Applications	0.543	869
55	Environmental Science & Technology	0.541	874
Total = 278			

Hot Papers

ESI establishes citation thresholds for hot papers, which are selected from the highly cited papers in different fields, but the time frame for citing and cited papers is much shorter—papers must be cited within 2 years of publication and the citations must occur in a 2-month time period. Papers are assigned to 2-month periods and thresholds are set for each period and field to select 0.1% of papers. There were no hot papers identified for the current 2-month period (i.e., March-April 2007), but there were a number of hot papers identified from previous periods.

Using the hot paper thresholds established by *ESI* as a benchmark, 14 hot papers, representing 1.54% of the drinking water papers, were identified in four fields—Economics & Business, Environment/Ecology, Multidisciplinary, and Pharmacology & Toxicology. The number of drinking water hot papers is 15.4 times higher than expected. The hot papers are listed in Table 15.

Table 15. Hot Papers Identified Using *ESI* Thresholds

Field	<i>ESI</i> Hot Papers Threshold	No. of Cites in 2-Month Period	Paper
Economics & Business	3	3 cites in November 2002	Irwin EG, Bockstael NE. The problem of identifying land use spillovers: measuring the effects of open space on residential property values. <i>American Journal of Agricultural Economics</i> 2001;83(3):698-704.
	4	4 cites in November 2002	Irwin EG, Bockstael NE. Interacting agents, spatial externalities and the evolution of residential land use patterns. <i>Journal of Economic Geography</i> 2002;2(1):31-54.
Environment/Ecology	7	10 cites in July-August 2004	Styblo M, et al. The role of biomethylation in toxicity and carcinogenicity of arsenic: a research update. <i>Environmental Health Perspectives</i> 2002;110(Suppl 5):767-771.

Field	ESI Hot Papers Threshold	No. of Cites in 2-Month Period	Paper
Environment/ Ecology	6	12 cites in December 2006-January 2007	Glassmeyer ST, et al. Transport of chemical and microbial compounds from known wastewater discharges: potential for use as indicators of human fecal contamination. <i>Environmental Science & Technology</i> 2005;39(14):5157-5169.
	3	3 cites in September 2006	Chiu WA. Issues in the pharmacokinetics of trichloroethylene and its metabolites. <i>Environmental Health Perspectives</i> 2006;114(9):1450-1456.
	3	4 cites in June 2006	Craun GE, Calderon RL. Observational epidemiologic studies of endemic waterborne risks: cohort, case-control, time-series, and ecologic studies. <i>Journal of Water and Health</i> 2006;4(Suppl 2):101-120.
	3	5 cites in June 2006	Colford Jr. JM, et al. A review of household drinking water intervention trials and an approach to the estimation of endemic waterborne gastroenteritis in the United States. <i>Journal of Water and Health</i> 2006;4(Suppl 2):71-88.
	3	5 cites in June 2006	Craun GF, et al. Assessing waterborne risks: an introduction. <i>Journal of Water and Health</i> 2006;4(Suppl 2):3-18.
	3	5 cites in June 2006	Calderon RL, Craun GF. Estimates of endemic waterborne risks from community-intervention studies. <i>Journal of Water and Health</i> 2006;4(Suppl 2):89-100.
	3	6 cites in June 2006	Craun, et al. Waterborne outbreaks reported in the United States. <i>Journal of Water and Health</i> 2006;4(Suppl 2):19-30.
	3	3 cites in May-June 2006	Groffman P, et al. Ecological thresholds: the key to successful environmental management or an important concept with no practical application? <i>Ecosystems</i> 2006;9(1):1-13.
Multidisciplinary	9	9 cites in September-October 2004	Abrahamsen MS, et al. Complete genome sequence of the apicomplexan, <i>Cryptosporidium parvum</i> . <i>Science</i> 2004;304(5669):441-445.
Pharmacology & Toxicology	6	7 cites in November-December 2002	Thomas DJ, et al. The cellular metabolism and systemic toxicity of arsenic. <i>Toxicology and Applied Pharmacology</i> 2001;176(2):127-144.
	9	11 cites in August-September 2004	Nesnow S, et al. DNA damage induced by methylated trivalent arsenicals is mediated by reactive oxygen species. <i>Chemical Research in Toxicology</i> 2002;15(12):1627-1634.

Author Self-Citation

Self-citations are journal article references to articles from that same author (i.e., the first author). Because higher author self-citation rates can inflate the number of citations, the author self-citation rate was calculated for the drinking water papers. Of the 13,632 total cites, 661 are author self-cites—a 4.85% author self-citation rate. Garfield and Sher³ found that authors working in research-based disciplines tend to cite themselves on the average of 20% of the time. MacRoberts and MacRoberts⁴ claim that approximately 10% to 30% of all the citations listed fall into the category of author self-citation. Kovacic and Misak⁵ recently reported a 20% author self-citation rate for medical literature. Therefore, the 4.85% self-cite rate for the drinking water papers is well below the range for author self-citation.

Highly Cited Researchers

A search of Thomson's *ISI HighlyCited.com* revealed that 20 (0.93%) of the 2,142 authors of the drinking water papers are highly cited researchers. *ISI HighlyCited.com* is a database of the world's most influential researchers who have made key contributions to science and technology during the period from 1981 to 1999. The highly cited researchers identified during this analysis of the drinking water publications are presented in Table 16.

Table 16. Highly Cited Researchers Authoring Drinking Water Publications

Highly Cited Researcher	Affiliation	ESI Field
Allen, Herbert E.	University of Delaware	Environment/Ecology
Anderson, Melvin E.	CIIT Centers for Health Research	Pharmacology
Birnbaum, Linda S.	U.S. Environmental Protection Agency	Pharmacology
Boobis, Alan R.	Imperial College London	Pharmacology
Brusseau, Mark L.	University of Arizona	Environment/Ecology and Engineering
Dubey, Jitender P.	U.S. Department of Agriculture/ Agricultural Research Services	Plant & Animal Science
John, Giesy P.	University of Saskatchewan	Environment/Ecology
Glass, Roger I.	Centers for Disease Control and Prevention	Microbiology
Groffman, Peter Mark	Institute of Ecosystem Studies	Environment/Ecology

³ Garfield E, Sher IH. New factors in the evaluation of scientific literature through citation indexing. *American Documentation* 1963;18(July):195-210.

⁴ MacRoberts MH, MacRoberts BR. Problems of citation analysis: a critical review. *Journal of the American Society of Information Science* 1989;40(5):342-349.

⁵ Kavaci N, Misak A. Author self-citation in medical literature. *Canadian Medical Association Journal* 2004;170(13):1929-1930.

Highly Cited Researcher	Affiliation	ESI Field
Johnson, Kenneth M.	University of Texas Medical Branch at Galveston	Pharmacology
Kimber, Ian	Syngenta Central Toxicology Laboratory	Pharmacology
Lindsay, David S.	Virginia Polytechnic Institute and State University	Plant & Animal Science
Liu, Jie	National Institute of Environmental Health Sciences	Pharmacology
Paerl, Hans E.	University of North Carolina–Chapel Hill Institute of Marine Sciences	Plant & Animal Science
Pearson, William R.	University of Virginia	Biology & Biochemistry
Schwartz, Joel D.	Harvard School of Public Health	Environment/Ecology
Thurman, E. Michael	U.S. Geological Survey	Environment/Ecology and Engineering
Truhlar, Donald G.	University of Minnesota	Chemistry
Turner, Monica G.	University of Wisconsin	Environment/Ecology
Wiens, John A.	Nature Conservancy	Environment/Ecology
Total = 20		

Patents

There was 1 patent issued to an investigator during the period 1996 to 2006 for research that was conducted under EPA's Drinking Water Research Program. This patent has been cited by one other patent. The patent and the patent that cites it are listed in Table 17.

Table 17. Patent from the Drinking Water Research Program (1996-2006)

Patent No.	Inventor(s)	Title	Patent Date	Patents that Referenced This Patent
6,365,048	Masten SJ Yavich AA	Method for treatment of organic matter contaminated drinking water	4/2/02	Referenced by 1 patent: (1) 6,893,559 System and method for removing organic compounds from waste water by oxidation

This bibliometric analysis was prepared by
Beverly Campbell of The Scientific Consulting Group, Inc.
in Gaithersburg, Maryland
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