Bibliometric Analysis for Papers on Topics Related to Land/Remediation Research

This is a revised bibliometric analysis of the papers prepared by intramural and extramural researchers of the U.S. Environmental Protection Agency (EPA) on topics related to land/remediation. This analysis was revised in June 2007 because the journals were initially categorized into the fields used by Thomson Scientific's *Essential Science Indicators (ESI)* using information provided in Thomson's *Journal Citation Reports (JCR)*; for this revised analysis, the journals were categorized into *ESI* fields using the journal category list by *ESI* that is available on the Internet at http://in-cites.com/journal-list/index.html. The Journal List for *ESI* was made available in 2006 and the current list contains all of the 12,734 journals covered for *ESI* up to December 31, 2006. This list is updated bimonthly by Thomson. This revised bibliometric analysis will allow comparison of the results of this 2005 analysis to those of the analysis performed in 2007.

This is a bibliometric analysis of the papers prepared by intramural and extramural researchers on topics related to land/remediation research. For this analysis, 1,141 papers were reviewed. These 1,141 papers, published from 1995 to 2005, were cited 14,477 times in the journals covered by Thomson's Web of Science.[1] Of these 1,141 papers, 1,030 (90.3%) have been cited at least once in a journal.

The analysis was completed using Thomson's *ESI* and *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. The chief indicators of output, or productivity, are journal article publication counts. For influence and impact measures, *ESI* employs both total citation counts and cites per paper scores. The former reveals gross influence while the latter shows weighted influence, also called impact. *JCR* 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.

Summary of Analysis

Nearly one-fifth of the land/remediation publications are highly cited papers. A review of the citations indicates that 227 (19.9%) of the land/remediation papers qualify as highly cited when using the *ESI* criteria for the top 10% of highly cited publications. Fifteen (1.3%) of the land/remediation papers qualify as highly cited when using the criteria for the top 1%. One (0.1%) of these papers qualify as very highly cited (in the top 0.1%). None of the papers meet the highest threshold (the top 0.01%) for highly cited papers.

The land/remediation papers are more highly cited than the average paper. Using the *ESI* average citation rates for papers published by field as the benchmark, in 9 of the 16 fields in

[1] Thomson's *Web of Science* provides access to current and retrospective multidisciplinary information from approximately 8,500 of the most prestigious, high impact research journals in the world. *Web of Science* also provides cited reference searching.

which the EPA land/remediation papers were published, the ratio of actual to expected cites is greater than 1, indicating that the land/remediation papers are more highly cited than the average papers in those fields.

Nearly one-quarter of the land/remediation papers are published in very high impact journals. Two hundred seventy-six (276) of 1,141 papers were published in the top 10% of journals ranked by *JCR* Impact Factor, representing 24.2% of EPA's land/remediation papers. Two-hundred forty-three (243) of the 1,141 papers appear in the top 10% of journals ranked by *JCR* Immediacy Index, representing 21.3% of EPA's land/remediation papers.

Eleven of the land/remediation publications qualified as 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. Using the current hot paper thresholds established by *ESI* as a benchmark, 11 of the land/remediation papers, representing 1.0% of the land/remediation publications, were identified as hot papers in the analysis.

The authors of the land/remediation papers cite themselves less than the average self-citation rate. Seven hundred sixty-seven (767) of the 14,477 cites are author self-cites. This 5.3% author self-citation rate is well below the accepted range of 10-30% author self-citation rate.

Highly Cited Land/Remediation Publications

The 1,141 land/remediation papers reviewed for this analysis covered 16 of the 22 *ESI* fields of research. The distribution of the papers among these 16 fields and the number of citations by field are presented in Table 1.

Table 1. Land/Remediation Papers by *ESI* Fields

***ESI* Field**	**No. of Citations**	**No. of EPA Land/ Remediation Papers**	**Average Cites/Paper**
Environment/Ecology	8,928	659	13.55
Chemistry	1,447	112	12.92
Microbiology	1,168	41	28.49
Engineering	1,098	159	6.91
Biology & Biochemistry	533	41	13.00
Plant & Animal Science	412	44	9.36
Pharmacology & Toxicology	356	23	15.48
Geosciences	259	34	7.62
Physics	138	7	19.71

***ESI* Field**	**No. of Citations**	**No. of EPA Land/ Remediation Papers**	**Average Cites/Paper**
Materials Science	47	1	47.00
Agricultural Sciences	43	8	5.38
Clinical Medicine	30	5	6.00
Computer Science	6	4	1.50
Multidisciplinary	6	1	6.00
Molecular Biology & Genetics	5	5	1.00
Mathematics	1	1	1.00
	Total = 14,477	**Total = 1,141**	**12.69**

There were 227 (19.89% of the papers analyzed) highly cited EPA land/remediation papers in 12 of the 16 fields—Environment/Ecology, Engineering, Chemistry, Microbiology, Pharmacology & Toxicology, Plant & Animal Science, Physics, Biology & Biochemistry, Geosciences, Materials Science, Agricultural Sciences, and Multidisciplinary—when using the *ESI* criteria for the **top 10% of papers**. Table 2 shows the number of EPA papers in those 12 fields that met the **top 10% threshold in *ESI***.

Fifteen (1.31%) of the papers analyzed qualified as highly cited when using the *ESI* criteria for the **top 1% of papers**. These papers were categorized in six fields—Environment/Ecology, Chemistry, Microbiology, Engineering, Pharmacology & Toxicology, and Materials Science. Table 3 shows the 15 papers by field that met the **top 1% threshold in *ESI***. There was one (0.09% of the papers analyzed) very highly cited EPA land/remediation papers in one field—Pharmacology & Toxicology. This one paper met the **top 0.1% threshold in *ESI***. None of the land/remediation papers met the highest threshold for highly cited papers (i.e., the **top 0.01% threshold)** in *ESI*., which is not surprising given that the expected number of papers that would meet this threshold is 0.11.

Table 2. Number of Highly Cited Land/Remediation Papers by Field (top 10%)

***ESI* Field**	**No. of Citations**	**No. of Papers**	**Average Cites/Paper**	**% of EPA Papers in Field**
Environment/Ecology	4,804	134	35.85	20.33%
Engineering	665	40	16.62	25.16%
Chemistry	664	15	44.27	13.39%
Microbiology	554	8	69.25	19.51%
Pharmacology & Toxicology	205	6	34.17	26.09%

***ESI* Field**	**No. of Citations**	**No. of Papers**	**Average Cites/Paper**	**% of EPA Papers in Field**
Plant & Animal Science	187	9	20.78	20.45%
Physics	158	5	31.60	71.43%
Biology & Biochemistry	116	2	58.00	4.88%
Geosciences	100	5	20.00	14.71%
Materials Science	47	1	47.00	100.00%
Agricultural Sciences	13	1	13.00	12.50%
Multidisciplinary	6	1	6.00	100.00%
	Total = 7,519	**Total = 227**	**33.12**	**19.89%**

Table 3. Number of Highly Cited Land/Remediation Papers by Field (top 1%)

***ESI* Field**	**No. of Citations**	**No. of Papers**	**Average Cites/Paper**	**% of EPA Papers in Field**
Environment/Ecology	430	8	53.75	1.21%
Chemistry	202	2	101.00	1.79%
Microbiology	119	1	119.00	2.44%
Engineering	104	2	52.00	1.26%
Pharmacology & Toxicology	83	1	83.00	100.00%
Materials Science	47	1	47.00	100.00%
	Total = 985	**Total = 15**	**65.67**	**1.31%**

The citations for the highly cited papers in the top 1% are presented in Tables 4 through 9. The citations for the very highly cited papers are listed in Table 10.

Table 4. Highly Cited Land/Remediation Papers in the Field of Environment/Ecology (top 1%)

No. of Cites	First Author	Paper
125	Ankley GT	Technical basis and proposal for deriving sediment quality criteria for metals. *Environmental Toxicology and Chemistry* 1995;15(12):2056-2066.
109	Haggerty R	Multiple-rate mass-transfer for modeling diffusion and surface-reactions in media with pore-scale heterogeneity. *Water Resources Research* 1995;31(10):2383-2400.
88	Xia GS	Adsorption-partitioning uptake of nine low-polarity organic chemicals on a natural sorbent. *Environmental Science & Technology* 1999;33(2):262-269.
56	Su CM	Arsenate and arsenite removal by zerovalent iron: kinetics, redox transformation, and implications for *in situ* groundwater remediation. *Environmental Science & Technology* 2001;35(7):1487-1492.
27	Braida WJ	Sorption hysteresis of benzene in charcoal particles. *Environmental Science & Technology* 2003;37(2):409-417.
10	Nguyen TH	Sorption nonlinearity for organic contaminants with diesel soot: method development and isotherm interpretation. *Environmental Science & Technology* 2004;38(3):3595-3603.
10	Williams AGB	Spectroscopic evidence for Fe(II)-Fe(III) electron transfer at the iron oxide-water interface. *Environmental Science & Technology* 2004;38(18):4782-4790.
5	Kuder T	Enrichment of stable carbon and hydrogen isotopes during anaerobic biodegradation of MTBE: microcosm and field evidence. *Environmental Science & Technology* 2005;39(1):213-220.

Table 5. Highly Cited Land/Remediation Papers in the Field of Chemistry (top 1%)

No. of Cites	First Author	Paper
113	Wang J	Sol-gel-derived thick-film amperometric immunosensors. *Analytical Chemistry* 1998;70(6):1171-1175.
89	Ravikovitch PI	Unified approach to pore size characterization of microporous carbonaceous materials from N-2, Ar, and CO_2 adsorption isotherms. *Langmuir* 2000;16(5):2311-2320.

Table 6. Highly Cited Land/Remediation Papers in the Field of Microbiology (top 1%)

No. of Cites	First Author	Paper
119	Macnaughton SJ	Microbial population changes during bioremediation of an experimental oil spill. *Applied and Environmental Microbiology* 1999;65(8):3566-3574.

Table 7. Highly Cited Land/Remediation Papers in the Field of Engineering (top 1%)

No. of Cites	First Author	Paper
53	Helland BR	Reductive dechlorination of carbon-tetrachloride with elemental iron. *Journal of Hazardous Materials* 1995;41(2-3):205-216.
51	Annable MD	Partitioning tracers for measuring residual NAPL: field-scale test results. *Journal of Environmental Engineering-ASCE* 1998;124(6):498-503.

Table 8. Highly Cited Land/Remediation Papers in the Field of Pharmacology & Toxicology (top 1%)

No. of Cites	First Author	Paper
83	Ding XX	Human extrahepatic cytochromes P450: function in xenobiotic metabolism and tissue-selective chemical toxicity in the respiratory and gastrointestinal tracts. *Annual Review of Pharmacology and Toxicology* 2003;43:149-173.

Table 9. Highly Cited Land/Remediation Papers in the Field of Materials Science (top 1%)

No. of Cites	First Author	Paper
47	Neimark AV	Capillary condensation in MMS and pore structure characterization. *Microporous and Mesoporous Materials* 2001;44:697-707.

Table 10. Very Highly Cited Land/Remediation Papers (Top 0.1%)

Field	No. of Cites	First Author	Paper
Pharmacology & Toxicology	83	Ding XX	Human extrahepatic cytochromes P450: function in xenobiotic metabolism and tissue-selective chemical toxicity in the respiratory and gastrointestinal tracts. *Annual Review of Pharmacology & Toxicology* 2003;43:149-173.

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 9 of the 16 fields in which the EPA land/remediation papers were published, the ratio of actual to expected cites is greater than 1, indicating that the EPA papers are more highly cited than the average papers in those fields (see Table 11).

Table 11. Ratio of Average Cites to Expected Cites for Land/Remediation Papers by Field

ESI Field	Total Cites	Expected Cite Rate	Ratio
Environment/Ecology	8,928	5,526.67	1.62
Chemistry	1,447	1,076.74	1.34
Microbiology	1,168	732.99	1.59
Engineering	1,098	594.27	1.85
Biology & Biochemistry	533	692.97	0.77
Plant & Animal Science	412	309.53	1.33
Pharmacology & Toxicology	356	253.41	1.40
Geosciences	259	265.29	0.98
Physics	138	46.99	2.94
Materials Science	47	4.31	10.90
Agricultural Sciences	43	59.95	0.72
Clinical Medicine	30	38.92	0.77
Computer Science	6	9.59	0.62
Multidisciplinary	6	2.28	2.63
Molecular Biology & Genetics	5	33.49	0.15
Mathematics	1	3.77	0.26

JCR Benchmarks

The 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 12 indicates the number of land/remediation papers published in the top 10% of journals, based on the *JCR* Impact Factor. Two hundred seventy-six (276) of 1,141 papers were published in the top 10% of journals, representing 24.2% of EPA's land/remediation papers.

Table 12. Land/Remediation Papers in Top 10% of Journals by *JCR* Impact Factor

EPA Land/Remediation Papers in that Journal	Journal	Impact Factor (IF)	*JCR* IF Rank
180	Environmental Science & Technology	3.557	540
23	Applied and Environmental Microbiology	3.810	470
12	Environmental Health Perspectives	3.929	439
11	Analytical Chemistry	5.450	243
8	Journal of Bacteriology	4.146	385
6	Drug Metabolism and Disposition	3.836	461
5	Electrophoresis	3.743	482
4	Langmuir	3.295	622
3	Applied Catalysis B-Environmental	4.042	411
3	Toxicological Sciences	3.391	591
2	Journal of Chromatography A	3.359	602
2	Geochimica et Cosmochimica Acta	3.811	468
2	Journal of the American Society for Mass Spectrometry	3.760	479
2	Biosensors & Bioelectronics	3.251	636
1	Current Opinion in Biotechnology	8.080	129
1	Siam Review	6.118	203
1	Journal of Pharmacology and Experimental Therapeutics	4.335	356
1	Ecology	4.104	394
1	Journal of Analytical Atomic Spectrometry	3.926	440
1	Pediatrics	3.903	447
1	TRAC-Trends in Analytical Chemistry	3.888	452

EPA Land/Remediation Papers in that Journal	Journal	Impact Factor (IF)	*JCR* IF Rank
1	Biochemical Pharmacology	3.436	581
1	Ecological Applications	3.287	623
1	Advances in Agronomy	3.212	652
1	Chemical Geology	3.174	670
1	Journal of Mass Spectrometry	3.056	722
1	Limnology and Oceanography	3.024	737
Total = 276			

Immediacy Index

The journal 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 13 indicates the number of EPA papers published in the top 10% of journals, based on the *JCR* Immediacy Index. Two hundred forty-three (243) of the 1,141 papers appear in the top 10% of journals, representing 21.3% of EPA's land/remediation papers.

Table 13. Land/Remediation Papers in Top 10% of Journals by *JCR* Immediacy Index

EPA Land/Remediation Papers in that Journal	Journal	Immediacy Index (II)	*JCR* II Rank
180	Environmental Science & Technology	0.623	617
12	Environmental Health Perspectives	1.202	202
11	Analytical Chemistry	0.885	346
8	Journal of Bacteriology	0.827	383
6	Drug Metabolism and Disposition	0.590	676
5	Electrophoresis	0.575	697
4	Langmuir	0.566	717
2	Tetrahedron Letters	0.583	681

EPA Land/Remediation Papers in that Journal	Journal	Immediacy Index (II)	*JCR* II Rank
2	Hydrobiologia	0.681	532
2	Geochimica et Cosmochimica Acta	0.680	535
2	Journal of the American Society for Mass Spectrometry	0.575	697
1	Ecotoxicology	1.450	151
1	Pediatrics	0.935	311
1	TRAC-Trends in Analytical Chemistry	0.583	681
1	Ecology	0.590	676
1	Current Opinion in Biotechnology	0.919	322
1	Marine Geology	0.842	373
1	Journal of Pharmacology and Experimental Therapeutics	0.797	419
1	Ecological Applications	0.747	466
1	Journal of Analytical Atomic Spectrometry	0.641	588
Total = 243			

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., September-October 2005), but there was one hot paper identified from previous periods.

Using the current hot paper thresholds established by *ESI* as a benchmark, 11 hot papers, representing 1.0 % of the land/remediation papers, were identified in the fields of Environment/Ecology, Pharmacology & Toxicology, Engineering, and Biology & Biochemistry. The hot papers are listed in Table 14.

Table 14. Hot Papers Identified Using Current *ESI* Thresholds

Field	*ESI* Hot Papers Threshold	No. of Cites in 2-Month Period	Paper
Environment/Ecology	8	13 cites in November-December 1996	Berry WJ, et al. Predicting the toxicity of metal-spiked laboratory sediments using acid-volatile sulfide and interstitial water normalizations. *Environmental Toxicology and Chemistry* 1996;15(12):2067-2079.
	8	11 cites in December 1996	Hansen DJ, et al. Chronic effect of cadmium in sediments on colonization by benthic marine organisms: an evaluation of the role of interstitial cadmium and acid-volatile sulfide in biological availability. *Environmental Toxicology and Chemistry* 1996;15(12):2126-2137.
	8	10 cites in December 1996	Hansen DJ, et al. Predicting the toxicity of metal-contaminated field sediments using interstitial concentration of metals and acid-volatile sulfide. *Environmental Toxicology and Chemistry* 1996;15(12):2080-2094.
	8	9 cites in December 1996	Liber K, et al. Effects of acid-volatile sulfide on zinc bioavailability and toxicity to benthic macroinvertebrates: a spiked-sediment field experiment. *Environmental Toxicology and Chemistry* 1996;15(12):2113-2125.
	6	6 cites in February-March 2003	Williams AGB, Scherer MM. Kinetics of Cr(VI) reduction by carbonate green rust. *Environmental Science & Technology* 2001;35(17):3488-3494.
	5	5 cites in January-February 2005	Ryan JA, et al. Reducing children's risk from lead in soil. *Environmental Science & Technology* 2004;38(1):18A-24A.
	5	5 cites in August-September 2005	Williams AGB, Scherer MM. Spectroscopic evidence for Fe(II)-Fe(III) electron transfer at the iron oxide-water interface. *Environmental Science & Technology* 2004;38(18):4782-4790.
	5	5 cites in August-September 2002	Pruden A, et al. Biodegradation of methyl tert-butyl ether under various substrate conditions. *Environmental Science & Technology* 2001;35(21):4235-4241.

Field	*ESI* Hot Papers Threshold	No. of Cites in 2-Month Period	Paper
Pharmacology & Toxicology	5	9 cites in September-October 2004	Ding XX, Kaminsky LS. Human extrahepatic cytochromes P450: function in xenobiotic metabolism and tissue-selective chemical toxicity in the respiratory and gastrointestinal tracts. *Annual Review of Pharmacology and Toxicology* 2003;43:149-173.
Engineering	4	4 cites in June-July 1998	Hurst CJ, et al. Soil gas oxygen tension and pentachlorophenol biodegradation. *Journal of Environmental Engineering-ASCE* 1997;123(4):364-370.
Biology & Biochemistry	3	3 cites in May-June 1995	Ely RL, et al. A cometabolic kinetics model incorporating enzyme-inhibition, inactivation, and recovery. 2. Trichloroethylene degradation experiments. *Biotechnology and Bioengineering* 1995;46(3):232-245.

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 land/remediation papers. Of the 14,477 total cites, 767 are author self-cites—a 5.3% author self-citation rate. Garfield and Sher[2] found that authors working in research-based disciplines tend to cite themselves on the average of 20% of the time. MacRoberts and MacRoberts[3] claim that approximately 10% to 30% of all the citations listed fall into the category of author self-citation. Therefore, the 5.3% self-cite rate for the land/remediation papers is well below the range for author self-citation.

[2] Garfield E, Sher IH. New factors in the evaluation of scientific literature through citation indexing. *American Documentation* 1963;18(July):195-201.

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