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An Initial Effort to Count Environmental Engineers in the USA

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ABSTRACT

This paper critiques available environmental engineering demographics and presents estimated populations for students, faculty, and practitioners in the USA. Limited environmental engineering demographics exist because most data are collected for named environmental engineering degrees and named environmental engineering departments. American Association of Engineering Societies Engineering Workforce Commission (http://www.asee.org, 2004) has the best student data with comprehensive participation, and annual reports. Estimates for 2004 graduates suggest approximately 496 bachelors, 590 masters, and 119 doctorate degrees. However, many academic programs do not offer undergraduate environmental engineering degrees. Based on civil engineering student populations, the authors suggest that 1,245 undergraduates who will practice environmental engineering received engineering degrees (regardless of title) in 2004. American Society for Engineering Education is the main source for demographics for faculty; however, only members in stand-alone departments are counted, and the data were first reported in 2003. 2003 estimates are just over 100; however, the authors suggest that there are approximately 1,100 environmental engineering faculty based on Association of Environmental Engineering and Science Professors membership. For environmental engineering practitioners, the Bureau of Labor Statistics (BLS) provides a reasonable, 2003 lower end estimate (based on statistical samples) of 45,500. Based on population, the authors conclude that environmental engineering is midsized relative to other engineering disciplines. Recognized sources of demographics for engineers should be encouraged to report environmental engineering as a distinct category. Also, relevant organizations should work with EWC and ASEE to determine better estimation methods for those environmental engineering students, faculty, and resources currently aggregated with other disciplines.

Key words: demographics; faculty; students; practitioners

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INTRODUCTION

Environmental engineers apply scientific and engineering principles to assess, manage, and design sustainable systems for the protection of human and ecological health. Historically, environmental engineers focused on two goals: the production of potable water for the general public to consume, and the treatment of wastewater so that it could be returned to the environment without detrimental impact. The publication of Rachel Carson's *Silent Spring* in 1962, followed by the enactment of legislation such as the Clean Air Act, the Hazardous and Solid Wastes Act, and the Comprehensive Environmental Response, Compensation and Liability Act, led to the broadening of the discipline to include air pollution, solid waste, hazardous waste, etc. Environmental engineering in the 21st century has evolved to become inherently and extensively interdisciplinary. Indeed, environmental engineers routinely receive their undergraduate educational training in a variety of engineering disciplines (e.g., agricultural, civil, chemical, and mechanical engineering) and even within the basic sciences (e.g., chemistry, biology, and geology).

The breadth of the profession and the diverse educational training of its members may be the reasons why the environmental engineering community remains ill-defined. There is no single professional society that represents the spectrum of environmental engineers. During a recent workshop, the Association of Environmental Engineering and Science Professors (AEESP) concluded that the fragmentation of the discipline limits its ability to represent relevant issues to decision makers and to fully demonstrate its importance to society (Aitken *et al.,* 2004). Aitken *et al.* (2004) described many impacts such limitations can have in terms of promoting the profession, identifying emerging environmental issues, developing interdisciplinary solutions to complex environmental problems, securing necessary funding, and so on.

One of the ways to demonstrate the importance of the environmental engineering community is by its demographics, including the number of environmental engineers in the United States and the projected growth. The AEESP workshop participants suggested that such demographics for environmental engineering are not being accurately tracked (Aitken *et al.,* 2003). In this paper, the authors critique efforts of various organizations that collect and report demographic data for environmental engineers, and develop best estimates for the environmental engineering population. The environmental engineering population is defined to include students, faculty, and practitioners. Relevant demographic data were collected from 18 government organizations and professional societies (Table 1) via a combination of telephone interviews, published reports, and Internet-based resources. The authors decided not to use data on the licensing of environmental engineers because the license is not available in every state and is fairly recent.

Table 1. Government organizations and professional societies contacted for demographics for environmental engineers.

Organization/Society
Accreditation Board of Engineering and Technology (ABET)
American Academy of Environmental Engineers (AAEE)
American Association of Engineering Societies (AAES)—Engineering Workforce Commission (EWC)
American Chemical Society (ACS)
American Institute of Chemical Engineers (AIChE)
American Society of Agricultural Engineers (ASAE)
American Society of Civil Engineers (ASCE)
American Society of Engineering Education (ASEE)
American Society of Mechanical Engineers (ASME)
American Water Works Association (AWWA)
Association of Enrivonmental Engineering and Science Professors (AEESP)
National Center for Education Statistics (NCES)
National Science Foundation (NSF)
National Society of Professional Engineers (NSPE)
National Research Council (NRC)
U.S. Census Bureau (USCB)
U.S. Department of Labor, Bureau of Labor Statistics (USDL/BLS)
Water Environment Federation (WEF)

The data collected from the organizations were first evaluated in terms of what is available, how it is collected, and how it is reported. Based on this evaluation, relevant sources of data were supplemented with more detailed studies and used to develop best estimates of the number of students (based on degrees granted), faculty, and practitioners in environmental engineering for the latest year that data was available. The results confirm that shortcomings exist with the reported demographics for environmental engineers. Although the authors refrain from making specific recommendations for individual organizations, this paper includes several suggestions for future consideration.

DATA COLLECTION METHODS USED BY RELEVANT ORGANIZATIONS

Overview of data collection and reporting

Sixteen out of the 18 organizations categorize environmental engineers either as a separate group, or a combination with other engineering disciplines or other nonengineering, environmentally related disciplines

Table 2. Reporting for environmental engineering demographic data.

	Demographics		
Organization/society[a]	*Lumped w/other engineering disciplines*	*Lymped w/other professions*	*Available as environmental engineering*
ABET			X
AAEE			X
AAES/EWC			X
ACS		X	
AIChE			
ASAE	X		
ASCE			X
ASEE			X
ASME			
AWWA			X
AEESP		X	
NCES		X	
NSF	X		
NSPE	X		
NRC	X		
USCB	X		
USDL/BLS			X
WEF		X	

[a]Abbreviations described in Table 1.

(Table 2). In terms of the professional societies, the American Society for Mechanical Engineers (ASME) and American Institute for Chemical Engineers (AIChE) do not collect demographic data specifically about environmental engineers. Three others, American Society of Agricultural Engineers (ASAE), American Society of Engineering Education (ASEE), and National Society of Professional Engineers (NSPE) combine environmental engineers with other engineering disciplines for reporting. However, based on a Board directive, ASEE recently changed its data reporting method to include environmental engineering as a separate category (Gibbons, 2004). Three other professional societies, American Chemical Society (ACS), Association of Environmental Engineering and Science Professors (AEESP), and Water Environment Federation (WEF), combine demographics about environmental engineers with those for scientists and other professionals.

In terms of the relevant government organizations, demographics data are collected primarily with periodic surveys of sample populations. Despite listing environmental engineering on many of these surveys, the results reported in the main publications from these organizations often combine environmental engineering into an "other engineers" category. These government organizations include National Center for Education Statistics (NCES), the National Science Foundation (NSF), the National Research Council (NRC), and the U.S. Census Bureau (USCB). The Accreditation Board of Engineering and Technology (ABET) only characterizes those graduating from ABET-accredited environmental engineering programs as "environmental engineers."

Only 6 of the 18 government organizations and professional societies separately identify environmental engineers in their demographics data. These include American Academy of Environmental Engineers (AAEE), the American Association of Engineering Societies (AAES)/Engineering Workforce Commission (EWC), the American Society of Civil Engineers (ASCE), the American Society of Engineering Education (ASEE), the American Water Works Association (AWWA), and the U.S. Department of Labor, Bureau of Labor Statistics (BLS). Table 3 summarizes the comparison of demographics data available from these six entities. As shown, the most promising sources of data are AAES/EWC for students, ASEE (since 2003) for students and faculty, and BLS for practitioners.

Table 3. Comparison of demographics reported for the specific category of environmental engineers.

Organization[a]	*Tool*	*Frequency*	*Population*	*Most recent*	*Category*
AAEE	Membership data	Ongoing	Members	2003	Practitioners
AAES/EWC	Survey open to all engineering colleges	Annual	Students at every ABET accredited college	2003	Students
ASCE	Membership data and irregular online surveys	Ongoing	Members	2003	Practitioners
ASEE	Web survey open to all engineering colleges	Annual	Students at ABET accredited colleges	2003	Students and Faculty
AWWA	Membership survey	Annual	Members	2003	Practitioners
BLS	Survey of a sample of industry employers	Semiannual different samples over three years	Employees of non farm establishments	2003	Practitioners

[a]Abbreviations described in Table 1.

Data collection methods of the AAES, ASEE, and BLS

AAES is a coordination organization for the various engineering societies who choose to join. One key product from AAES is the set of reports published by its EWC (EWC, 2004). The EWC conducts three annual surveys on undergraduate and graduate students regarding enrollment, degrees granted, and starting salaries. EWC data provides historical trends as well as the latest 1-year change. The data covers doctorate, masters, and undergraduate students. The EWC survey forms are sent every year to engineering deans at all ABET-accredited engineering and engineering technology colleges who then self-report the data based on registrar records of degrees granted. Data are included for both ABET and non-ABET accredited engineering degrees, although the ABET status is noted. The resulting data are provided for free to the member engineering societies and are often used by them for their own tracking purposes. Nonmembers may purchase the data.

According to Gibbons (personal communication with Sharon Jones, 2004), ASEE conducts an annual Web-based survey that is open to all colleges from mid-September to the end of December, with 1 month to revise. The data are then reviewed for accuracy over another 2 months. The data collected is similar to that for EWC for students; however, ASEE also collects data regarding faculty and college expenditures. An overview of the results is provided online with a data-mining tool for each participating school. The discipline categories are based on ABET definitions. For the 2003 data, ASEE changed some of the survey methodology based on a decision by its Board to add eight new disciplines including environmental engineering. However, the environmental engineering category is limited to ABET-accredited environmental engineering degrees and stand-alone environmental engineering programs.

BLS conducts a semiannual mail survey of nonfarm establishments by geographical area and by industry type with the results published online. Each survey covers approximately 200,000 establishments. The complete survey of 1.2 million establishments takes about 3 years to complete. BLS develops the methods and reports while the State Workforce Agencies collect the data. Employers provide the responses. Industry classifications and occupation classifications have changed over time, and are now based on the same standards used by all federal agencies. Environmental engineers are defined by BLS as those who “design, plan, or perform any duties in the prevention, control, and remediation of environmental health hazards using various engineering disciplines. Work may include waste treatment, site remediation, or pollution control technology." Employees include those who are full-time and part-time, but do not include those who are self-employed.

BEST ESTIMATES

Students

The most comprehensive source of data about environmental engineering students (and engineering students in general) is either the AAES/EWC, or ASEE. Both organizations rely on registrar-supplied information, collect annual data, and try to obtain data from all engineering programs. ASEE's data are somewhat different from EWC's data due to a reliance on self-reporting. As stated, ASEE began collecting and reporting data about environmental engineers as a separate category starting with 2003; therefore, the EWC data are used in this paper with some comparisons to ASEE data. EWC estimates for 2004 graduates include 496 bachelors, 590 masters, and 119 doctorate degrees.

Since EWC's and ASEE's data are based on registrar-supplied information, the name of the actual degree is very important. The degree name is a particular problem at the undergraduate level since there are only 50 ABET accredited environmental engineering undergraduate programs in the United States, and 38 have only been accredited since 1990 (ABET, 2004). However, there are many additional environmental engineering curricula incorporated into the traditional engineering majors. As such, many engineers at the undergraduate level who consider themselves environmental engineers are not included in the reported demographics.

To account for the discrepancy for environmental engineering students, the authors made an adjustment in this paper for the estimate for undergraduate degrees. The estimate of 1,245 bachelors degrees awarded in 2004 to future environmental practitioners is based on an adjustment for the proportion of engineers who receive civil engineering masters degrees versus environmental engineering masters degrees [$ENV_{bachelors}$ = bachelors degrees (of any kind) awarded to environmental engineers; $CIVIL_{bachelorsEWC}$ = named civil engineering bachelors degrees awarded reported by EWC; $ENV_{bachelorsEWC}$ = named environmental engineering bachelors degrees awarded reported by EWC; $ENV_{mastersEWC}$ = named environmental engineering masters degrees awarded reported by EWC; $CIVIL_{mastersEWC}$ = named civil engineering masters degrees awarded reported by EWC; $ENV_{bachelors} = (CIVIL_{bachelorsEWC} + ENV_{bachelorsEWC}) * ENV_{mastersEWC}/(CIVIL_{mastersEWC} + ENV_{mastersEWC})$.] The authors assumed that the data for masters degrees are more representative because there are many more de-

Table 4. Environmental engineering decree recipients.

Degree level	*2003 Engineering Workforce Commission*	*2003 American Society of Engineering Education*	*1997 Water Environment Federation Study (Wolfe, 2000)*
Bachelors Environmental Engineering	496 (0.7% of total)	501	831
Bachelors Environmental Engineering (revised)[a]	1,245 (1.7% of total)	—	—
Masters Environmental Engineering	590 (1.6% of total)	457	1,014
PhD Environmental Engineering	119 (2% of total)	80	71

[a]$ENV_{bachelors}$ = bachelors degrees (of any kind) awarded to environmental engineers; $CIVIL_{bachelorsEWC}$ = named civil engineering bachelors degrees awarded reported by EWC; $ENV_{bachelorsEWC}$ = named environmental engineering bachelors degrees awarded reported by EWC; $ENV_{mastersEWC}$ = named environmental engineering masters degrees awarded reported by EWC; $CIVIL_{mastersEWC}$ = named civil engineering masters degrees awarded reported by EWC; $ENV_{bachelors} = \frac{(CIVIL_{bachelorsEWC} + ENV_{bachelorsEWC})*ENV_{mastersEWC}}{(CIVIL_{mastersEWC} + ENV_{mastersEWC})}$.

grees titled "environmental engineering" at the graduate level than at the undergraduate level. However, this estimate ignores other undergraduate programs that produce environmental engineers, and assumes that civil engineering masters recipients do not practice environmental engineering.

Table 4 reports the estimates for the three categories of environmental engineering students based on degrees granted. Comparisons with several engineering fields are also shown in Table 5. At the undergraduate level, 0.7% of all engineering degrees granted went to environmental engineers in 2003, based solely on the named programs. However, with the adjustment as described above, 1.7% of all engineering undergraduate degrees are estimated to have gone to environmental engineers. The higher estimate is slightly smaller than the percentage of degrees granted to aeronautical engineers and biomedical engineers, and is substantially higher than several other engineering majors that are reported as separate categories (not lumped into "other engineers") by NSF (http://srsstats.sbe.nsf.gov) and NCES (http://nces.ed.gov/) (e.g., nuclear engineering). At the masters level, approximately 1.6% of all engineering degrees granted in 2003 went to environmental engineers. At the PhD level, approximately 2% of all engineering degrees granted in 2003 went to environmental engineers. These estimates are smaller than the percentage of doctoral degrees granted to aeronautical and biomedical engineers in a similar time period.

As stated, ASEE data exists for environmental engineers for 2003. As shown in Table 4, the data is fairly similar to the EWC data at the undergraduate level, but is different at the graduate levels. The only other comparison found for these estimates was a recent WEF report (also shown in Table 4). As stated, WEF does not track demographics for environmental engineers based on its membership. However, WEF completed a market report in 2000 using data from the 1999 Digest of Education Statistics produced by the NCES, the USCB's Statistical Abstract for the United States, and Petersons online list of graduate programs in environmental engineering. The 2000 (1997 data) WEF estimate for environmental engineering undergraduate degrees is somewhat different than the ASEE and EWC data (Wolfe, 2000).

Table 5. Comparison of Engineering Workforce Commission (EWC) demographics across the less populated engineering disciplines for degrees granted in 2003.

Discipline[a]	*Bachelors*	*Masters*	*PhD*
Nuclear	123	139	86
Mining	276	155	55
Agricultural	330	132	74
Petroleum	330	213	40
Metallurgical and Materials	869	695	421
Engineering Science and Engineering Physics	1,018	668	195
Environmental	*496*[b] *1245*[c]	*590*	*119*
Biomedical	1,962	765	225
Aeronautical	2,024	708	190
Total (includes other (categories)	75,031	36,611	6,027

[a]All disciplines in the table except environmental engineering are reported as separate categories in National Science Foundation summaries; [b]actual degrees reported by EWC; [c]$ENV_{bachelors}$ = bachelors degrees (of any kind) awarded to environmental engineers; $CIVIL_{bachelorsEWC}$ = named civil engineering bachelors degrees awarded reported by EWC; $ENV_{bachelorsEWC}$ = named environmental engineering bachelors degrees awarded reported by EWC; $ENV_{mastersEWC}$ = named environmental engineering masters degrees awarded reported by EWC; $CIVIL_{mastersEWC}$ = named civil engineering masters degrees awarded reported by EWC.

$$ENV_{bachelors} = \frac{(CIVIL_{bachelorsEWC} + ENV_{bachelorsEWC})*ENV_{mastersEWC}}{(CIVIL_{mastersEWC} + ENV_{mastersEWC})}$$

Table 6. Comparison of engineering teaching faculty with students for 2003 (ASEE, http://www.asee.org).

Major[a]	*Faculty*	*Enrolled undergrad*	*Student/faculty*
Electrical and computer	4,450	70,659	16
Mechanical	4,275	75,650	18
Civil	3,320	41,776	12
Chemical	1,897	21,889	12
Industrial	1,257	13,511	11
Environmental[b]	1,180	5,848	5
Metallurgical	761	3,234	4
Biomedical	707	10,471	15
Aerospace	705	10,874	15
Agricultural	364	2,514	7
Engineering Science and Engineering Physics	320	4,414	14
Nuclear	169	1,259	7
Petroleum	113	1,604	14
Mining	64	429	7

[a]Estimates for environmental engineering faculty assume that some faculty members are counted as civil, chemical, and other engineering disciplines. These assumptions have not been subtracted from the faculty numbers for these other departments.

[b]Enrolled undergraduate data is based on an estimate of 14% of civil engineering undergraduates. These numbers have not been subtracted from the student numbers for these other departments.

Faculty

Out of the organizations contacted, ASEE is the only entity that provides demographics data for the category of faculty. ASEE reported that there were 111 environmental engineering teaching faculty in the United States in 2003. This estimate was based on named departments specifically designated as "environmental engineering." This estimate is among the lowest of the engineering disciplines; however, most environmental engineering faculty are in departments other than those specifically named as environmental engineering.

Because of the problems with the ASEE faculty data, the authors developed an estimate based on AEESP membership data for this study and searches of department Web sites. As of May 2004, ABET recognized 50 undergraduate environmental engineering programs with 392 professors in the "environmental engineering department" at 48 of these institutions. One of the programs was excluded because its Web site was not accessible; the other program was excluded because environmental engineering professors could not be accurately differentiated from other types of faculty (e.g., environmental scientists, water resources engineers, etc.). The 2004 AEESP membership directory showed 210 professors from these same colleges and universities. Therefore, the AEESP membership accounted for approximately 59% of the actual environmental engineering faculty population at ABET accredited undergraduate environmental engineering programs in 2004.

AEESP combined membership includes professors and nonfaculty members (e.g., students, postdoctoral associates, practitioners, etc.) (Fetzner, 2003, personal communication with Sharon Jones). Of the total AEESP membership in 2004, there were 634 assistant, associate, and full professors (not including emeritus) from the United States. An extrapolation of these numbers based on the study of ABET accredited programs described in the last paragraph, suggests that there are 1,180 environmental engineering professors in the United States; a substantially higher estimate than the 111 reported by ASEE. As a comparison, the 2000 WEF study mentioned before estimated 700 full- and part-time environmental engineering faculty members in the United States using an estimate of 15% of the civil engineering faculty population (Wolfe, 2000).

Table 6 presents the range of these estimates and also includes the ratio of students to teaching faculty. As shown, the estimated environmental engineering faculty population is near the median in terms of size. However, student to faculty ratios vary widely across disciplines with environmental engineering faculty estimated at having lower than average ratios. These ratios may differ for several reasons, including a lack of distinction between teaching vs. nonteaching faculty in the estimate developed for environmental engineering, and the difference in service course requirements across disciplines.

Table 7. Environmental engineering employment statistics (Bureau of Labor Statistics, 2003).

Category	*Estimates*
Employment	45,500
Median salary	$62,800
Breakdown of employment sectors	
Architectural/engineering services	29%
Management/technical consulting	13%
State government	13%
Federal government	9%
Local government	8%
Best paying industries	1. oil and gas
	2. chemical merchant wholesaling
	3. support activities for mining
	4. rail transportation
	5. federal government
States with highest concentration of workers as percent of state employment	1. District of Columbia
	2. Alaska
	3. Virginia
	4. Montana
	5. Wyoming
Top paying states	1. Alaska
	2. Hawaii
	3. New Mexico
	4. Nevada
	5. Washington

Practitioners

Of the professional societies and government organizations contacted, the BLS provides the most comprehensive information on the current number of practicing environmental engineers (Table 7). The BLS reports that there were 45,500 practicing environmental engineers in 2003. From this data, the Office of Technology Policy at the Department of Commerce (Sargent, 2004, personal communication with Sharon Jones) projects 65,000 environmental engineers for 2012 and predicts 26,000 job openings for environmental engineers between 2002 and 2012. The 2003 median annual earnings for environmental engineers reported by BLS was $64,820. Table 8 presents a comparison of employment demographics for various engineering disciplines based on the BLS data. As shown, environmental engineering is within the middle category of engineering disciplines based on population; the field is expected to grow with substantial job openings (Sargent, 2004, personal communication).

The definition used by BLS for environmental engineers appears to encompass the breadth of the profession. Coincidentally, approximately 45,000 members of ASCE classify themselves as environmental engineers (includes practitioners and professors) (Parsons, 2003, personal communication with Alok Bhandari). Because not all ASCE members respond with their areas of practice, not all environmental engineers are members of ASCE, and environmental engineering constitutes one of the eight specialty areas listed by ASCE's Environmental and Water Resources Institute, the estimate of approximately 50,000 is a lower bound for the number of environmental engineers in the U.S. workforce.

The authors checked the accuracy of the estimates with a different method that assumes environmental engineers join ASCE at the same rate as other civil engineers. Because 45,000 (34.5%) out of the 130,000 ASCE members (2003) classify themselves as environmental engineers, it may be estimated that 34.5% of the 330,200 (1999 NSF estimate) civil engineers in the work force in 1999 were environmental engineers. This assumption yields an estimate of 114,000 environmental engineers in the 1999 U.S. workforce. Thus, a high end estimate of approximately 100,000 environmental engineers in the U.S. work force seems reasonable.

Although there is limited historical data, estimates for total environmental engineering degrees (graduate and undergraduate) granted annually ranges between 1,200 and 2,000 using the 2003 EWC data. Therefore, as-

Table 8. Engineering employment trends (Sargent, personal communication, 2004).

Discipline	*2002*	*% of total*	*2012*	*% of total*	*Projected openings*	*% of total*	*2002 median annual earnings*
Aerospace	78,000	5%	74,000	4%	19,000	4%	$72,750
Agricultural	3,000	0.2%	3,000	0.2%	1,000	0.2%	$50,700
Biomedical	8,000	0.5%	10,000	1%	3,000	1%	$60,410
Chemical	33,000	2%	33,000	2%	10,000	2%	$72,490
Civil	228,000	13%	246,000	14%	55,000	11%	$60,070
Computer Hardware	74,000	4%	78,000	4%	17,000	3%	$72,150
Electrical	156,000	9%	160,000	9%	34,000	7%	$68,180
Electronics (except Computer)	136,000	8%	149,000	8%	40,000	8%	$69,930
Environmental	47,000	3%	65,000	4%	26,000	5%	$61,410
Industrial	158,000	9%	175,000	10%	55,000	11%	$62,150
Marine	5,000	0.3%	5,000	0.3%	2,000	0.4%	$66,650
Materials	24,000	1%	25,000	1%	7,000	1%	$62,590
Mechanical	215,000	13%	225,000	12%	69,000	14%	$62,880
Mining	5,000	0.3%	5,000	0.3%	2,000	0.4%	$61,770
Nuclear	16,000	1%	16,000	1%	5,000	1%	$81,350
Petroleum	14,000	1%	12,000	1%	4,000	1%	$83,370
Total (including other categories)	1,691,000		1,817,000		492,000		

suming no growth rate over a 40-year career span, the number of environmental engineers in the workforce ranges from 48,000 to 80,000. Based on the several assumption methods, it is reasonable to conclude that there are between 50,000 to 100,000 environmental engineers in the current U.S. workforce. This range is large, and demonstrates uncertainty regarding the number of environmental engineering practitioners in the

Table 9. Range of estimates for environmental engineers in the current workforce.

Data source	*Estimation method*	*Estimate*
Bureau of Labor Statistics (BLS)	2003 data	45,500
National Science Foundation (NSF) and American Society of Civil Engineers (ASCE)	1999 data for civil engineers adjusted by the percentage of ASCE members that are reported as environmental engineers (34.5%)	114,000
American Society of Civil (ASCE) Engineers	2003 membership data	45,000
Engineering Workforce Commission (EWC)	EWC estimate for total degrees (bachelors, masters, PhDs) granted in 2003 multiplied by a 40-year career	48,000—EWC estimate for bachelors degrees 80,000—EWC estimate for bachelors degrees revised to include environmental engineers without a named degree in that field

US. Table 9 shows the various estimates and the data sources.

CONCLUSIONS

The primary objectives of this paper were to critique the current system for counting environmental engineers, and to provide best estimates for the current number of environmental engineering students, faculty, and practitioners in the United States. As shown, there are many entities that already collect demographics data about the environmental engineers; however, the estimates differ due to varying collection methods.

Both EWC and ASEE appear to be comprehensive sources of demographic data for the engineering profession at the academic level. The authors believe EWC's sample size for students is more comprehensive than those for NSF and NCES, and the data for environmental engineers have been collected longer than for ASEE. EWC estimates that in 2004, environmental engineering graduates included 496 bachelors, 590 masters, and 119 doctoral. The major problem with the data for environmental engineers is that EWC (and ASEE) do not count "environmental engineers" who are at colleges that do not offer a separate named environmental engineering bachelors degree. Based on comparisons with civil engineering graduates, the authors suggest that a realistic estimate for bachelors degrees in environmental engineering in 2004 is 1,245.

A similar problem exists for environmental engineering faculty demographics because data (recently collected by ASEE) are only collected for separate stand-alone environmental engineering departments. The ASEE estimate is there were 111 environmental engineering faculty members in 2003. This estimate significantly underestimates the amount of faculty in the United States who specialize in environmental engineering as evidenced by the 2004 AEESP membership of over 600 faculty. Based on the AEESP membership data for 2004, and an actual count of faculty at ABET-accredited environmental engineering undergraduate programs, the authors suggest that there are approximately 1,180 environmental engineering faculty in the United States.

In terms of practitioner data, BLS provides comprehensive data about environmental engineers based on statistical samples of the population. The data is reported annually for various occupations including environmental engineering. For 2003, the BLS data reports that there are 45,500 environmental engineering practitioners with a median salary of $62,800 and expected growth. The authors suggest that this is a reasonable lower bound estimate when compared to estimates for environmental engineering graduates over the last 40 years.

Several strategies may be considered to improve the estimating and reporting of demographics for environmental engineers. One consideration is for relevant professional organizations to work with EWC and ASEE to determine better estimation methods for those environmental engineering students, faculty, and resources currently aggregated with other disciplines. It should be noted that both EWC and ASEE staff are in the business of reporting data supplied by colleges, and may be reluctant to interpret such data. As the representative of environmental engineering at the academic level, AEESP should consider the value of improved demographics when evaluating the overall advantages and disadvantages of stand-alone environmental engineering departments and undergraduate environmental engineering degrees.

Another consideration is for AEESP to assume the role of tracking environmental engineering faculty. This may involve increasing AEESP membership, and obtaining more comprehensive membership data to differentiate between teaching faculty, research faculty, emeritus faculty, students, faculty resources, service loads, diversity, and so on. In terms of practitioners, NSF (and other relevant organizations) should be encouraged to report data collected for environmental engineers as a distinct category, and to use consistent definitions of the profession.

The problems with obtaining good demographic data for environmental engineers were expected. However, it was unclear at the onset of this study whether the size of the profession validated the need for separate categorization in the various demographic summaries reported. Based on the estimates reported in this paper, the authors suggest that environmental engineering is a discrete, mid-sized, engineering discipline given its population relative to the other engineering disciplines, and the projected growth of the profession. The recognized sources of nationwide data on the status of engineers should be encouraged to report environmental engineering as a separate and distinct category.

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