Self Study Report

Department of Earth and Space Sciences
College of the Environment

Submitted

November 1, 2010

Department Review History

Department of Geological Sciences: Previous 10yr Review February, 1999.

Geophysics Program: Previous 10yr Review March 1999.

Department of Earth and Space Sciences: HECB Graduate Program Review 2006-07.

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PART A

Section I: Overview of Organization.

1.1. *Department's Mission*

The mission of the Department of Earth and Space Sciences (ESS) is to further the understanding of Earth, the solar system, and their histories. Our task is to study and provide international leadership, trained professionals and informed citizen on all aspects of earth interactions, including studies of the past and present so that we are better able to predict future developments.

The Department's scope extends from the center of Earth to the rim of the solar system, and its activities cut across traditional disciplines of physics, chemistry, biology, geology, and mathematics. Our faculty, students, and staff examine Earth's interior structure, chemistry, motion, and dynamics; geologic hazards; processes affecting the surface environment; the surrounding space environment; planetary processes; interactions between the biosphere and lithosphere and / or the atmosphere (geobiology), and the evidence and /or potential for a biosphere on other planets (astrobiology).

We provide a foundation for interdisciplinary teaching and research that is based on the geologic record, and on rigorous observation and modeling of Earth's present state, and extension to solar system objects. Our research aims to provide a basis for making accurate predictions of future conditions.

Through these activities, we contribute to the education of undergraduate and graduate students seeking careers in science and technology, provide broad educational opportunities about Earth, environmental and space sciences, conduct outreach on related issues of societal concern, and provide fundamental research insights into our planet's past, present and its context within the solar system. As such it will play a central role within the newly formed College of the Environment.

In accomplishing this mission, the department fosters collaborations with multiple programs with ties to many units within the University of the Washington, and with state and federal agencies. These units include:

Pacific Northwest Seismic Network (PNSN), which seeks to reduce risk within the states of Washington and Oregon by: (a) monitoring ground motions within the region in order to better understand earthquake and volcano hazards and their impacts on the physical, economic, political, and social environment, (b) providing the most accurate information about earthquakes and volcanoes as rapidly as possible to public officials, the public, and for education, and (c) advocating comprehensive and cost-effective measures for reducing the harmful effects of earthquakes and volcanoes.

PNSN is the authoritative source for state-of-the-art knowledge about earthquake occurrence and ground shaking hazards in the Pacific Northwest, providing reliable hazard and risk mitigation information and tools for the region in cooperation with its national and international partners. The PNSN is the Pacific Northwest's Tier-1 Regional Seismic Monitoring Network within the Advanced National Seismic System (ANSS) and coordinates the seismic monitoring of Cascade volcanoes.

Quaternary Research Center (QRC) which fosters interdisciplinary environmental research at the University of Washington through strategic investments in seed grants, expeditions, seminars and workshops, and through publication of the internationally recognized journal, Quaternary Research. QRC-supported research focuses on the Quaternary geologic period -- the last 2½ million years of Earth history -- a time encompassing massive and abrupt changes of climate, sea level, global biota, and ice extent, as well the evolution of humans and the advent of civilization. We study processes that drive environmental changes in order to understand how the Earth sustains humanity, and to prepare for future environmental changes.

Program on Climate Change (PCC) whose mission is to develop a successful interdisciplinary research and teaching program on climate change at the University of Washington that will integrate all climate change activities on campus and direct our attack on the scientific questions of climate variability in a coordinated way across the disciplines.

The UW Astrobiology Program promotes research and education in the interdisciplinary field of astrobiology, the study of life on Earth in a cosmic context, as well as planetary and astronomical investigations conducted with an eye toward the possibility of extraterrestrial life. The Program is committed to breaking down the usual disciplinary barriers and offers a graduate Certificate in Astrobiology, which is an add-on to a student's usual requirements for the Ph.D. in his/her home department.

Washington Space Grant Consortium (WSGC) whose mission is to (a) promote a strong science, technology, engineering, and mathematics education base from elementary through secondary levels while preparing teachers in these grade levels to become more effective at improving student academic outcomes, (b) establish and maintain a national network of universities with interests and capabilities in aeronautics, space and related fields, (c) encourage cooperative programs among universities, aerospace industry, and federal, state and local governments, (d) Encourage interdisciplinary training, research and public service programs related to aerospace and (e) Recruit and train U.S. citizens, especially women, underrepresented minorities, and persons with disabilities, for careers in aerospace science and technology.

1.2. Department History

The department is simultaneously both young and old. The department was officially formed in 2001 from an amalgamation of the Department of Geological Sciences and the Geophysics Program. This amalgamation was initiated by the then Dean of Arts and Sciences, David Hodge, in 1999 shortly after the submittal of the previous 10-year report. Faculty discussed the merger process, concerns about the amalgamation, and the steps to reconcile the different curriculum between the two units in 2000. During this period, Prof. Darrel Cowan was the interim chair of Geological Sciences and Prof. J. Michael Brown was the chair of the Geophysics Program. Formal approval by the two units occurred in 2000 with the Regents approval occurring in 2001, and the formal first courses under the Department of Earth and Space Sciences occurred in Fall of 2001.

The Department of Geological Sciences can trace its roots back over a century to the formation of the Department of Geology and Mineralogy in 1899. It was renamed the Department of Geological Sciences in 1969. The Geophysics Program was a much younger entity, having officially formed in 1969 as an interdisciplinary graduate program. A full history of these two units is given in Appendix A. Our emphasis here is on how ESS has evolved over the last decade since the last 10-year report.

The best way to summarize the last 10 years of department history is one of continuous changes. In the summer of 2002, it was announced that Johnson Hall would be the first in the renovation of the core buildings on campus. Planning for the renovation was reduced from the usual 24-month period to an 18-month design period due to the fact that construction had to start in the beginning of 2004. Faculty responded exceptionally well to this challenge and the design phase was completed on schedule with the move to temporary facilities in Condon Hall occurring December 2003. The department moved back to the newly renovated building in December 2005. It was a great credit to all the faculty and staff who worked countless long hours to ensure that there was no disruption to student instruction despite the moves occurring in the middle of the academic year. The renovation of Johnson Hall resolved one of the major issues identified in the previous 10-yr report, where it was noted that the Johnson facilities were hopelessly inadequate for a first tier research university.

The other major transition for the Department was of its move from the Department from the College of Arts and Sciences to the College of the Environment. A plan for creating the new college was initiated in 2008 by Provost Phyllis Wise. The participation of ESS in the new college was controversial. On the positive side ESS participation in the new college would see the reunification of the earth science units on campus. The negative side is the potential for a dilution of the science and academic mission of the department in a college where the exact goals of the college are still forming and shifting. Despite the uncertainty the faculty members voted with a strong majority (but not a unanimous vote) to move into the new college, with ESS as one of the inaugural units of the college at the beginning of the academic year, 2009-2010.

A list of losses and hires over the last 10 years is given in Table 1. The losses of Professor Ghiorso (to the University of Chicago) and Associate Professor Willet (to ETH Zurich) both members of the former Department of Geological Sciences were due to outside offers for which the UW could not provide competitive counter offers. Assistant Professors Harris and Cooper, both new hires in the new department, were both lost to UC Davis due to the inability of UW to resolve spousal hiring issues. In addition to these academic hires, the department lost three research faculty (Research Assistant Professors Aalto, Putkonen and Matsuoka) who obtained tenured or tenure track positions at other institutions with UW unable to offer comparable positions. During this period UW did make successful retention offers to Prof. Montgomery (who later became the department's first MacArthur awardee) and a pre-emptive offer to Prof. Steig with the hiring of his spouse Assistant Prof. Juliet Crider.

Retirements or deaths caused the loss of the rest of the faculty listed in the left hand column of Table 1 except for those where some fractional FTE's were transferred to other departments. Professors Evans, Porter, Rensberger, Ghose, Cheney, Stewart and McCallum and Principle Lecturer Chernicoff were members of the former Department of

Geological Sciences while Professors Raymond, Crosson, Baker, Merrill and Booker were former members of the Geophysics Program. These retirements represent a loss of approximately 40-45% of the original faculty from the two units that now make up ESS. With these losses and those from the above losses from outside recruitments, ESS was struggling to maintain critical mass in many of its key areas.

However, the department since 2007 has been able to make several critical hires that have helped maintain a vibrant department. These hires include Professors Vidale and Houston from UCLA specializing in seismology, Associate Professors Catling (without tenure; Astrobiology) and Liz Nezbitt (without tenure, without salary, paleontology), and Assistant Professors Bachmann (volcanology), Huntington (tectonics and landscape evolution), Gorman-Lewis (geobiology) and Crider (neotectonics), along with the hires of Steig (paleoclimatology), Buick (Geobiology) and Roe (Modern and Paleo Climate) shortly after the formation of the new department.

The effect of the losses and hires on the total headcount and the number of full time equivalent (FTE) faculty are shown in Figure 1. The profile of the FTE count is approximately flat during the recession of 2001-2003 and then declines sharply due to retirements as the economy starts to recover. As a result, our faculty numbers decline from its peak value of 30-31 FTEs (which had been sustained for over a decade) to a minimum 22 in the academic year 2006-2007. This drop represents a loss of nearly 28% of the total FTE's since the last 10-yr report. The potential for this large drop was foreseen in the previous 10-yr report. It should be noted that two other departments (Chemistry and Biology) in the Division of Natural Sciences with the College of Arts and Sciences had similar declines to their total FTE count. However, the overall loss rate from Arts and Sciences during this period was only 10%. Cuts to ESS were approximately twice that experienced by the rest of Arts & Sciences over the reporting period.

ESS Academic Faculty Lost or Reduction in ESS FTE				ESS Academic Faculty Gained		
QTR End/Chg	**Faculty**	**FTE***		**QTR/Start**	**Faculty**	**FTE***
Spr 2011	Booker	-1.00				
				Spr 2010	Crider	1.00
				Spr 2009	Catling	0.50
Win 2009	McCallum	-1.00		Aut 2008	Huntington	1.00
Spr 2008	Chernicoff	-1.00		Spr 2008	Gorman-Lewis	1.00
				Aut 2007	Bachmann	1.00
Spr 2007	Harris	-1.00		Win 2007	Nesbitt	0.00
				Aut 2006	Houston	1.00
				Aut 2006	Vidale	0.33
Spr 2006	Willett	-1.00				
Win 2006	Stewart	-1.00				
Win 2006	Warren***	-0.17				
Aut 2005	Cooper	-1.00				
Aut 2005	Merrill	-1.00				
Spr 2005	Cheney	-1.00				
Spr 2005	Ghose	-1.00				
Spr 2004	Baker	-0.67				
Spr 2004	Crosson	-1.00				
Spr 2004	Rensberger	-0.50		Aut 2003	Harris	1.00
Spr 2003	Ghiorso	-1.00		Win 2003	Roe	1.00
Spr 2003	Ward***	-0.67		Aut 2002	Cooper	1.00
Spr 2002	Porter	-1.00				
Spr 2002	Raymond	-1.00				
Sum 2001	Evans	-1.00		Aut 2001	Buick	1.00
				Spr 2001	Steig	0.67
	Total loss=	**-16.0**			**Total gain =**	**10.5**
		Net Change	=	**-5.5**		

* woman
** person of color
***reduction in ESS FTE

Table 1. Faculty Hires and Losses – Last 10 yrs.

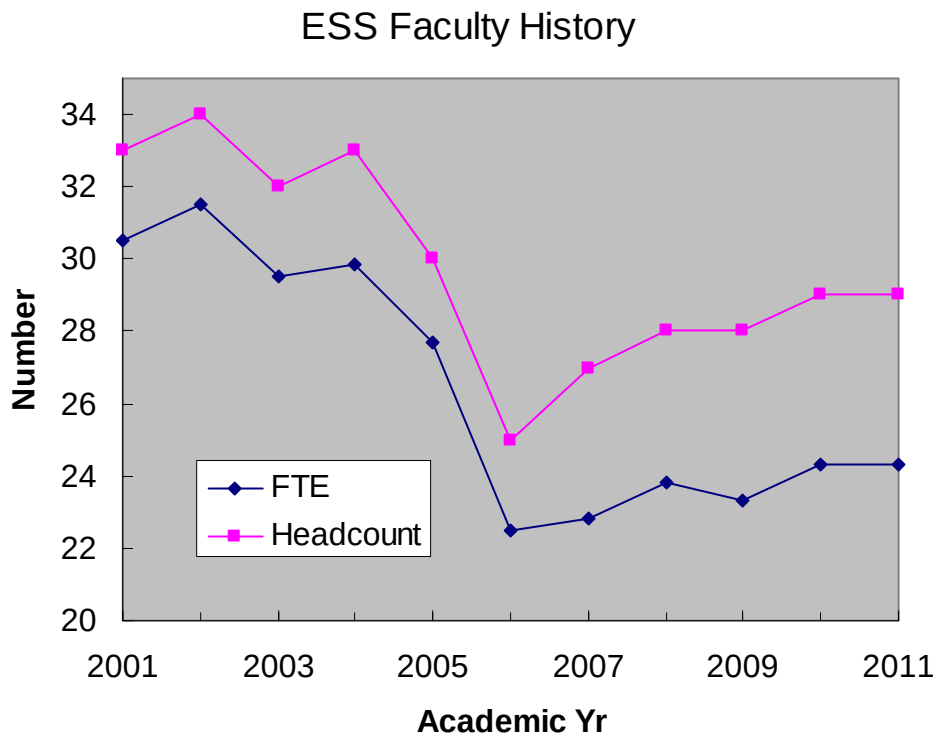

Figure 1. Headcount and FTE as a function of academic year for the reporting period.

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Some new hires that occurred after the 2001-2003 recession allow the department to have local maximum in 2009-2010 of 24 FTEs. The difference between the headcount and the FTE count increases from 1.5 in 2000 to 4.66 in 2010. This difference arises from a series of fractional hires that has allowed ESS to become more interdisciplinary. Professors Ward and Warren reduced their FTE fraction within ESS so that the majority of their positions are in other departments (Biology and Atmospheric Sciences, respectively). ESS presently shares appointments with Oceanography (Nitrourer), Atmospheric Sciences (Warren), Biology (Ward), and Astrobiology (Buick and Catling). In addition, Prof. Steig and Gillespie have two-third appointments. Interdisciplinary appointments strengthen the overall impact of the department, but the demands that these faculty members face with fractional appointments can be disproportionate to the funding level provided so that there are both positive and negative aspects to these fractional positions. Excessive reliance on fractional appointments can also lead to dilution of the core competency and teaching and research capability of the department; stabilization of this trend needs to occur in the next few years.

During the current Big Recession the change in department FTE will likely repeat the pattern of the 2001-2003 recession. During the worst of the recession the FTE profile is flat as retirements are postponed. Prof. Booker's retirement will occur at the end of the academic year 2010-2011 and no new hires have been approved for this year. A steady drop in FTE will recommence in 2011-12. The question remains whether another steep

drop in FTE will occur. At this time (July 2010) there are some economic indicators suggesting that the recession may be ameliorating. On the other hand, there are also indications of a possible second dip in economic activity, with full economic recovery several years away. Regardless of how the economy evolves, the age distribution of the faculty which is discussed in Section 4.1 gives a strong indication of potential threats to the future health of the department.

The above short chronology shows that ESS faced major transitions almost routinely on a 2-year period during the last decade. Despite these transitions, the efforts of the faculty are internationally recognized. In particular, geosciences at the University of Washington ranks fifth in the entire world in a survey of scientific journal publications by Thomson Scientific, and is second only to one other public University in the U.S. From the University of Washington Weekly News: "The UW scored very high in a survey of published geosciences research by Thomson Scientific, both in the number of times UW research was cited by other scientists (12934 citations for 6th place) and the average number of times a UW paper was cited (12.57 citations per paper for 5th place)." This survey was conducted by Science-Watch and Thomson Scientific's "Essential Science Indicators", looking at 224 scientific journals containing 150K+ papers, from 1996-2007. In another indication of the success of ESS, the annual US News and World Report ranking of colleges and universities for 2010 ranked both the Geology and Geophysics programs as in the top ten in the US.

Our faculty are internationally recognized with our faculty (including emeritus faculty) being awarded the following honors:

4 American Association for the Advancement of Science Fellows
14 American Geophysical Union Fellows; 1 Fleming Award, 1 Macelwane Medal
4 American Meteorological Society Fellows
1 American Physical Society Fellow
2 American Quaternary Society Distinguished Career Awards
1 Archeological Institute of America Pomerance Award
1 Arctic Institute of North America Fellow
1 European Geophysical Society Néel Medal
1 European Geosciences Union Agassiz Medal
21 Geological Society of America Fellows; 1 Penrose Medal, 1 Distinguished Career Award
1 International Association of Sedimentologists Sorby Medal
1 International Glaciology Society Seligman Crystal
1 MacArthur Fellow
5 Mineralogical Society of America Fellows; 1 Dana Medal, 1 Roebling Medal
2 National Academy of Sciences Members
2 UW Distinguished Teaching Awards.

1.3. Academic Programs.

The department has a comprehensive portfolio of academic programs that provides a resource to the University of Washington and to the College of the Environment at all levels. These programs include (a) non-science major classes that reach probably a third of students on campus to provide campus wide

environmental/natural world classes; (b) BS and BA degrees with several options for concentration, (c) Undergraduate Minors and (d) MS and PhD degrees. Trends for enrollments, along with learning objectives and assessment are discussed in Section II. A key component of all the academic problems is the immersion our students in hands-on experiences in the field and/or within research laboratories. This is true irrespective of whether the student is a non-science major, or major or a graduate student.

All the department's programs are very healthy. Indeed the department takes great pride in the fact that US News and World Reporting in 2010 ranks our degree programs in top 10 in the nation in both geology and geophysics. Only 6 other universities have both geology and geophysics programs ranked in the top 10 in the nation. Just two years ago ESS geophysics was ranked 10^{th} and the ESS Geology was ranked 12^{th} so that the strength of our programs has continued to increase.

1.4. Department Governance.

ESS has a very open governance that allows input at multiple levels so that the department can respond proactively as situations develop. The organization of the department that facilitates this open governance is documented in Appendix A. Every five years the chair is selected by the college dean from candidates identified by an external search committee with input from the faulty. The chair reports to the Dean of the College of the Environment. The chair works with the Department Administrator to develop financial plans for the biennium. In helping to form this plan and handle day-to-day issues, the chair is advised by an executive committee that represents the diversity of disciplines, gender, race and rank. The executive committee consists of three members plus the chair of the department. Committee members are chosen by faculty. Senior faculty have a term of 3 yrs. Assistant professors are encouraged to participate with a 1-yr term with the restriction that they cannot participate in any discussion directly involving a faculty member of higher rank. This allows the younger faculty to have a direct say in future developments within the department and develop leadership experience. Standing committees handle regular business including admissions, curriculum, and budget oversight, and report to the faculty at the scheduled Faculty Meetings. These meetings are held in line with the College Code and occur once a month during the academic year. During the summer, the faculty can meet as a Committee of the Whole to address any critical issues that might arise.

The department also has the policy that graduate students serve on department committees. The graduate students hold a retreat in Fall and elect members to the department committees. The chair meets with the graduate student representatives in Fall to determine issues that need to be addressed, and then in Spring to determine whether sufficient progress has been made and whether there are additional issues to address.

The department also has an active undergraduate group that organizes their activities through Geoclub. Similar to the graduate students, the officers are elected and participate in faculty committees that directly affect the undergraduate program. The chair also meets with the elected representatives in Fall and Spring to go over issues, similar to the graduate student interactions.

1.5. External Constituents.

ESS has substantial reach beyond department-mandated activities. ESS faculty are core members in several interdisciplinary programs including Program on Climate Change (PCC), the Quaternary Research Center (QRC), Astrobiology, Pacific Northwest Seismic Network (PNSN) and the Washington Space Grant Consortium (WSGC). The department also has 35 affiliates who greatly augment the expertise available to faculty and students within the department. Affiliates are required to have close collaborative ties with faculty and students within the department, and the chair communicates with affiliates once a year.

Members of PCC and QRC are actively involved in working with national and international committees to document and predict potential effects of climate change. Members of the PNSN interact with state agencies, including the Department of Natural Resources and the Emergency Management Division, on geological hazards. WSGC works with both state and federal agencies on the enhancement of education with the fields of Science, Technology, Engineering and Math (STEM).

The department is also fortunate to have members of the US Geological Survey (USGS) embedded within its ranks. Through this collaboration both ESS and USGS gain critical mass and have greater national and international impact. Over the last 5 years, this joint collaboration has greatly strengthened and enhanced the arrival of additional staff/faculty to both groups.

The department has also worked with the local branch of the Association of Environmental and Engineering Geologists (AEG), and we have met on a yearly basis over the last few years to expand opportunities available to students and increase the presence of the AEG on campus. Future directions could be in the creation of an advisory board to formalize some of the above ties.

Through initiatives from the graduate students, and support from the department and WSGC, the outreach program *Rockin' Out* provides support for K-12 education on earth and space topics that meet state educational standards. Activities at several schools in the Seattle area reaching several hundred students are supported each year. PNSN also host school visits each year at its facilities provide outreach efforts to several hundred students as well. PNSN is also involved in multiple news media events each year that reach a significant fraction of the population of Washington State. Outreach activities by faculty members within ESS have also created strong ties with The Museum of Flight and the Pacific Science Center and involve interactions involving several hundred people within the general public each year.

Through the graduate student organized the department's first annual Research Gala that highlighted student research efforts within the department. External members of the community were invited and participated in the activities. This year the department news letter was re-established after a hiatus of several years, and efforts are being made to increase the number of recipients which presently numbers about 300.

1.6. Budget Outline.

Details of the present permanent funding of faculty and staff are given in Appendix B. The overall department funding profile from permanent funds (general operating funds or GOF) is shown in Figure 2. Between 2004 and 2007 significant efforts were made to improve faculty salaries relative to their peers; ESS faculty salaries were more than 20% below their peer group. Because of these unit adjustments department faculty salaries were raised to being only 15% below their peer institutions; consequently, the GOF budget for the department does not mirror decline in the FTE count in Figure 1. Note though that the funding for ESS only increased on average by about 2.6% over the period which is equal to the US inflation rate for the same period. There has been no net real increase to the department's permanent budget.

The budget cuts of 2009-2010 and 2010-2011 associated with the Big Recession impacted many of the services that the department attempts to offer. In particular, the department has reduced the number of staff positions supported by permanent funds by 2 FTEs, and an open lecturer position was lost. In addition, the permanent funding for the TA budget has been severely cut (Figure 3). Permanent funding to the TA budget is almost at the same level as at the end of the 2001-2003 recession, which represents a decrease in real terms of more than 16%. In addition another budget cut of 13% will occur in 2010-2011. The department has been fortunate in that much of these cuts were offset by increases in temporary funds, which is also shown in Figure 3. This funding has enabled the department to complete its academic mission with little interruption to classes offered to students, although the TA-to-student ratio has decreased substantially in our core courses. However, the fact that temporary funding is now one-third of the total funding source is not sustainable and represents a major source of concern for the next few years.

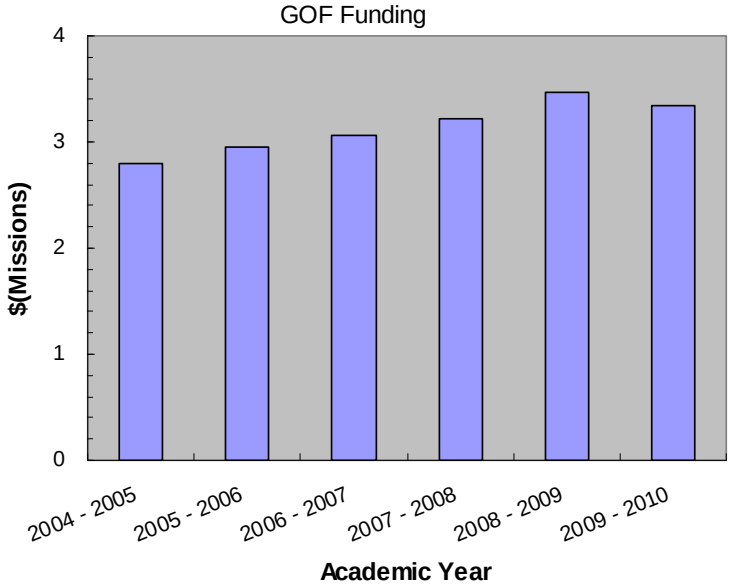

Figure 2. ESS funding profile for the last 6 yrs.

The other major source of funding for the department is through its research efforts. These efforts have remained robust over the last 10 years despite the loss of

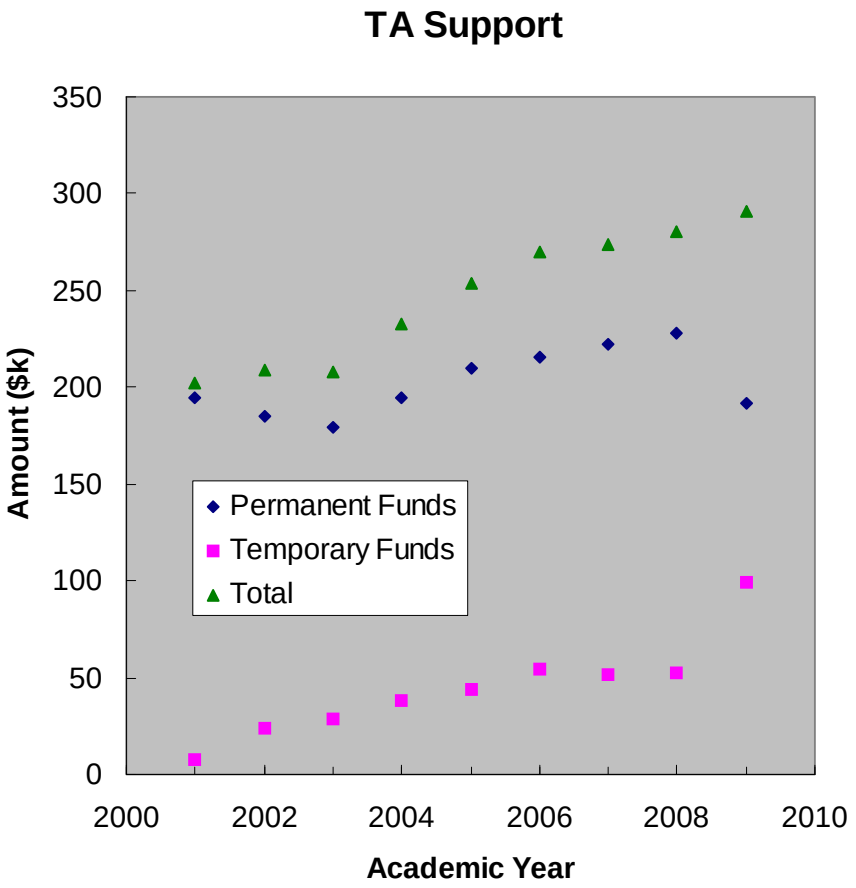

Figure 3. TA funding over the last 10 yrs from permanent and temporary sources.

faculty lines (Figure 4). The level of grants and contracts is cyclic due to the fact that larger multi-year contracts can be received by faculty so that there is less need to obtain additional grants in subsequent years. A running three-year average indicates that the average annual amount of grants and contracts has risen from about $6.5M to about $7.3 M. This is in spite of a 28% drop in FTE.

The corresponding level of research cost recovery (RCR) generated by ESS is shown in Figure 5, and indeed has less volatility than the grant level. The amount actually returned to the department jumps in 2004-2005* due to reformulation of the RCR calculation that gave higher returns back to the department albeit at the expense of the departments local fund allocation (LFA). The net balance between the reduction in LFA and increase in department RCR was approximately revenue neutral for the department and over the last few years, it has been approximately constant at about 400k. These funds are used to pay for grant related activities, including startups, shared staff support, and graduate student and faculty support on an as needed basis.

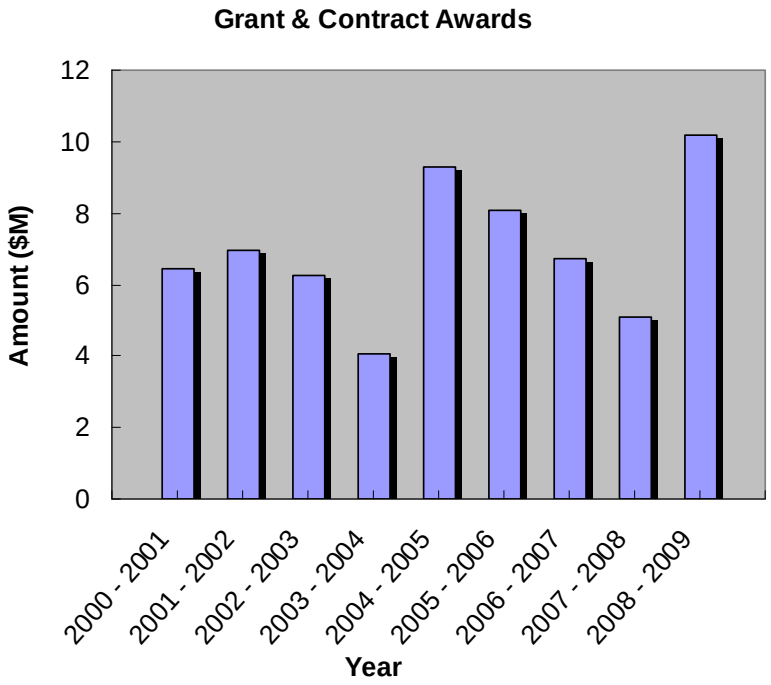

Figure 4. Amounts in millions of dollars of new grants and contracts to ESS (Source: University of Washington Annual Report in Awards and Expenditures).

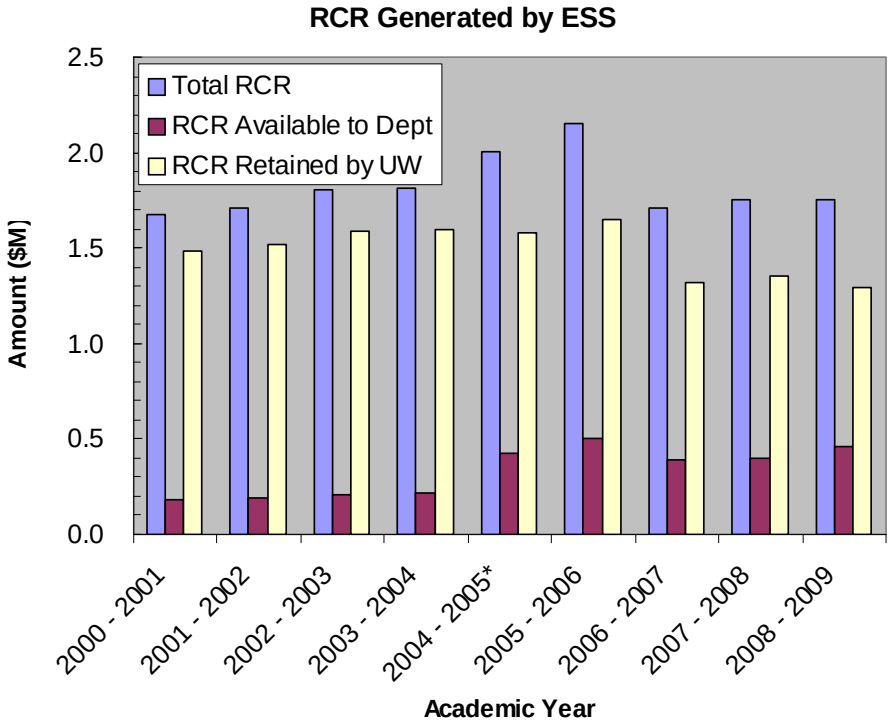

Figure 5. Amounts in millions of dollars RCR generated by ESS (Source: University of Washington Annual Report in Awards and Expenditures) and its distribution to the department and to the upper administration at UW.

1.7. Budget Distribution.

The distribution of resources is determined by the faculty. The faculty develop the strategic plan, and requests for new faculty positions are based the plan. The Promotions, Merit and Tenure Committee examines the files of the faculty and make recommendations to them at scheduled faculty meetings. Their recommendations are discussed and the faculty vote to adopt or reject the recommendations. Generalized policies for the distribution of RCR and TAs are also set at faculty meetings. An oversight committee, which consists of an academic and research faculty member review the departments spending record and report to the faculty whether the distribution of resources has been made relative to the approved guidelines.

1.8. Fund Raising.

ESS has also collaborated with other agencies including the US Geological Survey (USGS), Department of Natural Resources (DNR), and Emergency Management Division (EMD) to develop initiatives that have direct impact on the monitoring of seismic hazards to the state of Washington. These efforts brought the first permanent state funding to the Pacific Northwest Seismic Network (PNSN) in 2006-07. In 2008-2009 an earth hazards initiative was developed to provide a comprehensive treatment of geological hazards in the Pacific Northwest. It sought to leverage state and federal funding but efforts collapsed due to the Big Recession.

ESS has a Development Committee and this committee along with the Chair work closely with the Advancement Office within the College of the Environment to steward fund raising. The Research Gala and the Department's Award Ceremony are two annual funds to which donors and potential donors are invited and acknowledged. The Department Newsletter as well as revamping of the department's web pages allow enhanced contact with alumni and donors.

II. Teaching and Learning.

ESS seeks to provide a rigorous, interdisciplinary field-based curriculum at all levels in order to enable students to actively participate in earth-related issues regardless of the student's career path. Our efforts are focused on providing:

- Non-science major classes that provide campus-wide education in earth-related issues that student will encounter in everyday life,
- Bachelor of Arts degrees that are designed for undergraduates who wish to study earth sciences as a background for other careers, such as teaching, science journalism, environmental law or policy.
- Bachelor of Science degrees for students interested in pursuing careers in geology and geophysics, irrespective of whether their career paths are in the private sector or in future graduate studies.
- MS and PhD programs for those students seeking leadership roles in the earth sciences in the private sector or in academia.

An important aspect of all the above programs is that the students are immersed in hands-on experiential learning. Even students in the non-science major classes are expected to participate in laboratory sessions and/or field trips so that the full impact of the material that is being taught can be fully appreciated by participating students. On any weekend the department will be typically placing more than a 100 students in the field somewhere in Washington, with nearly 1000 students each week participating in laboratory sessions. In addition, our department is one of the few programs around the country that offers an intensive 6 week field camp for majors. The faculty provide at least 20-30 undergraduate research opportunities each year. This full immersion in field and laboratory work is a huge undertaking by the department, but one which the department highly values, as do the participating students. Our efforts in ensuring experiential learning for the students are a significant factor in the success of the department

2.1. Non-Science Major Classes

The learning objectives for our non-science majors classes are to provide literacy for all students on issues related to the earth and its environments, including its history, geological processes and hazards, surface process, and solar system environments. The intent is to provide any student on campus with sufficient background so that they can become informed citizens and act in a knowledgeable fashion in a dynamically changing world. The department provides a suite of these courses at primarily the 100 and 200 level, and these classes also add to the flow of majors into ESS. The total enrollments for the four largest of these classes are given in Figure 6.

The largest non-majors class is ESS:101 Introduction to Geology (5 cr) with class sizes that average about 550 each quarter, plus a small class of 50 during summer. There continues to be growth of about 3% per year on average, and this growth is a testament to the skill of the instructor—Senior Lecturer, Terry Swanson—and to critical support by graduate student TAs.

The next largest class in terms of size is ESS 100; Dinosaurs (2 cr). This class is taught only once a year to 700 students by Assoc. Prof Liz Nesbitt who is “without tenure and without salary.” Funding for her teaching comes from the temporary pool of department funds. It should also be noted that Prof. Nesbitt is above the minimum retirement age so that there is a definite risk that the expertise to teach this class will be lost from the department in the near future. The number of students in the class is at saturation due to size of the lecture hall and insufficient resources to provide multiple offerings of the class.

The second largest class in terms of student credits hours is ESS:102 Space and Space Travel (5 cr). This course differs from astronomy courses in that it focuses on purely solar system aspects including solar and planetary sciences plus the engineering aspects of space exploration. The interdisciplinary nature of the course allows the course to appeal to students across multiple colleges. The enrollments in this class show no sign of saturation, with the class typically filled to room capacity of 198. It was originally developed by regular faculty, but the losses described in Section 1.1 mean that it is now taught by temporary faculty. As such the teaching of this class is also at risk without appropriate resources being allocated to the department.

ESS106: Living with Volcanoes (3 cr) is taught two quarters each year at room capacity of 198 students. On quarter is taught by a regular faculty member and the other by a temporary teaching faculty member. Enrollments show that there is continued potential for growth in the student enrollments but since half the teaching is already done by temporary teaching staff, the department is reluctant to increase capacity in this area until other areas are first stabilized.

In summary, of the four largest non-science-major classes taught by the department, teaching for three of them is substantively dependent on temporary or department-discretionary funding. These classes, which represent a large service to the general University community, have a tenuous future without permanent resources. Regular teaching faculty already have a substantial presence in additional 100- and 200-level courses, so that simple reallocation of teaching resources is not feasible without severely impacting the core major curriculum.

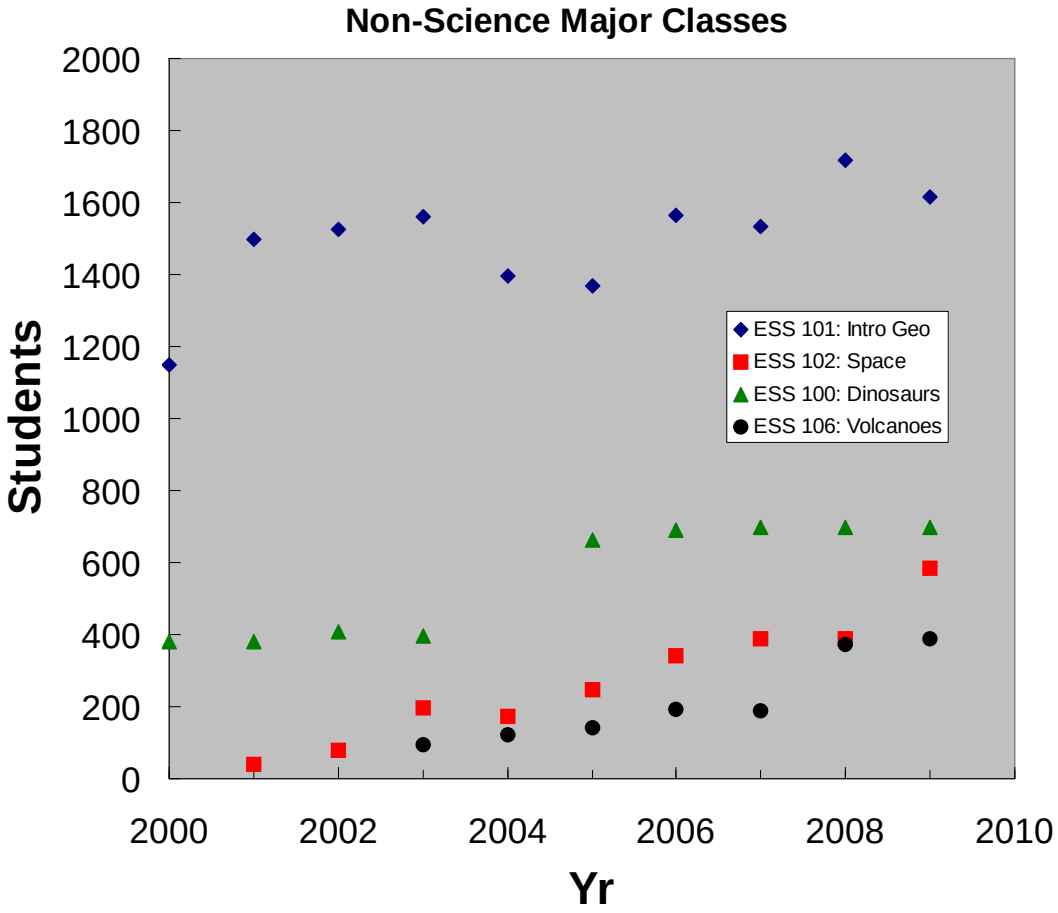

Figure 6. Total enrollments in the four most popular non-science major ESS classes. The reduction of student in ESS101 in 2004-2005 tracks total enrollments at UW. ESS100 was not taught in 2004 due to a faculty retirement.

The other ESS non-science major classes all have robust enrollments, with our other 100 level classes with enrollments of 100 and those at 200 and 300 level enrollments of between 30 and 80. The total number of students in these classes

represents approximately one-third of the students on campus. This is a major contribution to the campus in terms of educating students in natural-world processes.

ESS also has a Minor that is designed to provide non-majors maximum flexibility by allowing them to sample from the full range of ESS courses, including undergraduate courses in both geological sciences and geophysics. The requirements for the Minor are 30 ESS Credits of which at least 15 credits must be in upper division (300 or 400 level) ESS courses of with at least 3 credits in ESS courses numbered 401-488. All courses counted to towards the Minor must be completed with a *minimum* grade of 2.0.

2.2. Undergraduate Degrees and Objectives.

The learning objectives of both the BS and BA are:

- to demonstrate the ability to use multi-disciplinary quantitative approaches to critically evaluate earth science questions and their potential impact on society and the planet; demonstrate competence in scientific inquiry, writing, and oral presentation;
- to develop competence in key tools of the discipline including computer applications, laboratory methods, and field methods;
- to demonstrate competence of scientific inquiry, writing, and oral presentations so that graduates can easily communicate with audiences at all levels, from the general public, to peers and reporting agencies;
- to have experience with full immersion in field and/or research methods so that students have first hand knowledge of fundamental principles in action and have obtained skill sets emphasized by potential employers.
- to graduate students who are employable in earth science-related fields, or able to further their education in graduate programs.

To achieve these outcomes, proficiency is expected in:

1. Core Sciences including Mathematics, Chemistry and Physics
2. Earth Science Breadth including solid earth geology, geophysics, geobiology, surface processes, space physics, and planetary studies
3. Core discipline Depth through completion of requirements in one of four options: geology, geobiology, geophysics, or environmental
4. Experiential components including fieldwork and/or laboratory experiences
5. Quantitative Analysis of natural systems including interpretation and prediction of their behavior
6. Communication skills (oral/written) including the ability to read, understand, and use scientific literature.

A full listing of the BS and BA requirements are on the department web site at http://www.ess.washington.edu/ess/education/undergrad/degrees.html. With the move into the College of the Environment, the requirements for the degrees were revamped. The new college requirements reduced the general education requirements from 110 credits to 75 credits with reductions in foreign language from 15 to 0 credits, reduction of visual, literary, and performing arts (VLPA) from 20 to 10 credits, and a reduction of additional areas of knowledge in the natural world (NW), individuals and society (I&S),

from 15 to 0 credits and an increase in quantitative and symbolic reasoning from 5 to 10 credits. The reductions in VLPA, I&S and foreign languages brings ESS in line with the other units in the college and allows students to have greater supporting sciences classes and greater immersion in ESS core areas.

The core requirements for the BS requires 20 credits in supporting sciences (Math, Chem, Phys) and 15 credits in the core ESS 200 level courses. Additional supporting science and ESS core courses are required dependent on the option taken by the student. There are four options: standard (geology), environment, physics and biology options. The physics option has the most requirements in supporting sciences at 32-35 credits and 14 credits of ESS core classes and 15-18 credits in ESS electives, while the environment option has the least in supporting sciences at 10 credits and the most in ESS required classes at 44-46 credits and 10 credits in electives. The BA requirements are similar to the BS requirements except Quantitative Sci classes can replace the Math classes and ESS 400 field camp is not required.

2.3. Departmental Honors Program.

The department also has an Honors Program to provide additional enrichment and mentoring of its best students. To be part of the honors program a student must have a 3.4 GPA in the ESS major, and have achieved a 3.3 cumulative GPA upon graduation. The students must complete a 3-credit ESS 489 Honors Seminar course which is centered on important and controversial scientific issues, techniques of reading and critique of scientific literature, individualized development of speaking and scientific presentation skills, and development of individual research projects. In addition, students must serve as an assistant (T.A.A.) to a graduate teaching assistant in the laboratories for an undergraduate ESS course, which requires the student to formulate, synthesize and present knowledge gained during prior coursework., and they must complete an independent research project under the supervision of at least one ESS faculty member. The project must be approved by the ESS Honors Program Committee. The student are strongly encourage to present their results of the research orally within the department, and at the UW Undergraduate Research Symposium, either orally or as a poster.

2.4. Undergraduate Enrollments.

The number of majors within ESS over the last ten years is shown in Figure 7. The overall profile tracks admissions to UW with the large drop in 2005 and 2006 coinciding with the overall UW admissions but delayed by about a 2 years. The dip is also seen in the total number of students enrolled in ESS 101 but without the delay. One possible contributing factor for the decline was the department's move to Condon Hall during the renovation which placed the department at the fringes of the campus and was a major distraction to students and faculty alike. The delay arises because most ESS majors declare in their junior or senior year, with less than 10% of majors declaring as freshman or sophomores. Since the minimum in 2006, the department has been seeing about a 6-8% annual growth rate, and this trend appears to be continuing in 2010-2011 where the numbers of majors is up more than 20% from the same time last year.

The break-down of undergraduates in the program as major or minor, BA or BS student is shown in Figure 8. The number of students in the minor is robust with typically 10-15 students in the program. The number of students in the BA has dramatically fallen in the last 10 years from a high of 30 students to less than 10 in this year. The reason for this is drop is not known but there are two potential factors. The first is that prospects for students that wish to continue in the field, including the private sector have better opportunities with a BS as opposed to a BA, though a BA is suitable for students continuing on in Education and related fields. Second, many of the BA students may be getting their degree from the Program on the Environment as opposed to ESS.

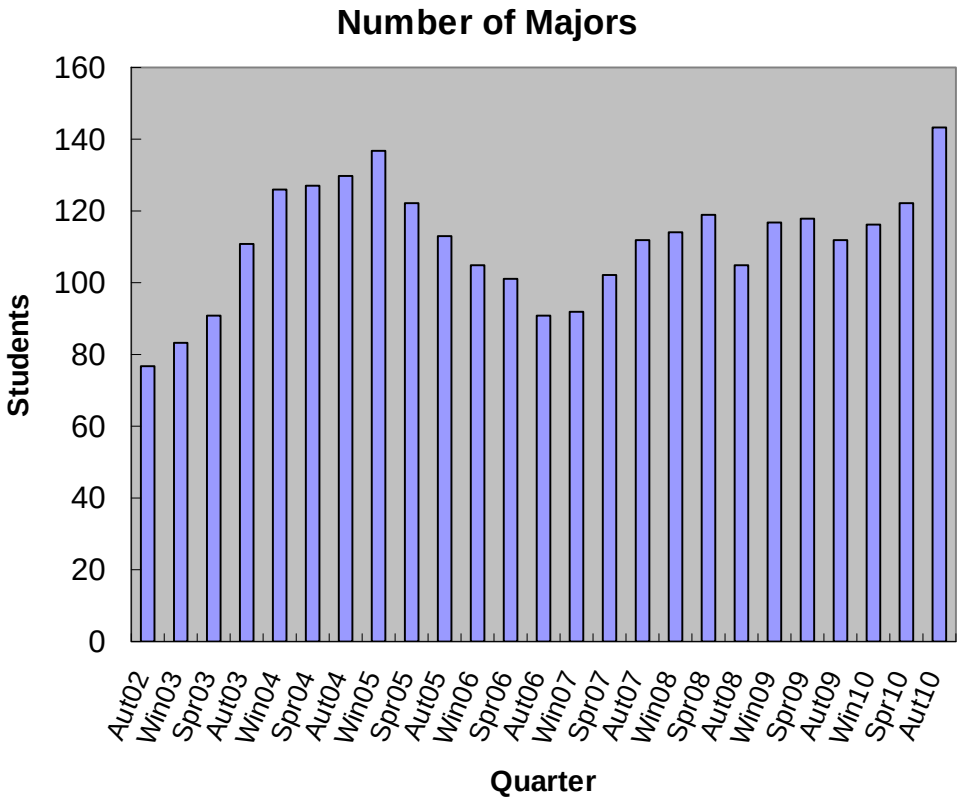

Figure 7. The number of majors by quarter since the formation of the ESS.

The number of students in the Standard (Geology) major has been increasing over the last 5 years. The environment option which was initiated in 2006 has been very popular with the students and now comprises 20-25% of the total number of majors in the BS program. The number of students in the physics option has been fairly steady at about 10 students each year. The numbers in the biology option have tracked the overall enrollments reaching a minimum in 2007 then returning to a more typical value of about 10 students, similar to the physics option.

The number of students that graduate with distinction through the ESS Honors program or through UW Honors program is about 10% of the BS graduates.

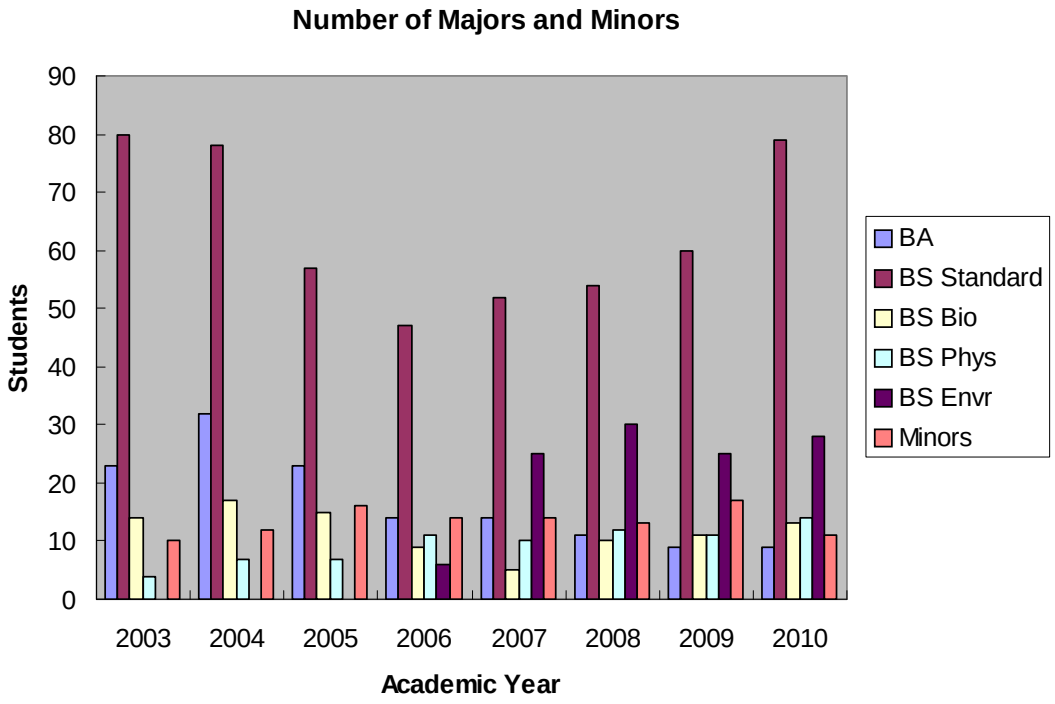

Figure 8. Distribution of students in the different BS options, BA and minor.

2.5. Graduate Learning Objectives

The PhD and MS students are a vital part of multi-million dollar research programs within the department that serve the state (e.g. through studies of seismic and other geological environmental hazards) and the nation (e.g. through internationally recognized programs including global change and space physics). Students graduating from ESS have been and continue to be recruited for positions within the private enterprise (including visits by recruiters from Exxon-Mobil and Chevron), faculty and research positions at academic institutions across the nation.

MS and PhD students must obtain demonstrable analytic and communication skills including:

Analytic Skills

- Understand the current status of one of the four cornerstones of the department (solid earth, surface processes, geobiology, and atmospheres and space);
- Recognize outstanding scientific questions and the underlying limitations within our knowledge base that need to be solved in order to address these questions;
- Locate, process, and interpret additional sources of information including literature searches and archived data sets;

- Develop new methodologies and techniques that may lead to new solutions/insights into scientific problems;
- Grasp how future technical and theoretical developments may assist in solving problems.

Communication Skills

- Express their ideas in written reports and oral presentations to specialists and to non-specialist audiences and orally defend these ideas under a critical examination.

In addition to the above learning objectives, PhD students are expected to develop an independent research project and demonstrate proficiency through field work, laboratory experiments, computer modeling and/or data analysis. Students need to be able to collect, store, manipulate, analyze, and display data/information/theories for the purpose of problem solving and decision making in a research environment. Students must also be able to apply new theory, develop or interpret existing theory, and compare the existing literature to support their research and prove its originality and applicability.

2.6. PhD Program

Students in PhD Program are required to complete a minimum of 90 credits (a master's degree from UW or another institution may substitute for 30 credits). A minimum of 60 credits must be completed at the University of Washington. Prior to the General Examination, a student must satisfactorily complete a total of 60 credits. 30 credits from a Masters degree from UW or another institution may be substitute for 30 of these 60 credits. Of these 60 credits, a student must complete at least 18 credits of UW course work at the 500 level and above, with at least 18 numerically graded UW credits of approved 400 and 500 level courses. A minimum cumulative GPA (grade point average) of 3.00 is required. A minimum of 27 dissertation credits over a period of at least three quarters must be completed. With the exception of summer, students are limited to a maximum of 10 dissertation credits (ESS800) per quarter. The median time to degree for students graduating between 2000 and 2010 is 5.4 yrs, which is appropriate.

The enrollments for the PhD program have been very robust over the last few years as shown in Figure 9. The average number of students within the graduate program has remained steady at about 78 students per year averaged over the last decade. The vast majority of the students are in the PhD program and we expect that the number of students in the PhD program will remain approximately constant for the next 10 yrs. The slight decline in number between 2004 and 2008 reflects the loss of faculty described above. The fact that the drop is very much less than the drop in the faculty speaks to the energy of the present faculty. It is even of greater credit to the faculty that despite deep cuts to the state support to the department funding, the number of graduate students is actually on the rise. This has been possible through greater federal funding of faculty research, and a strong undergraduate program that allows teachings assistantships for many of the graduate students.

The proportion of women in the graduate program has risen over the last few years to the point where they are close to exceeding the number of male graduate

students. It is important for the department to provide role models for women to encourage their continuation of their careers in geosciences beyond their graduate studies.

The recruitment of minorities shows a lapse between 2003 and 2006. Once the problem was noted, additional procedures for minority recruitment were put in place to encourage stronger minority recruitment and thereby ensure a diverse graduate student population within the department. These additional procedures included verification that all top-ranked minority students are identified with a faculty member for recruitment, that graduate student fellowships for minorities are fully tapped, and that visits of minorities to the department are coordinated with graduate school's Graduate Opportunities and Minority Achievement Program (GO_MAP). The present percentage on minorities is consistent with the campus average.

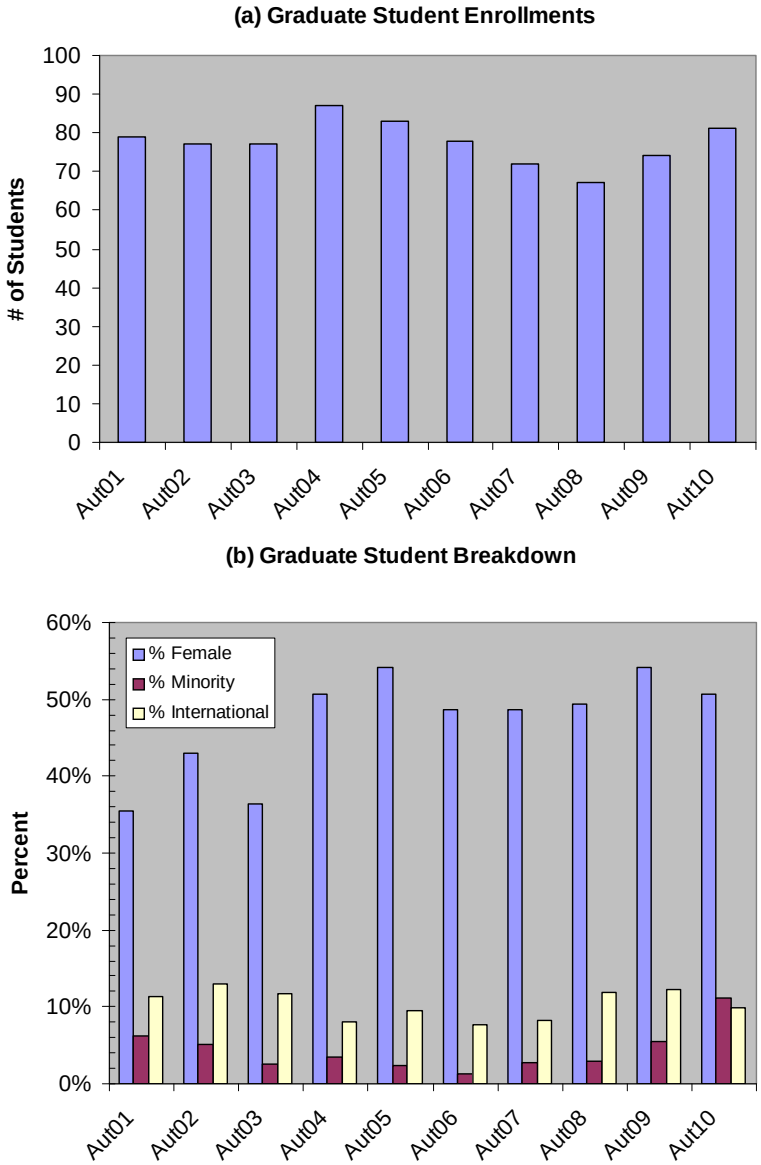

Figure 9. (a) Total number of graduates enrolled in ESS and (b) breakdown of the graduate student population. The MS students represent at most 10% of the total number of graduate students.

The percentage of international students also has a minimum between 2004 and 2007. Part of this decline is due to increased visa restrictions on international students, and their larger cost of support. Another reason is that the US students that enter the program are highly competitive and in general meet all the needs of the faculty.

2.7. Masters Program.

For the MS Program, students must complete 36 credits. Only courses numbered 400-799 that are numerically graded 2.7 and above, or have a grade of Satisfactory or Credit ('S' or 'CR') count toward the 36 credit total. ESS 498 "Special Topics" and ESS 499 are not counted in the 36 credit total. At least 18 credits must be in courses numbered 500 and above and 18 credits must be numerically graded in department approved 400-level courses accepted as part of the major and in all 500-level courses. A minimum cumulative GPA (grade point average) of 3.00 is required. All MS students in ESS are required to demonstrate proficiency in breadth in the Earth Sciences, and expertise in their discipline, including field/laboratory work, data acquisition and analysis, and theoretical and computational underpinnings. The median time to degree for MS students that graduated between 2000 and 2010 was 3.9 yrs. This duration is on the long side with a desired time to degree should be closer to 3 yrs. The long duration of the MS students is a symptom of how the MS program is presently set up

To date the number of students accepted directly into the MS program as opposed to the PhD program has been small due to the desire to support the research mission of the department. In some respects this is a lost opportunity for students as many are not seeking the complete PhD research experience, but do need additional expertise to have a leadership role in the private sector. We have determined that there is, in fact, a large demand for this type of graduate experience both by potential students and potential employers. In addition to meeting this demand, developing an MS-only graduate track would diversify our student base, specifically respond to objectives of the new College of the Environment, and provide additional resources to support teaching and research in fields which are not well-represented in the department.

Thus, in the late 2009 an *ad hoc* committee was formed to investigate the development of an option within the MS program would directly address the needs of students wanting to go into the private sector with a graduate degree. The committee met with members of the private sector. Following these discussions, the recommendation is to create an Applied Earth Sciences (Engineering Geology) Option within the existing MS program with specific course requirements. MS students would be accepted into the program but not guaranteed RA or TA support as the department has done in the past, essentially making it a fee-based program. The department would also investigate streaming technologies to allow asynchronous online delivery of class material to increase access to the program. We anticipate that this program could have annual enrollments as large as the existing PhD program. The details of the proposed MS option are described in Appendix E and a market survey for the program is included in Appendix F.

The resources to launch this option would be relatively small because of leveraging with the existing PhD program. However, even these limited resources are presently not available. Nevertheless we hope that such resources could be found within the next few years to allow launching of the program. If such resources cannot be found in that time frame or if critical mass for the program cannot be achieved, then it would probably be appropriate to drop plans in this area and move resources to address other priorities within the department.

2.8. Learning Assessment.

All programs within ESS are reviewed on a regular basis through diverse methods. Core classes plus large non-science majors classes are evaluated through student course evaluations. Faculty and TAs who score low are mentored in order to identify and address concerns. A signature of the department is that many of these activities outside of the lecture are led by regular faculty members so that there is substantial amount of one-on-one time between students and faculty. This results in close mentoring of students and, if students develop problems, faculty insight can aid the student advisers to find a means to enable the student to remain successful in their studies. It is also a remarkably effective system for identifying students with excellent but unrealized academic potential, and engaging them in research activities.

Both graduate and undergraduate students are asked to participate in exit surveys. Students are asked on how well the program has prepared them for their chosen career paths, and whether there are any academic gaps or other impediments for students to reach their goals. In addition, the chair meets with elected representatives of both undergraduate and graduate student bodies where such issues can also be discussed. These meetings occur at both the beginning and end of the academic year to go over goals and whether those goals for the year have been achieved.

Examples of developments from these exit surveys and meetings include revamping of the material in ESS 212: Earth Materials and Processes; the development of the new course ESS 454: Hydrogeology; more microscope facilities for teaching and research; and substantially improved computer classrooms and graduate computing resources.

2.9. Teaching and Mentoring Outside the Classroom

Teaching and mentoring outside the classroom occur on many fronts. The department's academic counselor participates in campus recruitment events both on and off campus and provides information about opportunities within ESS. For the undergraduates a social function is sponsored by the department in Fall and Spring quarters. In addition, undergraduates are encouraged to join the Geoclub which organizes additional geological and social activities that often include faculty participation. These joint student/faculty activities include a hike into the Mt St Helens Crater, and a spring break field trip to Hawaii and to the Utah/Nevada area in alternate years. In addition, the department also sponsors an annual social for majors interested in teaching and provides information and opportunities for networking along this career path.

In 2010 the department held its first Research Gala which was a two-day event that highlighted research efforts of both graduate and undergraduates, and involved mentoring and social events with students, faculty and employers from the private sector. Donations by faculty and the private sector provided funds for awards for best student papers in a variety of categories. This event – initiated and organized by the graduate students - was so successful that it will now become an annual event.

The department also sponsors seminars on 'How to apply to graduate school', and 'How to apply for research opportunities within ESS' for the undergraduates. Some startup funds for undergraduate research are also provided by the department. For the graduate students a seminar on "How to apply to NSF Graduate Student Fellowships' is also sponsored by the department. This program appears to be very successful with three NSF Fellowship awards made to graduate students in 2010.

In 2009-2010 the department web site was redesigned to provide increased transparency to department activities, a greater resource for students in terms of class schedules, and an enhanced resource for faculty and staff.

Section III. Scholarly Impact.

3.1. H-Index

The scholarly impact of ESS faculty is measured by internal and external factors. As an external measure of ESS scholarly impact we have taken the H-index as provided by ISI Web of Knowledge (Table 2). There is some controversy in the literature on the accuracy of the H-index, particularly at the level of a single individual, or by subdiscplines. It is provided here as a simple quantitative measure, and the emphasis should be on the ensemble average and not the individual. In the field of physics, the H-index is designed so that a value of 10-12 is a guideline for tenure, ~18 a full professor, a value of 15-20 would be for a fellowship in a national society and greater that 45 for a membership in the US National Academy of Sciences. Little research has been done on other disciplines. The department's MacArthur Awardee Prof. David Montgomery has the highest H-index and is in the range of that expected for National Academy membership. The vast majority of our full professors have H-indices exceeding 20 and our assistant professors are well on the way to exceeding the range for tenure decisions.

The high overall H-Index of our faculty is part of the reason why US News and World Report and Thomson Scientific rank ESS in the top 10 departments in geology and in geophysics in the nation. The recent National Research Council report on graduate schools placed the department with a similar ranking when the individual fields of geology and geophysics are sorted individually.

Faculty Member	PhD Yr	Institution	Citations	Articles	H-index
Olivier Bachmann	2000	U. Geneva	441	19	11
George W. Bergantz	1988	J. Hopkins	782	37	15
John R. Booker	1971	UW	4167	169	33
Jody Bourgeois	1980	U. Wisc.	842	24	10
J. Michael Brown	1980	U. Minn.	1563	49	22
Roger Buick	1986	U W. Aust.	2231	42	24
David C. Catling	1994	Oxford	1073	19	19
Darrel S. Cowan	1975	Stanford	1481	36	21
Ken C. Creager	1984	UCSD	1498	44	21
Juliet G. Crider	1998	Stanford	149	8	4
Alan R. Gillespie	1985	Caltech	2938	120	30
Drew J. Gorman-Lewis	2006	Notre Dame	144	15	6
Bernard Hallet	1975	Stanford	1864	50	24
Robert H. Holzworth	1977	UC Berk	1477	98	20
Heidi Houston	1987	Caltech	675	26	16
Kate W. (Ruhl) Huntington	2006	MIT	153	11	7
David Montgomery	1991	UC Berk	6415	129	44
Bruce K. Nelson	1985	UCLA	1556	41	18
Gerard H. Roe	1999	MIT	409	23	9
Eric J. Steig	1995	UW	2255	64	26
John O. Stone	1997	ANU	1627	43	22
John E. Vidale	1987	Caltech	3225	98	31
Edwin D. Waddington	1981	UBC	2740	72	23
Peter D. Ward	1978	McMaster	1726	84	25
Robert M. Winglee	1984	U of Sydney	2172	96	25

Table 2. Measurement of the ESS science impact as determined by citations and H-index (data from ISI Web of Knowledge). Results may not be fully inconclusive due to difficulty of searching for individuals with common names.

3.2. SCH and SCH/FTE.

For an internal measure of the scholarly impact we use the total number of student credit hours (SCH) and the SCH/FTE as shown in Figure 10. For reference the average SCH/FTE in the College of Arts and Sciences in 2008-2009 was about 900. Efficiencies within the department have led to a steady increase in both total SCH and SCH/FTE. The value for SCH/FTE exceeds the average value of the College of Arts and Sciences and is the highest of the units within the new College of the Environment. It should also be

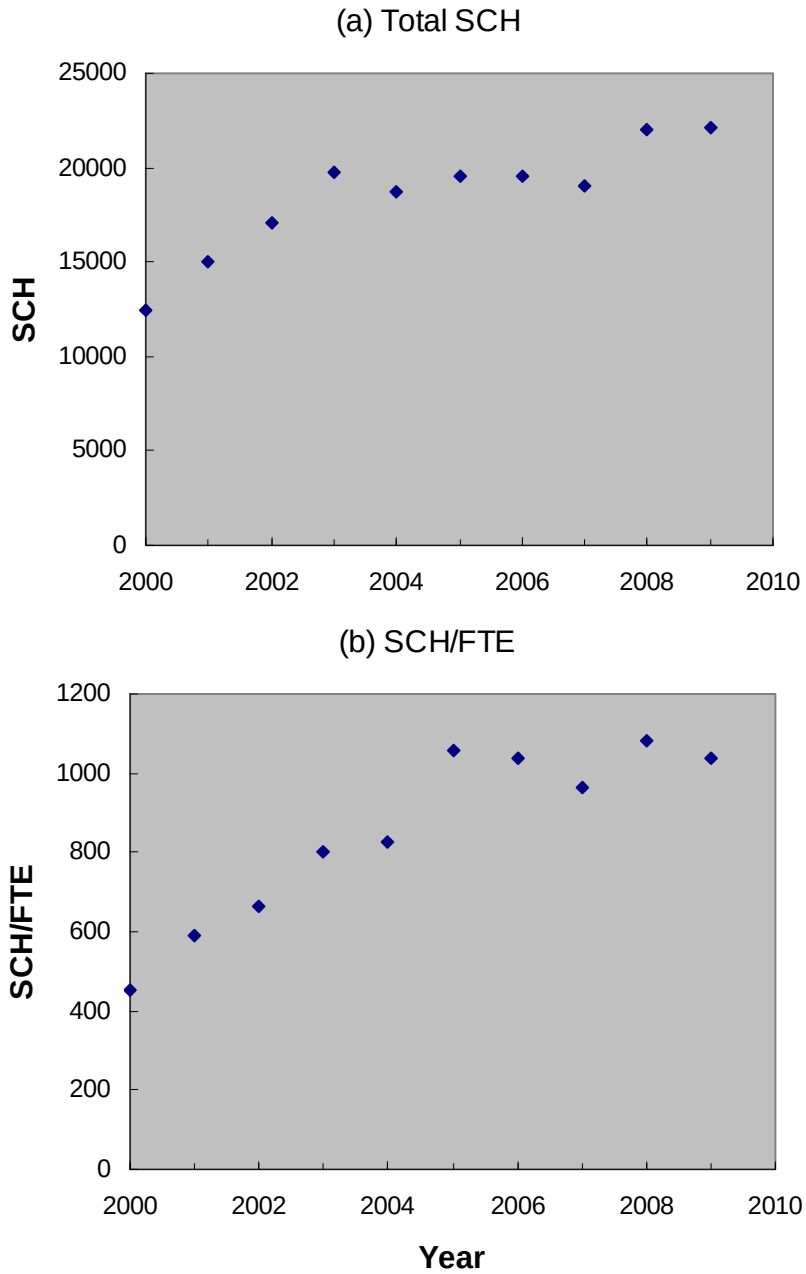

Figure 10. (a) Total student credit hours (SCH) and (b) SCH/FTE over the last ten years. Efficiencies within the department have led to a steady increase in both areas and the department's efforts are close to saturation.

noted that both values are near saturation, and this is occurring because of the overall loss of faculty (see discussion in Section 1.2).

Section IV. Future Directions

The state of Washington is a region of a great beauty and active geological processes, including earthquakes, volcanic activity, ground failures, lahars, landslides, tsunamis, and flooding. Human developments continue to expand into areas that are routinely subject to such hazards. The general public is substantively impacted by these processes and the private sector has major need for geologists and geophysicists to monitor and diagnose these hazards in efforts to mitigate their effect on the population and economy of the Pacific Northwest. In addition, Washington is fortunate to house several aerospace and other industries, and exploring beyond the Earth remains of great interest to the residents of Washington and to the US. Because of this need, enrollments in our non-science major classes continue to rise and are basically at saturation due to classroom capacity. There is also strong demand for the BS degree offered with continuing increase in undergraduate majors at 6-8% per year over the last four years. The graduate program is equally robust with sustained enrollments of 70-80 students in the PhD. In order to address growing demands for highly skilled students in the geotechnical sector, ESS will soon launch a new focus within the MS program that is expected to add yearly enrollments of about 20 students per year.

4.1. Department Composition

The last 10-year report noted two important issues in relation to the faculty composition. One issue was the diversity of faculty, and the other was the potential for a retirement wave to produce a significant reduction in the department's capabilities. The department has made significant progress on the first of these issues but attrition of faculty from a retirement wave has meant loss of critical mass in key areas in the department and in some cases groups are but one position away from going unstable.

Based on the academic faculty age distribution (Fig. 11), there are presently four professors at or near the typical retirement age of 65 and significantly more faculty are above the eligible retirement age of 62. In two years time, a total of 11 faculty will be eligible for retirement; i.e., more than one-third of the headcount will be eligible for retirement. The seriousness of the problem can be seen by looking at the faculty distribution in 5 years time. At this point we will have 11 faculty above the average retirement age, with one-third of them well above the average retirement age. If one started a hiring process at the time of the submittal of this report and hired two faculty per year for 5 years, and not even allowing for the delay in the actual arrival of a hire, then after this 5 year period the faculty headcount will have declined by 1 assuming no one in the present group of 55-59 retire or other losses from outside recruitments occur. Since the economic factors strongly suggest that a hiring program will not be initiated for a couple of years, the conclusion is that the department will suffer another major net loss of faculty, similar to the results from the previous recession. The only difference is that the department will lose functionality if another major loss occurs.

The age distribution for the research faculty is not as bad as teaching faculty, as shown in Figure 12. The department is fortunate to have several long-term research faculty who have international reputations including Research Professors Hernandez (Aeronomy), Mercer (Underwater Acoustics), Odom (Underwater Acoustics), Conway (Glaciology) Winerbrenner (Glaciology) and Research Associate Professors McCarthy (Space Physics), and Sletten (Aquatic Geochemistry). In recent years we have also been able to make new hires including Research Assistant Professors Bandfield (Planetary Sci), Wood (Planetary Sci), Harnett (Space Sciences), and Research Associate Professor Bodin (Seismology). As noted above we also lost Research Assistant Professors Aalto (Surface Process), Putkonen (Surface Processes) and Matsuoka (Glaciology) due outside hires to tenured/tenure track positions. Our research faculty enjoy the same rights as the academic faculty except for voting on tenure of academic faculty. Due to restrictions on funding, research faculty do not serve on any of the standing department committees (except for the oversight committee) unless they are on some fraction of state funding. Research faculty actively participate in student's examination committees, and thereby greatly enrich the capabilities of the department.

4.2. Objectives for the Next 10 Years.

Our goal is to provide excellence in teaching and research within Earth and Space Science and thereby continue to maintain our leadership in these fields. Our efforts must include

- Retention and recruitment of excellent and diverse faculty, both academic and research;
- Continued development of a rigorous and diverse undergraduate education program that supports majors so that they can be successful in the private sector or continue as graduate students;
- Maintenance of world class research facilities for earth and space sciences;
- Recruitment of the best graduate students, providing excellence in training, sustaining the health of the field and providing future generations with a critical infrastructure;
- Maintaining the critical mass of key areas in terms of faculty, graduate students, and research facilities that foster new science in both disciplinary and interdisciplinary studies;
- Sustain a dynamic program that provides non-majors across the campus with a solid understanding of earth and space sciences;
- Provide outreach programs for the general public and K-12 education wherever possible.

4.3. Critical Issues.

Maintaining critical mass in the department's key areas is critical to maintaining a top ranked department. Below we identify areas as identified in the department's 2008 strategic plan where investigators are urgently needed to sustain key elements of the

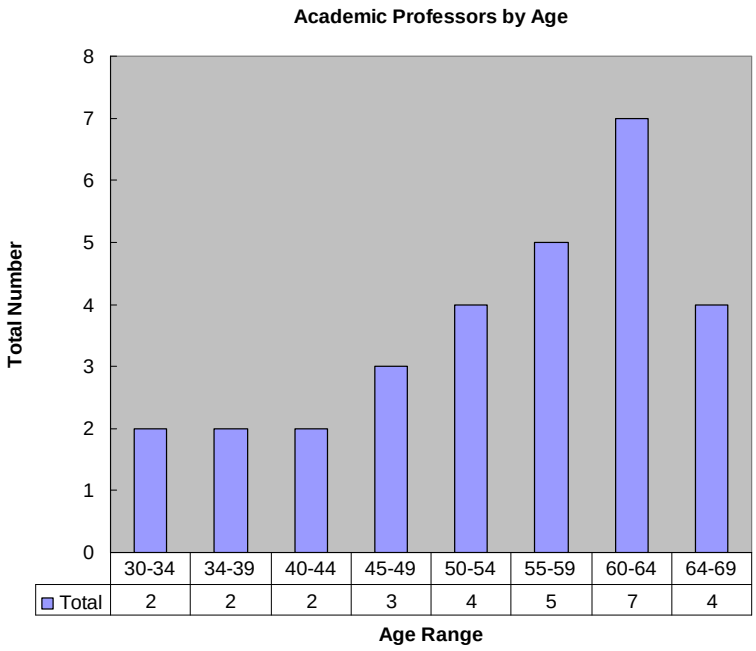

Figure 11. Age demographics of the Academic Faculty as of July 2010.

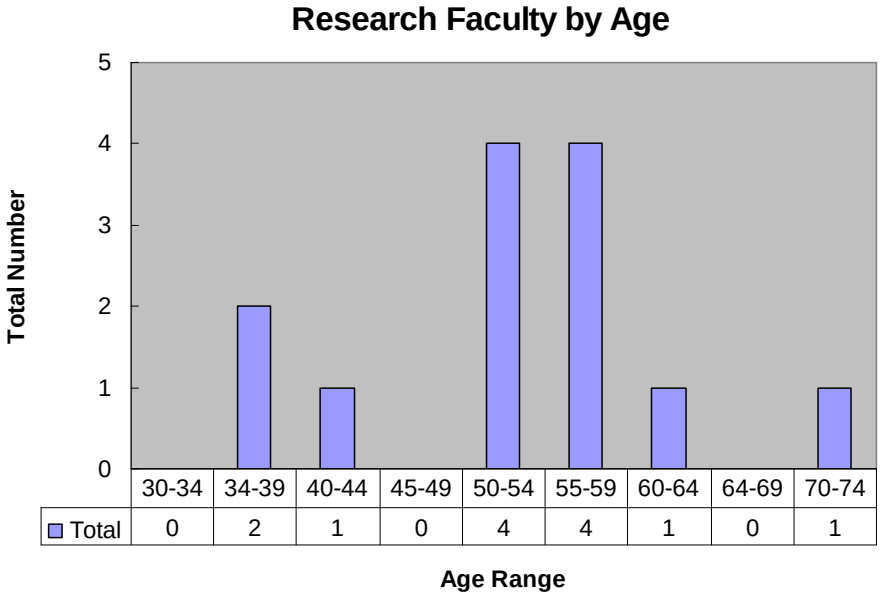

Figure 12. Age demographics of the Research Faculty as of July 2010.

department. (The strategic plan has not been updated since 2008 due to the continuing freeze on faculty positions).

Space Sciences. The space science group within Earth and Space Sciences is an internationally recognized group but has been subject to major losses. Space Sciences covers a variety of fronts, including thin atmospheres of solar system objects, space plasma environments and advance plasma propulsion, ionospheric and mesospheric dynamics, and atmospheric electrification. Over the last several years, studies in this area have been developed by three academic professors and three research professors that produced a very strong undergraduate and graduate program. The space science program has produced major growth in its undergraduate teaching responsibilities, including ESS 102 (200 students, 2 quarters); ESS 205 (50 students, 1 quarter), ESS 471 (10 to 20 students each, 1 quarter) and ESS 472 (20-30 students, 2 qtrs). This load does not include the contributions to the graduate classes. At the same time these classes have been developed, the group has taken two major hits. Professor Robert Winglee took over the duties of Chair of Earth and Space Sciences and Professor Harris was recruited to University of California, Davis. Currently, there is only one dedicated faculty member available for full time teaching. The hardware program and its experiential learning components are under critical mass. Several of the above courses including ESS102, ESS 205, and ESS472 are all highly demand at full or close to full capacity but without long term support that continued offering is in jeopardy. It is therefore imperative that a search be carried out to alleviate this critical situation and replace the loss of Professor Harris. In the 2008 a search was initiated but due to various reasons including budget cuts the position was never filled.

The urgent need to fill this position is as great as it was when the initial request for a search was made. Course loads remain high and there is an insufficient number of instructors to teach the courses. It is difficult to attract a qualified person with the required hands-on experience, and the results of this last search indicate that we are searching at the wrong level. Hands-on experience requires five to eight years experience after completing a PhD, particularly when we are requesting that the person have the ability to develop a large-scale rocket/satellite program. Given the present load and demographics it would be appropriate to have this position at the Associate Professor level or potentially the full Professor level, rather than an entry Assistant Professor level.

Glaciology. The cyrosphere is undergoing huge changes, raising unanswered questions about sea-level rise and potential impact on the environment. Earth and Space Sciences houses one of the best glaciology programs in the world, but it is supported by only one academic faculty member, Professor Waddington, and four research faculty. This area provides critical information on the processes leading to the thinning of ice sheets in Antarctica and Greenland and is a critical component for modeling the past, present, and future evolution of these continental ice sheets. The academic group in this area has fallen below critical mass with the retirement of Professor Charles Raymond in 2002. The group has held back from requesting a new hire in this area as the department has tried to consolidate from other losses to key programs. The situation though is now so critical that we can no longer wait. *Their efforts cannot be sustained with one faculty member.* If Professor Waddington were to leave, our world class glaciology group would disappear. Right now, key classes cannot be offered and one academic faculty member can no

longer sustain the excessive teaching load. *This search recommendation is supported by the Program on Climate Change and the Applied Physics Laboratory*. It is consistent with the President and Provost's stated areas of emphasis needed for the University of Washington.

Crustal Materials. This is a key area, particularly with respect to the department's undergraduate curriculum. It is an area that has seen numerous losses in its number of faculty members, and some areas are struggling to maintain critical mass. Cuts have been so deep that deciding on the next area to bolster has been difficult. Positions in physics, chemistry and thermodynamics of earth materials are badly needed. There is some assistance in the area with the arrival of Professor Olivier Bachmann. However, since the last 10 year plan (which foresaw this crisis) the retirement of Professors Eric Cheney, Bernard Evans, Subrata Ghose, and Stu McCallum and the departure of Research Associate Professor Victor Kress has moved the deficiency in this area from critical to urgent. We recommend casting a broad search that would encompass research areas from high P/T igneous and metamorphic systems to low P/T weathering systems. *Losses have been so large in this area that key elements of the undergraduate curriculum are being taught by temporary faculty and laboratories central to a top-ranked department such as the microprobe are already in serious degradation.* In order to maximize the available pool of candidates, we are using a fairly broad generic title of crustal materials that embraces substantial portions of solid earth geology and geophysics disciplines

Geomorphology. Geomorphology is a rapidly developing field that is becoming more important as populated areas expand into more hazardous geological areas. For example, flooding disasters in the winter of 2006/2007 demonstrated the increasing danger to communities, many of which were thought to be safe from the devastation that occurred. Quantitative links are now possible between tectonics, erosion, and climate. NSF's EAR program has substantially increased its budget to support this growing field. Within Earth and Space Sciences, we have two academic faculty members working in the area – Professor Hallet (glacial and periglacial geomorphology) and Professor Montgomery (tectonic, fluvial and planetary geomorphology). However, we have been unable to offer key courses consistently (e.g., fluvial geomorphology) or at all (e.g., hillslope geomorphology) and have had no room to expand our curriculum to cover key educational opportunities (e.g., river restoration and GIS). These areas not covered are having an ever increasing impact on the State of Washington. For us to fulfill our mission to the State, this gap needs to be corrected.

Geodesy: Earth and Space Sciences strives to be the foremost geological department in the Pacific Northwest and in the State with the 2nd highest seismic risk and highest volcanic risk in the country. The importance of understanding subduction zone dynamics has been recognized by NSF's EarthScope Plate Boundary Observatory, providing a major infusion of funding and technology into the region over the next 2-3 decades. An important discovery in this area is that we are subject to episodic tremor and slip events and the relationship of these events to general seismic activity is actively being investigated. A comprehensive study requires an examination of longer time scales than possible with a seismic network. Hence, there is a need for a Geodesist who can work with data from the hundreds of GPS stations presently being installed. Most west coast

universities, including Stanford, University of California, Berkeley, University of Oregon, Oregon State University and Central Washington University, have such a person working in this area. The University of Washington does not have such a position and has been left behind in this critical area. Beyond its importance to regional tectonics, geodesy provides an important multi-disciplinary toolbox and is needed by students in many Earth Science fields. A geodesist with expertise in InSAR, GPS, LIDAR, and GIS technologies would fill critical and broad curricular needs in the department and at the University.

Geobiology. ESS successfully recruited Dr. Drew Gorman-Lewis for Geobiology and Astronomy successfully recruited Dr Vicki Meadows in Astrobiology, relieving some of the pressure on Professor Roger Buick. The Geobiology program itself remains below critical mass for developing cutting-edge research and there is still an excessive teaching load for faculty in this area. This area should be given a chance to consolidate and continue expanding its contacts within the community to enhance future recruitments. Geobiology remains an area of continuing critical need, but without a recommendation for an immediate hire. The reasons for revisiting geobiology hiring in a few years remain the same. Reasons include the high teaching demand versus the low faculty numbers, that it's an under-staffed area but it remains one of our four research foci, and that the growth area in interdisciplinary geosciences should capitalize on the Century of Biology. Until Drew Gorman-Lewis has established himself and the possible impact of David Catling on the area is assessed, it is premature to search now.

Geodynamics. We successfully recruited Dr. Huntington in the geodynamics/petrology search area of tectonics and erosion. This position came at a time when there were two losses in one year in this field – Assoc. Profs Stewart and Willett. This still remains an area of growth for future development as modeling efforts become increasingly quantitative. Similar to Geobiology, a search in this area should be held off until our new hire becomes established and contacts are developed for possible new recruitments.

Planetary & Terrestrial Remote Sensing. This program is maintained by one academic professor, Dr. Alan Gillespie, who is close to retirement (possibly 3-4 years) and only has a 2/3 appointment within the department. Remote sensing is clearly a vital tool for the community and for students advancing in the field. Our need to strengthen expertise in this field is recognized by the fact that it has continued to be on the priorities list but more urgent issues, such as those listed previously, always manage to lower its priority. This area is important to the department, but the loss of so many faculty members has left the department struggling. This area is presently being built up through the hiring of research faculty. At some point in the near-future, the department will have to address the lack of academic faculty in this area. Otherwise, the group will be subject to outside raiding and losses will occur through the inherent instability in soft-money research faculty positions.

4.4. Strategies for the Future.

The development of the new option with the MS program is expected to produce sufficient new revenue to permit hires in applied earth sciences. We will continue to collaborate with outside agencies including the USGS, DNR and EMD for the development of a multi-hazards program for the northwest which would aid in securing funding for Geodesy, and climate change initiatives may help in the development of the

Glaciology position. Help in the other areas relies heavily of state resources though there is potential for the leveraging of resources with other departments, e.g. collaborations with Electrical Engineering and Aeronautics and Astronautics may aid in the development of a Space Physics position, and Astrobiology for the development of a planetary position, and the units with the College of the Environment for remote sensing.

The department has been very successful in developing a broad portfolio that reaches undergraduate and graduate students at all levels. Our program is nationally ranked and it is the department's goal to continue to improve the offerings provide by the department so that the national ranking of the department will continue to improve. These objectives can only be done if significant support of the department occurs.

PART B. UNIT QUESTIONS.

B.1. *Has the merger of the Geophysics Program and the Department of Geological Sciences enabled the achievement of increased impact in terms of research, teaching and scope of the department?*

The years 2000 to 2004 were exceptionally hard on the faculty within ESS. The merger brought together two very different cultures – the geophysics program exclusively concerned with graduate education and research and heavily reliant on research faculty, with the geology department heavily invested in undergraduate and graduate education both for majors and non-majors, and in maintaining a top-ranked research enterprise. To begin, the curriculum for the undergraduate and graduate programs had to be redesigned from the ground up. Future hiring plans had to be redeveloped in an entirely different context. If one adds in the extra effort needed for a building renovation and the associated two moves of the entire department, and subtracts a significant amount of resources from a retirement wave, then there was the potential for a major negative impact.

I think that the faculty and staff can take pride in noting that such a disaster did not in fact occur. Yes, there have been significant depletions in faculty and resources within key areas of the department, and this has caused some erosion of its core foundations. But given the present economic conditions, this erosion might have occurred even in the absence of the merger. In response to the changing circumstances, groups have been reformed and collaborations expanded beyond the department's boundary so that the ESS faculty continues to be leaders and innovators at all levels. The debates over differences between the geophysics and geology programs are well in the past.

The merged departments have come together to form a robust program with growing population of both non-science majors and majors, and a research program that has high scientific impact and strength in the number of research dollars awarded to faculty members. But it has come at a cost in capabilities. A comprehensive program in electromagnetism as applied to solid earth geophysics is all but gone; the only electromagnetism is taught through the space physics group. Earth materials group has lost critical mass so that the support of key infrastructure like the microprobe (now almost 25 yrs old) and experimental petrology is close to failure. The ability to keep

current with new developments in GIS and remote sensing has not been possible, which impacts the viability of the student education, and the department's research capabilities. The surface process initiative stalled with only half the planned hires completed and the portions of the environmental option for undergraduates continues to be taught by temporary teachers. While environmental areas remain interdisciplinary, the lack of critical mass in many areas has meant that the interdisciplinary ties among some groups have been greatly eroded in order to protect the core, so that the stated mission that led to the formation of the department to seek synergism between disciplines and continue to cultivate an interdisciplinary environment is at risk.

It is fair to say that with the formation of ESS, a single vital department was created that has outstanding programs at the undergraduate and graduate level. But that being said, the one thing the department cannot further absorb is continued losses to its support. A retirement wave is clearly approaching and without stabilization by an immediate and pro-active recruitment program, the department could easily lose the last remnants of critical mass and the gains made over the last few years will be lost.

B.2. *What are the future developments/challenges for the Department in the new College of the Environment*?

The events that transpired from 2000-2004 are likely to repeat from 2009 through to the next few years. Instead of turbulence produced by the merger of the two departments in 2001, in 2009-2010 ESS faces similar turbulence in moving to a new college where the cultures from the different units making up the College of the Environment are probably even more disparate than those involved in the merger that created ESS. A successful college will require at least in the initial years great faculty participation in a host of college committees and initiatives that will be required to set policies and overcome cultural differences.

The formation of this college is also occurring in the throes of a deep recession, similar to the formation of ESS during the 2001-2003 recessions. Both mergers also occur during a retirement wave that if not balanced will lead to further significant attrition to the department's faculty. The big difference between the two mergers is that the attrition from the first merger was never recouped. If the second retirement wave occurs without replacements due to the prevailing economic conditions then the future of ESS is bleak.

A concern of all departments that joined the College of the Environment, and who have research and teaching missions that are not precisely congruent with the College of the Environment, is that the emphasis and directions of the College will negatively impact fundamental research capabilities if the focus of the new college is just environmental issues. Expertise in the basic sciences that we have developed over decades, and that have recognized international excellence must be maintained. For example, in ESS we have excellent programs in Earth core dynamics, high temperature and pressure petrology and mineralogy, deep earth geophysics, outer planet environments, evolution of the Archean Earth, and remote sensing of extra-terrestrial bodies. These fields are not naturally central to the research and application missions of a

college of the environment, yet these fields are central to the state-mandated mission of training earth and space scientists, and to the research excellence of the department. Managing the tension over resources to attain objectives obviously related to the environment and objectives related to maintaining expertise in the non-surface and non-recent aspects of the Earth Sciences will be a continuing challenge.

Despite the huge looming economic threat, there are also major positive outcomes for the future of ESS. The new College of the Environment has enabled the assembly of all the earth science departments together under the same college for the first time in decades. The new college brings the opportunity to highlight the faculty's efforts with respect to both teaching and research that has been missing from campus for many years. New collaborations will also develop with the other units with the new college, and in the next few years the new college should become well known for its direct impact in Washington and across the nation. As an example, at the time of the writing of this report the nation was focused on the efforts of the disastrous oil spill in the Gulf of Mexico. It is the earth and biological sciences that are getting the call to arms to help mitigation of harm and identify solutions when engineering goes bad. Provided that the new college continues with solid support of the sciences across the full range of the scope of ESS, then ESS has a bright future of making significant new discoveries, and training national and world leaders.

Another area in which ESS is expected to thrive is through more focused efforts from fund raising and donors. With the targeted emphasis of the new college, ESS can look forward to increased endowments that will aid in the creation of greater student opportunities than in the past.

B.3. *How does the department cover all the subject areas that are critical to its mission, research efforts and students while retaining critical mass within disciplines and within its many interdisciplinary programs, and what are potential new directions that will be undertaken in the next 10 years?*

There are three basic scenarios for the future of ESS teaching and research efforts, which are dependent on how strongly the department is funded. The first scenario assumes that the retirement wave occurs without significant replacements. In this case the only way that the department would be able to proceed forward is to cut vertically and no longer support groups that have been key to the department's present stature. In some sense this has already occurred with the down sizing of the hard rock, surface processes and geophysics groups. The difference is this time around there would be the complete annihilation of the smaller groups, which will mean that the department would no longer be able to meet its mission. This would be catastrophic for the department, for UW and for the state.

The second scenario is that sufficient resources are provided so that the resource base is not further eroded. In this scenario, efforts would have to be made to rotate through the ESS strategic plan to ensure some resources eventually reach all groups. ESS has been essentially running under this mode for the last 5 years. While workable in principle, the problem with this scenario is that it only takes the loss of one or two key

faculty to completely destabilize the entire department. We have been lucky to avoid this situation to date, but it is only a matter of time before a critical turning point will be encountered. This second scenario requires an almost immediate start on one to two faculty hires per year to compensate for the coming retirement wave.

The third scenario is that additional new resources be provided to the department coincident with increased enrollments and which would bring the department up to parity with other units relative to teaching load per FTE. Such an increase would enable a dynamic turnover of faculty as retirements occur and allow some of the gaps developing in the program to be filled. In its part, ESS continues to be proactive in developing new opportunities for students and research to ensure the best education for students and economic viability for the department and its faculty. For example, ESS is highly competitive for the resources provided it under Activity Based Budgeting (ABB) though it has yet to see the flow down of resources promised by ABB. If funds from ABB do not flow back to the department as permanent funds, then the department will still be at risk. The launching of the new option within the MS program should facilitate additional graduate students to the program which will allow enhanced capabilities for both the department and for the students. In addition, the ESS needs to continue to collaborate with programs within UW such as PCC, PNSN, JISAO and WSGC and outside agencies including the USGS, DNR, and EMD to continue to secure funds for the development of infrastructure that helps fulfill the mission of the department and its collaborators.

Irrespective of the scenario that develops in the next 10 years, the department will need to continue to develop an adaptive strategic plan, and the faculty will have to be patient in their wait for resources that they so badly need already.

B.4. *How has the evolution of staff, space and equipment changed the ability of the department to continue its mission?*

Staff:

The staff within Earth and Space Sciences faced a number of challenges over the past several years that directly impact the level of support services that they are able to provide to the department in support of its primary educational and research mission, including the following:

- Merger of 2 units to create the Department of Earth and Space Sciences plus the administrative duties of the Quaternary Research Center
- Renovation of Johnson Hall and the move of the department offices, labs and teaching classrooms to/from surge space
- Budget cuts resulting in the cumulative loss of 4.6 FTE staff effort over the last several years
- Move to the College of the Environment
- Transfer of duties from central support units to academic departments
- Transition to the Activity Based Budgeting model

Some of these changes were temporary requiring additional time and effort from staff to accomplish in addition to their ongoing duties and the disruption of services was of limited duration. The impact of the budget cuts, the transfer of duties from central units to academic departments, and the transition to activity based budgeting will have long-term effects on the level of support services staff can provide to faculty and students. None of these required additional burdens are ameliorated by additional staff support; instead, state support for staff has eroded. The extra duties have been added to existing staff and transferred on to faculty.

The merger of units to create the Department of Earth and Space Sciences resulted in the elimination of three staff positions and the duties performed by the incumbents in these positions were assumed by the remaining staff. The recent budget cuts in staff were accomplished by a combination of reductions in appointment months and percentage of appointment, the transfer of partial appointment to a different budget, and the elimination of one staff position. While some tasks were assumed by existing staff within the department as much as possible, other support services had to be eliminated.

Of equal or perhaps greater impact to the staff's ability to provide support services is the transfer of tasks from central support units to academic departments along with additional reporting requirements from these units, often with short deadlines that conflict with existing deadlines from other central units, the first week of the quarter, finals week, graduation activities and department activities such as prospective graduate student visits. The transfer of duties and new reporting requirements from central support units to academic departments amount to an additional reduction in staff effort that can be devoted to the academic and research support services for the department as staff divert time from department functions to comply with these requests.

A number of new University web-based applications were implemented to improve efficiency in operations. While some of these new applications are more efficient and reduce the amount of time required to accomplish a task, some have embedded within them a transfer of responsibility to the departments, and actually create more staff effort and require additional resources at the department level (for example, assuming the cost of required hardcopy printing).

As operating budgets were reduced, the department reorganized functions and implemented a number of efficiencies to improve service and reduce costs at the department level including:

- converting all department administrative forms to interactive, web-based documents
- implementing an online grants information guide to answer common questions with links to University and granting agency websites
- creating an online spreadsheet to assist faculty in creating budgets for grant proposals that produces internal GC1s and budget pages for grant submission
- Utilization of CATALYST tools for teaching and student services functions.

A few additional measures are in progress for improvements to procedures but we are fast approaching the end of possibilities for operational efficiencies.

A list of the present department staff positions is given in Appendix C. The current level of support staff within the department continues to decline under the present series of budget cuts and will soon likely to become insufficient to cover essential and mandatory support services for the educational and research functions albeit at a reduced level of efficiency and with the elimination of some services. Continued and additional transfer of tasks from central support units to academic departments and more reporting requirements will impact whether support staff can sustain services in the future. Indeed, there is insufficient staff now to cover a position should a member of staff have a long term illness.

Space:

The renovation of Johnson Hall has improved operational efficiency by allowing all administrative personnel and commonly used equipment (FAX, copier, printers) to be centrally located as opposed to offices in various locations throughout the building where space was available. The renovated space allows for easy communications among the administrative staff and easy access to all administrative functions for faculty and students. Ironically while the number of faculty have declined their success as seen by increased research dollars per FTE, and increased undergraduate and graduate students within the program, means that the space available is close to fully used.

Equipment:

The department upgraded the equipment for teaching computer labs and servers and staff with temporary funds provided by the college for this purpose. We are fortunate to have relatively new equipment in our classrooms as a result of the renovation of Johnson Hall. The challenge the department will face in this area will be to replace or upgrade essential teaching equipment such as microscopes and the microprobe and replace computers, spectrometers and vacuum systems as they become obsolete. Prior to the recession, the cost of faculty startups were also and issue, and probably will be an issue in the future when hiring starts again.

B.5. *Has a diverse (gender, race, specialization) group of faculty and student population been obtained?*

Obtaining a diverse workforce is not only a national goal but it is also a goal of the department as it brings together a greater wealth of ideas and innovation. The diversity of the undergraduate population is determined by the university's admission committee and is beyond the control of the department. Presently, the UW's overall minorities represent about 9% of the total student population, and we do not have statistics of the fraction of our undergraduates that are minorities. The characteristics of the graduate student body were discussed in Section 2.4 (Figure 9). Since Fall 2004,

women have comprised about 50% of the student population. The number of minorities had a downturn in the first half of the reporting period reaching a low of 1.3% in 2006. Since then the department has made strides in minority recruitment with minorities now representing 9 % of the graduate student body, which is close to the University average. Continued efforts need to occur to at least maintain this level if not improved it.

Diversity of the faculty is an important issue that needs continuous evaluation. With respect to the women faculty, Prof. Jody Bourgeois has been a constant and remarkable role model for the last 10 yrs for the department. Prof. Marcia Baker was the other female full professor but retired in 2004. Assistant Prof. Kari Cooper was hired in 2002, but due to spousal issues resigned in 2005. Since 2005, diversity issues were explicitly added to the discussions and procedures for all new hires. New woman faculty added include Prof. Heidi Houston, Associate Prof. Liz Nesbit (without tenure and without salary), Assist Prof. Kate Huntington, and Assistant Prof. Juliet Crider. In terms of FTE's the female representation on the faculty went from just over 5% of the faculty to nearly 16% of the academic FTE's. As such a critical mass of women faculty is being developed and we hope to make continued improvements in this area over the next 10 year period. It should be also noted that having this critical mass is important to the woman graduate students who see a strong group of role models who demonstrate that they too can be successful and influential in academia in the future.

With respect to faculty of color, there was only one academic faculty member of color (Prof. Winglee) during much of the reporting period. The situation has improved somewhat with the hiring of an African-American (Asst. Prof. Gorman-Lewis) in 2008. When funds become available for new hires, it will be important to continue the hiring of a diverse faculty, in addition to retaining the faculty that we presently have.

SUMMARY

The department should be proud of its accomplishments over the last ten years. The population of students that it reaches has nearly double over the last 10 yrs, through its non-science major classes. The number of majors within the department has risen correspondingly with the addition of these classes. Enrollments have also been added by the introduction of options, which provide foci for students planning to work in specific areas within the very broad of Earth and Space Sciences. We continue to maintain immersive opportunities for students including a strong field component and research opportunities for our students.

Our graduate program is nationally ranked, and graduate enrollments have remained steady despite a substantial decline in the faculty numbers over the last 10 yrs, and there is strong recruitment of our graduates both within the private sector and in academia. We have been able to make several key hires that have filled in high priority areas and these hires have greatly improved the diversity of the teaching faculty and brought new vitally to programs including the Pacific Northwest Seismic Network. The department collaborates with several interdisciplinary programs that have created synergistic opportunities for students and research programs.

The department faces many challenges in the future, particularly with the possibility of a retirement wave occurring during a period still feeling the impact of the deep recession. With the dedication of the faculty and staff, and with support from the upper administration, there is no reason why these obstacles cannot be overcome to ensure a strong department and vibrant educational opportunities for graduate and undergraduate students alike.

Appendix A: Department Organization

A.1. Department Organization Chart

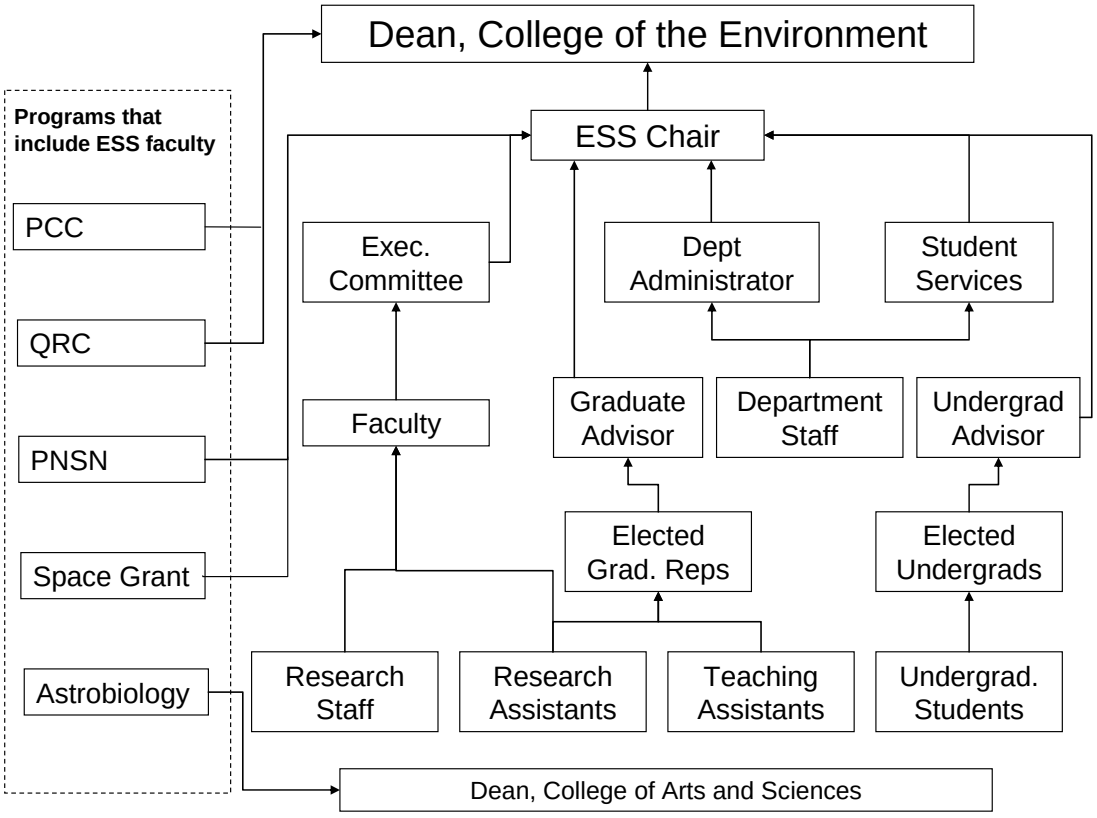

Figure A.1. Department Organizational Chart.

A.2. Extended Department History

In 2001, the Department of Earth and Space Sciences was created through the merger of two UW departments: the Department of Geological Sciences and the Geophysics Program.

The Department of Geological Sciences traces its origins to 1899 when the teaching of earth science began as an official unit within the College of Liberal Arts with the formalization of the Department of Geology and Mineralogy. The department consisted of one faculty member with a curriculum that encompassed physical and economic geology, assaying, and mining engineering (although a School of Mining had been proposed as early as 1888 it was not established until 1901). Considered a "pure science," geology remained in the College of Liberal Arts, which was reorganized into the College

of Arts and Sciences in 1910. In 1969 the department was renamed the Department of Geological Sciences.

The 1957-58 International Geophysical Year (when the first satellite orbited the earth) stimulated worldwide collaboration among disciplines and began the momentum at the UW to formalize the geophysical interdisciplinary ties already existing on campus. From 1959-1963 interdisciplinary geophysics was governed by a committee of faculty from several disciplines and in late 1963 officially became the Geophysics Group, a graduate interdisciplinary program through the Graduate School. Ultimately, in 1969, the modern Geophysics Program was formalized within the College of Arts and Sciences and the first full-time chair was appointed in 1970.

Brief History of Geological Sciences

The Department was established within the college in 1898 with an emphasis in mineralogy, petrology, and mining geology, and developed as a service to the mining, engineering, and forestry programs. Early broadening of the curriculum and research programs established some of the strengths for which the Department is still well known. In 1907 Charles Weaver arrived from U.C. Berkeley to found a program in paleontology, biostratigraphy, and sedimentary geology and George Goodspeed came in 1919 to teach petrology. J. Hoover Mackin began to teach geomorphology here in 1934. A few M.S. degrees and two Ph.D.s were awarded up to this time; the Department concentrated on undergraduate degrees.

Goodspeed's research on the origin of granites focused national attention on the Department beginning in the late 1930s, and Howard Coombs joined him in petrological research, before concentrating on engineering geology during World War II.

Julian Barksdale arrived at UW from Yale in 1936. He single-handedly mapped the Methow Valley in the northeastern Cascade Range for nearly 40 years and contributed greatly to UW as Chairman of the Faculty Senate, first Director of the A&S Honors Program, University Marshall, etc.

Harry Wheeler was hired away from the University of Nevada in 1948 and in the following three decades was one of the world's leading sequence stratigraphers (sequence stratigraphy is now one of the major concepts used in petroleum exploration).

Richard Fuller received one of the first Ph.D.s (1930) from the Department and probably was its first research professor; in mid-career as a volcanologist, he became Director of the Seattle Art Museum, which the family ultimately donated to the city of Seattle.

In 1947, Peter Misch arrived from the Geological Survey of China to broaden teaching and research in structure and petrology, and he supervised most of the approximately fifteen Ph.D. theses written between 1950 and 1964.

V. S. Mallory arrived from U.C. Berkeley in 1952 and set up a program in micropaleontology. Joseph Vance, a Washington Ph.D. with interests in petrology and Northwest geology joined the faculty in 1957. R.C. Bostrom arrived from the Chevron Company in 1964 to teach geophysics, and E.S. Cheney came from Yale the same year to teach economic geology.

The graduate program grew rapidly after 1960, and the acquisition of federal research support begun in 1960 by Mackin was continued by Porter, who replaced him, and by Czamanski. In the early 1960s the Department also received its first federal support for X-ray facilities. The Department's research program and graduate degree program grew gradually through the 1960s, but financial support came only slowly. Most M.S. and Ph.D. topics continued to be field-oriented; and the first Ph.D.s in geochemistry were awarded in 1968.

The award of an NSF Science Development Grant to the University in 1968 gave the Department the biggest financial stimulus it has ever experienced. The grant funded: a laboratory for research on the elastic properties of rocks and minerals at high pressure and temperature (Christensen); and electron microprobe laboratory (Evans); a K-Ar dating laboratory (Stuiver); geophysical equipment such as a gravity meter for teaching (Bostrom) and cold rooms for geocryology research (Washburn). The Department's faculty increased by four FTE in 1969, two with initial NSF-SDG assistance (Stuiver from Yale, Evans from U.C. Berkeley) and two justified by rapidly increasing undergraduate enrollments (Hanson, Stewart). At the same time J. Whetten replaced longtime chairman H.A. Coombs. Further growth in faculty occurred in 1970 with the appointment of I.S. McCallum (experimental and igneous petrology) and J.D. Blacic (experimental rock deformation). The rapid increase in faculty FTE was matched by corresponding growth in undergraduate and graduate enrollments, expansion of space for Geological Sciences in Johnson Hall, and an increase in financial support for research.

A Departmental Advisory Committee visited the campus in 1971 and included in its report the recommendation that the next appointment be in quantitative geomorphology.

This was needed to provide balance to the research and teaching program of Geological Sciences faculty affiliated with the Quaternary Research Center (Porter, Washburn, Stuiver). As a result, in 1973 Dunne was lured from the faculty at McGill University to open a program in the quantitative study of geomorphic processes. At the same time, a two-year renewal of the Science Development Grant permitted the Department to purchase modern single-crystal X-ray equipment, and S. Ghose was appointed to initiate a crystallography-mineralogy program. The 1973 retirement of J.D. Barksdale and resignation of E.B. McKee gave the Department an opportunity to appoint its first woman faculty member, B. Whitney (biostratigraphy) from VPI, and a new structural geologist, D.S. Cowan from Stanford via the Shell Oil Company.

B.W. Evans assumed the chairmanship in 1974. In 1975, J.B. Adams, a former doctoral student of the Department, returned to the campus as a research professor bringing with him a vigorous NASA-supported research program in remote sensing and planetary geology. In that year, undergraduate majors in Geological Sciences had risen to 134 and graduate enrollments leveled out at 65. The retirements of H.E. Wheeler and H.A. Coombs in the 1975-6 academic year enabled conversion of Ghose's position from research to teaching professor. A concurrent search for a new Director for the QRC Periglacial Laboratory to replace the retiring director A.L. Washburn proved most successful from the point of view of both the QRC and Geological Sciences. Bernard Hallet, concerned with the physics and chemistry of ice, water, and rock interaction as well as other geomorphic processes, was persuaded in 1979 to leave the Stanford faculty for the University of Washington.

J.B. Adams took over the chairmanship in 1979 and became a tenured professor of the Department. At the urging of a 1977 Visiting Committee, the Department responded to its deficiency in contemporary geochemical research, and in 1980 hired M.S. Ghiorso from U.C. Berkeley. At the same time, sedimentologist / stratigrapher J. Bourgeois was hired from the University of Wisconsin to replace B. Whitney, who took a job in the oil industry. Shortly thereafter, N.I. Christiansen departed in response to an irresistible offer from Purdue University. In 1981, S. Chernicoff was hired to replace lectured L. Hanson, with primary responsibility for teaching the Department's important introductory courses for non-majors. W.M. Bruner, a theoretical structural geologist, was hired from U.C.L.A. in 1983, in part to forge a linkage between Jim Smith's sediment transport research group in Geophysics and in part to support the Department's structural geology program, which was entirely the responsibility of D.S. Cowan. To increase the vigor of the program in paleontology and sedimentology, invertebrate paleontologist P. Ward was hired away

from U.C. Davis in 1984 to replace V.S. Mallory who retired from his professorship in geology.

Dunne assumed the chairmanship in 1984 and took up the task of strengthening the historically important program in geochemistry/petrology by acquiring B. Nelson, radiogenic isotope geochemist from U.C. Los Angeles and G. Bergantz, a physical petrologist interested in fluid dynamics of magma transport and storage from Johns Hopkins University. This left the Department with a strong and modern petrology/geochemistry program along with a very strong group in surface processes. Cowan followed Dunne as chairman in 1989. During his tenure, Jim Smith chose to leave the University for a position at the U.S. Geological Survey and the Department appointed D. McTigue from Sandia Laboratories to fill the research and teaching needs in sediment transport and dynamics. During Cowan's chairmanship, student numbers began their recovery from the depressed values experienced nationally in the mid-eighties, and that recovery has been constant ever since.

Ghiorso assumed the chairmanship in 1994. In 1995 Dunne decided to accept an offer from the University of California at Santa Barbara, and this touched off University wide concern over the future of the surface processes research group at the UW. Uncertainty over the future of the QRC fueled this concern and the Deans of Arts and Sciences and Ocean and Fisheries Sciences responded to the situation by conceiving a joint-college hiring initiative to bolster the surface process program both in Geological Sciences and Oceanography. The first hire in this initiative is D. Montgomery, who joined the faculty in 1996. Subsequent hires included J. Stone (cosmogenic isotopes, half-time QRC), S. Willett (geodynamics) and C. Nittrouer (sediment transport, full-time oceanography).

A brief history of the Geophysics Program: 1969-2001

A National Science Foundation Development Grant was awarded to the University of Washington to develop geophysics and Quaternary research in 1969. As a consequence, Lincoln Washburn was brought in to chair the Quaternary Research Center and Stewart Smith, a seismology professor at the California Institute of Technology, was hired as the first chair of the Geophysics Program beginning in 1970, a position he held for the next ten years.

Geophysics received the bulk of the funds, 2.5 million dollars, from the Development Grant. Many research fields were explicitly included in this grant, including seismology, gravity, solid-earth tides, paleomagnetism, marine geophysics, and glaciology. This new Program, unlike the Geophysics Group, which had been in the Graduate School, was now

to be a part of the College of Arts and Sciences. An associate dean of the College, Joe Creager, had been a major driving force behind the scenes in establishing the Geophysics Group and the Geophysics Program. He became the first associate (divisional) dean to oversee the development of the newly established Geophysics Program. The Development Grant provided seed funding for new faculty and facilities for five years, after which the University was to provide continued funding. The Geophysics Program was designed to act as a quasi-department. It was not to offer undergraduate degrees, setting it apart from standard departments.

Faculty members in various departments were asked whether they wanted to join the new Program. Most faculty members in the Geophysics Group elected to have adjunct or zero-time appointments. However, there were several exceptions, including Ken Clark (the last chair of the Geophysics Group), who chose to have a 1/3 appointment. Several faculty members in solid-earth geophysics also elected to be paid in part, or all, from Geophysics. Assistant professor, Robert Crosson switched his entire position from Geology to Geophysics and Oceanography assistant professors Clive Lister (who held a research faculty position at that time), Ronald Merrill, and Jim D. Smith elected to have half-time appointments in Geophysics. Robert Bostrom, a full professor in Geology, chose to have a 1/3 appointment in Geophysics. Bostrom received one of the largest components of the research funds from the Development Grant, which he used to develop instrumentation in a tunnel in the Cascade Mountains to measure solid earth tides. Lee Bennett, an Oceanography faculty member who had played a leading role in writing the Development Grant, was denied tenure and left the University.

Several faculty members were hired early on during Stewart Smith's chairmanship. These included academic faculty members, Marcia Baker (cloud physics; part time with Atmospheric Sciences), Jim Blacic (rock mechanics; part time with Geology), John Booker (solid-earth geophysics), Conway Leovy (planetary atmospheres; part time with Atmospheric Sciences), Brian Lewis (seismology; part time with Oceanography), George Parks (space physics), Charles Raymond (glaciology) and research faculty members, Steve Malone (seismology) and Gary Maykut (polar research; part time with Atmospheric Sciences). The different areas of research of these new faculty hires illustrated the diverse nature of the new Program. The character of the Program became well established during the first term of Stewart Smith's chairmanship.

The original geophysics curriculum was designed around the concept of applying physics and mathematics to the earth and its environment. In particular, graduate students were required to take six 'core' courses. These courses were continuum mechanics (which was supposed to emphasize matrix theory and tensors), fluid mechanics (which was supposed

to emphasize fluid mechanical applications to oceanography), atmospheric sciences (which was supposed to emphasize thermodynamics), space physics (which was supposed to emphasize electricity and magnetism), seismology (which was supposed to emphasize mathematical analysis of waves) and solid-earth geophysics (which was suppose to emphasize potential theory). In addition, there were specialized courses that reflected the research interests of the faculty. Although the courses and requirements evolved with time, during the last major review of the Geophysics Program, which occurred at the beginning of the 21st century, the external review committee concluded that the Geophysics faculty consisted primarily of applied physicists studying the earth and its environment.

As an aside, space physics received little funding from the Development Grant, but was judged by the Geophysics faculty to be an important component of the Program. The Physics Department dropped space physics as a formal group within its Department in the late 1980s. Concomitantly, the Geophysics Program increased the number of faculty members in this area of research.

The Geophysics Program had several chairs after Stewart Smith: Jim D. Smith (1980-1985), Ronald Merrill (1985-1992), John Booker (1992-1997) and Michael Brown (1997-2001). The Program reached a broad maximum in faculty and funding between the early 1980s to the mid-1990s. During this time faculty teaching equivalents (FTE; two half time faculty translates to one FTE) varied from 11 to 13 and the research faculty numbered around 10. The Geophysics Program had risen to be one of the top units within the College of Arts and Sciences in terms of total funding from grants received. The seismology group, with its large seismic network run by Robert Crosson and Steve Malone, and the space physics group, which had expensive research tied to rockets and satellites, brought in the most research dollars. However, all Geophysics faculty members maintained outside funding and made significant contributions to the total. The academic faculty members who received part or all of their salary from Geophysics in 1995 were: Marcia Baker, John Booker, Michael Brown, Ken Creager, Robert Crosson, Robert Holzworth, Conway Leovy, Ronald Merrill, George Parks, Charles Raymond, Stewart Smith, Steve Warren and Robert Winglee. The research faculty members were: Howard Conway, Gonzalo Hernandez, David Jay, Steve Malone, Mike McCarthy, Tony Qamar, Martin Unsworth and Ed Waddington. (Other research faculty members, such as Gary Maykut, received their salaries through their home departments and are not included here.) There were also many affiliate, adjunct and zero-time faculty members.

During the latter part of the 1990s the College increased its emphasis on undergraduate education. As the 21st century approached, only two major units in the College of Arts

and Sciences did not offer undergraduate degrees. One of these, Genetics, elected to leave the College to join the Medical School. The second of these, the Geophysics Program, merged in 2001 with the Department of Geological Sciences (which offered undergraduate degrees) to form the Department of Earth and Space Sciences, ESS. Michael Brown, the last chair of the Geophysics Program, became the first chair of ESS.

Appendix B: Budget Summary

General Operating Funds (GOF) for Instruction and Support Services

(excludes benefits cost paid by University budget)

YEAR	PERMANENT	TEMPORARY	TOTAL
2004 - 2005	2,625,742	173,326	2,799,068
2005 - 2006	2,599,643	348,502	2,948,145
2006 - 2007	2,699,670	369,058	3,068,728
2007 - 2008	3,068,153	152,767	3,220,920
2008 - 2009	3,372,871	98,324	3,471,195
2009 - 2010	3,074,069	270,851	3,344,920

University's Share of Joint Agreement Between
the University of Washington and
the U.S. Geological Survey for Operation of the
Pacific Northwest Seismic Network (PNSN)

YEAR	PERMANENT	TEMPORARY	TOTAL
2004 - 2005	113,691	0	113,691
2005 - 2006	119,803	0	119,803
2006 - 2007	525,613	0	525,613
2007 - 2008	487,293	40,218	527,511
2008 - 2009	375,990	39,849	415,839
2009 - 2010	447,695	39,849	487,544

YEAR	RESEARCH	TRAINING	FELLOWSHIPS[1]	OTHER[2]	TOTAL
2003 - 2004	5,496,688	483,946	103,820	222,333	6,306,787
2004 - 2005	5,411,865	537,804	148,884	289,336	6,387,889
2005 - 2006	5,860,186	482,106	158,826	438,295	6,939,413
2006 - 2007	5,229,304	623,706	83,289	302,750	6,239,049
2007 - 2008	4,778,303	583,290	144,016	261,743	5,767,352
2008 - 2009	4,822,965	811,227	180,116	382,906	6,197,214
2009 - 2010	not yet available	not yet available	not yet available	not yet available	

(1) Excludes fellowships awarded directly to students
(2) Includes institutes and conferences

Source: Annual Report of Awards and Expenditures

Appendix C: Faculty/Staff Information

C.1. Staff Information

POSITIONS	DUTIES/AREAS OF RESPONSIBILITY
Administrator Assistant to the Chair (11mo./90%) Fiscal Specialists (2) Fiscal Specialist Supervisor	Responsibility for operations, human resources, space allocation and renovation, endowments, development and gift processing functions; manage and reconcile state/local budgets (90+); develop budgets; complete reporting documents; provide advice and assistance to principal investigators; review and process grant proposals; provide grant/contract oversight and accounting functions (120+ budgets); process payroll, purchase orders, travel requests, reimbursements, and field advances; issue petty cash checks; order and maintain department supplies; resolve risk management and vendor issues; design, develop and maintain department databases for budgets, accounting, grants, directories, space allocation, and key inventory; update space inventory in University's Space Inventory Management System; program building access in CAAMS system; issue and distribute keys; initiate billing invoices; sort and distribute mail; initiate, receive and process freight shipments; process equipment insurance; initiate, process and approve Procard purchases and complete monthly reconciliations; create web-based administrative forms and maintain web-based administrative information on department website; initiate and complete faculty and staff searches and job postings; conduct new employee orientation; maintain timesheets and leave records in OWLS system; maintain department accounting and personnel files consistent with University records retention policy.
Counseling Services Coordinator Program Coordinator (11mo./75%)	Provide academic and program counseling; place orders for textbooks and request instructor copies from publishers; schedule classrooms; obtain and distribute entry codes; update University General Catalog and time schedule; coordinate registration and course fees; maintain students files; process graduate student applications; provide graduate student orientations; arrange and schedule required Environmental Health & Safety classes; coordinate submission of grade sheets; maintain student records; coordinate general exams and dissertations; update student information on the department webpage; and maintain department database on student classes and progress.
Research Aid 2 Scientific Instrument Designer 2	Maintain classroom labs; order and maintain instructional lab supplies and materials; provide teaching lab support; design, develop and set-up class lab exercises; train teaching assistants on lab procedures and safety; prepare, assemble and disassemble lab teaching materials; update and maintain library of field exercises; provide technical support on field exercises; administer department’s online teaching environment and train instructors in its use; advise and assist instructors in development and use of lab fees; ensure lab practices are in compliance with UW and EH&S rules and regulations; manage lab specimen storage facilities; prepare educational displays in public areas; maintain department library of dissertations; train and certify drivers of vans for field trips; arrange logistics for classroom field trips (averaging 3 per week); respond to questions from the general public and educators;

	manage and maintain Thin Section lab and train students on operation of equipment; prepare specimens for instruction and research labs; track and tag equipment and maintain equipment inventory in OASIS; complete physical equipment inventory; inventory surplus items and arrange pickup; handle building issues as building coordinator; arrange and coordinate moves of equipment and furniture; perform duties associated with safety and evacuation functions within the department and building; inventory and report chemicals stored within department labs.
Senior Computing Specialists (2)	Determine specifications, obtain quotes, order and install computer equipment purchases for faculty, staff and students (300+ computers); provide desktop computer support, maintenance and software upgrades and troubleshooting; resolve hardware and software computing problems; build, update and maintain computers for instructional computer labs (2 lab classrooms with 60 computers); build, install, maintain and secure department and research file servers and computer clusters; provide advice and technical support to instructors and research groups for all hardware and software computing issues; develop, maintain and update department website and directories; implement and maintain backup procedures for network file servers and key administrative and research computers; initiate security measures to prevent security breaches and loss of data consistent with University standards and requirements; write computer programs and scripts in support of academic and research activities.

C2. Faculty Information

Lecturers

Brittany **Brand**, Acting Instructor
Interests: Igneous Petrology and Volcanology

James Prager, Acting Instructor
Interests: Laboratory and space plasmas

Terry Swanson, Senior Lecturer
Interests: Quaternary Geology, Glacial Geomorphology, Environmental Geology and Geochronology

Assistant Professors

Olivier Bachmann, Assistant Professor
Interests: Igneous Petrology and Volcanology of large silicic systems.

Juliet Crider, Assistant Professor
Interests: Neotectonics, Structural Geology, volcano deformation, evolution of topography.

Drew Gorman-Lewis, Assistant Professor
Interests: Geomicrobiology, Low Temperature Aqueous Geochemistry, Thermodynamics of Natural Systems.

Katharine Huntington, Assistant Professor
Interests: Tectonics & landscape evolution.

Associate Professors

David Catling, Associate Professor
Interests: Planetary Atmospheres, Planetary Geomorphology (surface processes), Biogeochemistry, Astrobiology

Liz Nesbitt, Associate Professor (without salary, without tenure)
Interests: Paleontology and Stratigraphy

Gerard Roe, Associate Professor
Interests: Atmospheric Dynamics, Surface Processes, Modern climate and Paleoclimate

John Stone, Associate Professor
Interests: Cosmogenic Isotope Geochemistry

Professors

George Bergantz, Professor
Interests: Physical Petrology and Volcanology

John Booker, Professor
Interests: Magnetotellurics, Tectonics, Inverse Theory.

Joanne (Jody) Bourgeois, Professor
Interests: Sedimentology and Stratigraphy, Paleoseismology & Neotectonics

J. Michael Brown, Professor
Interests: Experimental and theoretical mineral physics

Roger Buick, Professor
Interests: Precambrian Life and Environments, Astrobiology

Darrel Cowan, Professor
Interests: Structural Geology, Tectonics

Kenneth Creager, Professor
Interests: Seismology and geophysical inverse theory

Alan Gillespie, Professor
Interests: Glacial geology, remote sensing, Mars landscape evolution

Bernard Hallet, Professor
Interests: Glacial and Periglacial Geomorphology

Robert Holzworth, Professor
Interests: Experimental atmospheric electrodynamics and Space and Plasma Physics

Heidi Houston, Professor
Interests: Seismology; Earthquakes, subduction zones.

Dave Montgomery, Professor
Interests: Geomorphology (fluvial, hillslope, tectonic, and planetary)

Bruce Nelson, Professor
Interests: Isotope Geochemistry; Igneous Petrology; Environmental Chemistry

Charles Nittrouer, Professor (joint Appointment with Oceanogrpahy)
Interests: Marine Geology and Geophysics

John Vidale, Professor
Interests: Seismology, Earthquake triggering, core/mantle dynamics, impacts, hazard mitigation

Ed Waddington, Professor
Interests: Glacier and ice sheet dynamics, paleoclimates

Peter Ward, Professor (joint with Biology)
Interests: Paleontology

Steve Warren, Professor (joint with Atmospheric Sciences
Interests: Solar radiation processes, antarctic climate

Robert Winglee, Professor and Chair
Interests: Space Plasmas, Magnetospheric Physics, Advanced Propulsion

Academic Faculty

Research Assistant Professors

Joshua Bandfield, Research Assistant Professor
Interests: Infrared remote sensing of Mars, the Moon, and Earth: Spectroscopic studies of surface materials and thermophysical modeling of planetary surfaces. Martian atmospheric monitoring.

Gary Hansen, Research Assistant Professor
Interests: Planetary Remote Sensing; Optical Properties of Materials; Calibration of remote sensing instruments

Erika Harnett, Research Assistant Professor
Interests: Space Physics, Advanced Computing, Planetary Science, Astrobiology and Comparative Planetology

Stephen Wood, Research Assistant Professor
Interests: Planetary surface processes; Mars polar caps, ground ice, and climate evolution; Icy satellite surface evolution; Microphysics of heat and mass transfer; Spacecraft and laboratory

Research Associate Professors

Evan H. Abramson, Research Associate Professor
Interests: Learning how the properties of fluids change at high pressures and temperatures, with an eye to the development of empirical, predictive associations among such properties.

Paul Bodin, Research Associate Professor
Interests: Seismology; Earthquake sources; Earthquake effects; Hazard mitigation.

Michael McCarthy, Research Associate Professor
Interests: Space Plasma Physics

Robert Odom, Research Associate Professor
Interests: Underwater Acoustics, Wave Propagation, Inverse Problems

Research Professors

James Mercer, Research Professor
Interests: Underwater Acoustics

Howard Conway, Research Professor
Interests: Glacier and Ice Sheet History, Snow Avalanches

Gonzalo Hernandez, Research Professor
Interests: Aeronomy, Optics

Dale Winebrenner, Research Professor
Interests: Applied Physics, Glaciology, Remote Sensing

Appendix D: HEC Board Summary

Name of Unit: Department Earth and Space Sciences

Name of College: College of the Environment

Degree Title: BA, BS, MS, PhD

Year of last review: Dept formed in 2001; Former departments reviewed in 1999.

Current date: 11/1/2010

A. Need for the Program. The state of Washington is a region of a great beauty and active geological processes, including earthquakes, volcanic activity, ground failures, lahars, landslides, and flooding. Human developments continue to expand into areas which are routinely subject to such hazards. The general public is interested in these processes and the private sector has major need for geologists and geophysicists to monitor and diagnose these hazards in efforts to mitigate their effect on the population and economy of the NW. In addition, Washington is fortunate to house several aerospace and other industries and interest in going beyond the Earth remains of great interest to the residents of Washington. Because of this need, enrollments in our non-science major classes continue to rise and are basically at saturation to due classroom capacity. There is also strong demand for the BS degree offered with over increase in undergraduate majors a n average growth 14% per year over the last five years. The graduate program is equally robust with sustained enrollments of 70-80 students in the PhD. In order to address demands for higher skilled students in the geotechnical sector, ESS could potentially launch a new focus within the MS program that is expected to have yearly enrollments of about 20 students per year. The launched though is delayed due to the present economic downturn.

B. Assessment Information.

All programs within ESS are reviewed on a regular basis through diverse methods. Core classes plus large non-science majors classes are evaluated through student course evaluations. Faculty and TAs that score low are mentored to address identified concerns. Many of the classes have laboratory and field components. A signature of the department is that many of these activities are led by regular faculty members so that there is substantial amount of one-on-one time between students and faculty. This results in close mentoring of students and, if students develop problems, consultation between faculty often aid in a deeper understanding of issues and in many cases solutions can be found so that the student can remain successful in their studies.

Both graduate and undergraduate students are asked to participate in exit surveys. Students are asked on how well the program has prepared them for their chosen career paths, and whether there are any participate issues or topics not fully covered or impediments for students to reach their goals. In addition, the chair meets with elective representatives of both undergraduate and graduate student bodies where such issues can

also be discussed. These meetings occur at both the beginning and end of the academic year to go over goals and whether those goals for the year have been achieved.

Examples of developments from these exit surveys and meetings including revamping of the material in ESS212: Earth Materials and Processes, the development of the new course ESS454: Hydrogeology, more microscope facilities for teaching and research, and substantially improved computer classrooms and graduate computing resources.

C. Plans to improve the quality and productivity of the program.

Productivity by ESS faculty as measurement by SCH/FTE exceeds 1000 which is greater than the average within the College of Arts and Sciences and is the highest within units of the College of the Environment. Within injection of resources to prevent major losses of FTEs from a probably retirement wave in the next few years, the department will be able to sustain this level of activity. Without this support, dramatic reduction in SCH/FTE is likely to occur in order to protect the BS and graduate programs within the department.

In 2009-2010 the department web site was redesigned to provide increased transparency to department activities, to provide a greater resource for students in terms of class schedules, and as an enhanced resource for faculty and staff. In 2011-2012 efforts will be made to launch an emphasis in applied earth sciences within the MS to better server the needs of the geotechnical community.

Number of instructional faculty, students enrolled, and degrees granted over last three years (Autumn-Summer)

	2007-2008	2008-2009	2009-2010	TOTAL
FTE instructional faculty	22	24	25	71
FTE graduate teaching assistants	8.7	9.3	9.5	27.5
Degree Program: BA				
Headcount of enrolled students	14	11	9	34
Number of degrees granted	7	6	7	20
Degree Program: BS				
Headcount of enrolled students	100	106	107	313
Number of degrees granted	28	34	35	97
Degree Program: MS				
Headcount of enrolled students	N/A	N/A	N/A	
Number of degrees granted	7	7	4	18
Degree Program: PhD				
Headcount of enrolled students	72	67	74	213
Number of degrees granted	4	8	8	20
TOTAL	241	272	279	

NOTE: "Headcount of enrolled students" (undergraduate) = number of declared majors as of 10th day of Autumn Quarter.

Appendix E: MS Option for Applied Earth Sciences

This MS option if implemented would be designed for students interested in working in the geotechnical sector. Areas of interest include behavior of earth materials, subsurface conditions, physical and chemical interactions within the subsurface and assessing risks to humans, properties and structures from natural hazards including earthquakes, volcanoes, landslides, sinkholes, toxins and soil liquefaction.

This degree fills a major gap in the present offerings by the department, which has major strength in the geology and geophysics of the Earth, but does not specifically consider and train students in the application of these disciplines that are relevant to the geotechnical community.

Requirements for entry into the program include a BS in geology or a BE in Civil and Environmental Engineering with a GPA greater than 3.2. Students should also have a strong field component in their studies or previous work experiences, and GIS experience. Students with a BA in Geology or with limited field experience can be accepted into the program if a field class equivalent to ESS 400 is taken prior to joining the program. Similarly students with no GIS experience can be admitted on completion of a basic GIS program available at UW. Students may participate in the program either remotely with steaming video and online material or participate in regular day classes.

As in the regular MS program, students will need to complete 36 credits -18 credits must be numerically graded at the 400/500 level. The main difference is that students must complete the following course distribution:

Earth Science Requirements (20 crs from the list below – equivalent 5 out of 7 classes)

Seismic Exploration – use of seismic waves to investigate subsurface structure on multiple scales and determine constraints on interpretation of subsurface structure; Application of refraction and reflection techniques to problems in engineering geology and mineral exploration.

Engineering Geology - field methods including USCS soil classification, ISRM Rock Classification, subsurface exploration methodology, groundwater monitoring methodology.

Fluvial Geomorphology - Hydraulic and morphological characteristics of streams and valley floors. Landscape evolution by stream erosion and deposition. Field exercises emphasize quantitative analysis of fluvial processes, channel forms.

Hillslope Geomorphology - hillslope evolution by mass wasting and water erosion, landslide vulnerabilities, modeling, and mitigation.

Hydrogeology - analysis of groundwater flow systems, geologic controls, and hydrologic properties; basics of chemistry and solute transport in groundwater; and the use of numerical models. Considers local examples and groundwater resource management.

Environment Geochemistry - soil/ground water composition; transport of chemicals in ground water; weathering and the carbon cycle; equilibrium computer modeling; colloids and clay minerals; organic geochemistry of water and soil; and groundwater quality.

GIS in the Ecosystem Sciences (available through Oceanography). - collection of georeferenced field measurements and observations (GPS), importing those spatial data into a GIS, classifying the landcover over the spatial extent of those data from remotely sensed imagery, and analyzing their spatial variability.

Expertise Classes (8 cr)

2 x 500 graded classes in area of desired expertise. Online delivery of material is by arrangement by instructor. Potential classes include but are not limited to:

Remote Sensing - spectral image processing with ENVI software, used in individualized projects involving satellite or aircraft images. Emphasis on integration of remote sensing and field measurement using process models and Geographic Information Systems (GIS).

Physical Hydrology (available through CEE) **-** Global water picture, data sources and data homogeneity, precipitation, evapotranspiration, hydrographs. Hydrologic data frequency analysis. Hydrologic design: flood mitigation, drainage.

Stratigraphy - Systematic study of stratified rocks and space-time implications. Principles of stratigraphy, including biostratigraphy, magnetostratigraphy, seismic stratigraphy, subsurface analysis. Basin analysis, evolution of sedimentary basins and continental margins.

Seismology - Theoretical and observational seismology. Elastic plane wave propagation through stratified media. Surface waves, eigenvibrations, ray theory. Structure of Earth's mantle and core. Seismicity distributions, earthquake focal mechanisms and relationship to tectonics.

Tsunamis – Generation mechanisms, modeling, coastal impacts, history and predictions.

Stream Restoration (joint with CEE) - Stream Corridor Functions and Dynamic Equilibrium; hydrological, geomorphic and biological processes, natural and human induced disturbances.

Volcanic Processes - Pre-eruption, eruption, and post-eruption processes. Examines triggers of magma ascent, controls on volatile build-up and loss, magma fragmentation, magma-groundwater interaction, eruption column dynamics, gravity-controlled eruptive phenomena, synchronous and post-eruption lahars and other re-working of deposits.

Policy/Communications (4 cr)

Mitigation of Geological Hazards – meet with local geotechnical experts to discuss ongoing projects and latest issues

Required Field Experience

Internship – involves the development of a project from start to finish including in initial research, proposal preparation, work plan development and implementation including, field work, analysis, report writing, health & safety, budget tracking.

Writing Requirements (4 cr)

Concurrent with the final stages of the internship and includes the development of a geotechnical engineering or engineering geology report based on the internship, includes abstract development, project history, methodology, data, analysis, and conclusions.

A marketing analysis for the proposed option is included in Appendix F.

Appendix F

PROFESSIONAL & CONTINUING EDUCATION
UNIVERSITY of WASHINGTON
Educational Outreach

Master's Degree in Applied Earth Sciences

Degree Feasibility Study

September, 2010

Questions:
Sara Pearson, Market Research Consultant
spearson@pce.uw.edu
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UW Professional and Continuing Education
Educational Outreach, Market Research
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Table of Contents

SUMMARY OF FINDINGS

Master's Degree in Applied Earth Sciences
Degree Feasibility Study

Background and Methodology

Background

The department of Earth and Space Sciences at the UW currently offers graduate degrees in the areas of both geological sciences and geophysics, but does not offer a degree in an applied area of Earth Sciences. The department is interested in partnering with UW Professional & Continuing Education to better serve the Geotech community by providing a Professional Master's Degree in Applied Earth Sciences aimed at working professionals.

The goal of the research is to determine demand for, and feasibility of, an accredited Professional Master's Degree in Applied Earth Sciences.

Specific Objectives

- Estimate demand for a Professional Master's Degree in Applied Earth Sciences
- Assess preferences for program specifics, including areas of study and program format
- Understand perceived employer perception of proposed degree and graduate qualifications
- Evaluate proposed price and payment options
- Gather an educational, professional and demographic profile of respondents

Methodology

Sampling Frame

Respondents were asked to participate in the online survey based on their inclusion in the following groups related to Earth Sciences:

- **UW ALUMNI**: Students who received a Bachelor's degree in the following UW programs (2000-2010): Civil and Environmental Engineering; Geological Sciences; Earth and Space Sciences
- **AEG:** Current members of the Association of Environmental and Engineering Geologists
- **GSA**: Current members of the Geological Society of America
- **NW Geological Society**: Current members of the Northwest Geological Society

Data Collection

Respondents were directed to the online survey in different ways depending on their sample category: 1) UW Alumni, AEG members and NW Geological Society members received a targeted email asking them to take the survey; 2) GSA members received an online newsletter containing the link to our survey.

Response Rates

A total of 174 participants completed the survey between July 7th and August 3rd, 2010. The UW Alumni response rate is provided in the table below. Response rates for the other groups are not available as we are unable to accurately estimate website activity or total membership levels.

	Number who completed survey	Total valid email sample	Response Rate*
UW Alumni	92	808	11.4%
Selected Professional Associations Total (AEG,GSA,NWGS) **	82	--	--

**Undelivered emails or unsubscribe requests were excluded from the response rate calculations.*

*** Total respondents include 13 AEG members, 20 GSA members, and 49 NEGS members*

Interpreting Results

Statistical results may only apply to the general, larger population of some of the sampled groups where the population size is known (for example, the UW Alumni population.) For groups with a small sample size (usually less than 30), there is no meaningful statistical base for interpreting results since the chance for error is too large. This applies to interpreting findings from the AEG, GSA and NWGS groups individually. Therefore in our analysis, we combine all professional associations that participated in this study (AEG, GSA and NWGS) into one group and refer them as "selected professional associations" to draw statistical conclusions.

Executive Summary

1. **Interest in the proposed Master's Degree in Applied Earth Sciences is limited, based on participant feedback**. Even though there is no significant competition regarding applied Earth Sciences Master's level programs elsewhere, the demand estimate based on survey results seem to suggest that the UW would run certain risks as a result of launching the program.
   a) Only 35% of the overall sample indicated a definite interest in pursuing any type of continuing education in earth sciences, even among the most "relevant" alumni group; of the Geological Sciences alumni, only 37% indicated that they would definitely pursue some kind of continuing education.
   b) In 2010, PCE science and professional terminal Master's programs experienced an average enrollment rate of 63%. By applying the same enrollment rates to the proposed AES program, we estimate a minimum of 9 students to enroll. PCE and the department must consider whether 9 enrollees is financially acceptable before launching the program.
   c) In terms of respondents' academic background, the two groups with the highest number of respondents are from **Geological Sciences** (106) and **Civil and Environmental Engineering** (31). None of the other majors have more than 7 respondents, showing the proposed program would have to recruit heavily from the prospective pool of those two top majors.
   d) Among those who have a plan for continuing education in earth sciences fields, the majority (approximately 60% among all groups) indicate they would be interested in the proposed UW degree program. In addition, 64 respondents requested that they receive additional marketing information about the degree when available. **These finding indicates that although the target market size is small, they have very clear educational goals.**

2. **Regardless of the limited demand, pricing is actually not a main concern among those who are interested.** Nearly three-quarters (73%) of respondents accepted the UW pricing structure (49% stated that they would be willing to pay $22,000 at the UW and an additional 24% would pay more for other schools)**.**

3. **Offering a hybrid delivery – some online and some classroom time - will have the broadest appeal.** If the UW were to launch this degree program, offering a hybrid online and onsite delivery will likely extend the reach of the program by providing opportunities to those residing outside of Seattle, especially given the higher interest levels of respondents in the Mountain

West regions.

4. **Increasing salary potential** is the primary motivating factor for professionals to pursue additional education in the field of Applied Earth Sciences. Additionally, the **ability to solve groundwater resource management issues** and **acquiring expertise in USCS soil classification** are considered the most powerful graduate qualifications. **Marketing efforts should highlight these as the perceived value of obtaining a Professional Master's in Applied Earth Sciences.**

Key Findings

Interest in Professional Development

- **Interest in pursuing any type of professional development in Applied Earth Sciences is low among all groups surveyed.** Among a total of 174 who responded to the survey, only one-third of them (35% or 60 respondents) indicated they have a plan to obtain further education in earth sciences related field. 25% (or 43) were unsure and over 40% had no plan.

Note: *Since 60 respondents (35% of 174) is too small a sample size to attempt any statistically meaningful estimation of this kind, we included respondents who are "unsure" about a continuing education plan (n=43) to answer all questions regarding this degree as well. That total subsample of respondents (n=103) is represented in the following findings, unless otherwise noted.*

- **A Master's Degree program (42%) and Continuing Education classes (22%)** are the types of further education that respondents are most likely to pursue in Applied Earth Sciences.
  - The University of Arizona (18%) and Central Washington University (15%) lead the list of Master's programs that respondents have already investigated.

- **Professionals in this industry are motivated by the potential to increase their salary.** Increasing earning potential (77%) and enhancing competitiveness in the job market (64%) were the most frequently mentioned reasons for interest in pursuing a Master's in Applied Earth Sciences.
  - Respondents are less likely to want a change in responsibility (7%) or a change in career (18%).

Interest in Professional Master's in Applied Earth Sciences

- Demand is limited, since only 37% of the entire sample indicated they already have a plan to pursue any type of continuing education in Earth Sciences fields. However, the limited target group has a clear educational goal, as most of those (60%) indicated they are either very interested (17%) or interested (43%) in the proposed UW degree program**.**
- Among this small group, interest jumps to 68% among those who hold only a Bachelor's degree or less. Interest level reaches 69% among those who obtained their highest degree within the last 5 years. In addition, respondents currently employed as engineers (67%) show increased interest. **Targeting those graduating with a college degree in related fields such as engineering within the past 5 years may increase the chance of successful recruitment for this program, if the decision is still to launch the program**.

Application and Enrollment Estimates

To determine the potential number of students who might apply to, and enroll in, the proposed degree, we analyzed responses from three questions: 1) Intent to pursue continuing education in a field related to Earth Sciences in the next 3 years; 2) Interest in the proposed AES degree; and 3) Desired delivery format (hybrid vs. traditional model). Combining responses from these three questions provides a range of application and enrollment estimates from conservative to more liberal.

In the following table, the most conservative application and enrollment estimate we provide (first row) looks at respondents who indicated they 'definitely or might' plan to pursue continuing education, they are 'very' interested in the proposed degree, and they prefer a hybrid delivery model. The least conservative estimate (bottom row) looks at respondents who indicated they 'definitely' plan to or 'might' pursue continuing education and also indicated they are 'very' or 'somewhat' interested in the proposed degree (this estimate does not take delivery preference into account).

				TOTAL ESTIMATE	
Number of respondents who…	**UW alumni**	**UW alumni not sampled***	**Professional associations**	**Application**	**Enrollment****
Plan to/might pursue continuing education AND are very interested in degree AND prefer a hybrid model	6	2	6	**14**	**9**
Plan to/might pursue continuing education AND are very interested in degree	7	2	10	**19**	**12**
Plan to pursue continuing education AND are very/somewhat interested in degree AND prefer a hybrid model	10	3	10	**23**	**14**
Plan to pursue continuing education AND are very/somewhat interested in degree	17	5	18	**40**	**25**
Plan to/might pursue continuing education AND are very/somewhat interested in degree AND prefer a hybrid model	23	7	17	**47**	**30**
Plan to/might pursue continuing education AND are very/somewhat interested in degree	35	10	26	**71**	**45**

** The number of prospects among alumni not surveyed is estimated by multiplying the known interest level to total number of alumni who don't have valid email addresses (236).*
***Using a 63% enrollment rate, as calculated below.*

Based on these calculations, it is estimated that between 9 and 45 respondents are likely to enroll in the proposed AES program. Assuming 15-20 enrollees is the 'break-even' point for a fee-based program, can the department and PCE accept the minimum of 9 enrollees? If yes, then the survey results support launching the program; otherwise the results warrant prudence.

Calculation Method

Enrollment Estimates

To estimate potential enrollment rates for the proposed degree, we applied the known application rates for terminal Master's degrees offered by PCE in 2010. We calculated an average enrollment rate among both Spring and Winter terminal Master's programs in science and professional fields, as these were most similar to the proposed degree. We excluded business, medicine, nursing and education programs for our estimates. These rates are known among PCE alumni and estimated for members of professional associations.

In 2010 (Spring and Winter combined), PCE science and professional programs yielded a **63.0%** enrollment rate (number of applications divided by number enrolled). This percentage was applied to the calculated application estimate.

Application Estimates

Our sampling frame for this project included UW Alumni who graduated from a variety of majors between 2000 and 2010. These majors were chosen because of their potential proximity to the Applied Earth Sciences industry. Of the 1,044 UW alumni names we received, 77% (808) had valid email addresses and 23% (236) did not. All those with valid email addresses received an invitation to take our survey. In addition, members of 3 professional associations (AEG, GSA and NWGS) were invited to take the survey. Application estimates for the sample UW alumni as well as the professional associations are based on survey responses.

To calculate the application estimates for the UW alumni that were not sampled, we assume that those who received the survey, but did not respond to it, would not be interested in the program. We therefore applied the known estimated percentage of prospects to the entire sampling frame. This procedure assumes that interest levels will be similar between those with and those without email addresses. We cannot apply this same calculation to the professional associations since we are unable to accurately estimate population size.

Preferences for Program Specifics

- **Offering a hybrid delivery structure (online and classroom) with a part-time option will have the broadest appeal**. Nearly three-quarters (74%) of those who are interested in the degree prefer a delivery method incorporating some level of online learning. 21% would prefer all online delivery, while 53% indicated a preference for a hybrid deliver with some online and some classroom time.
  - In addition, most respondents (67%) would prefer to complete their degree on a part time basis – either in 3 years (50%) or 4 years (17%).

- **Engineering Geology & Geotechnics (76%) and Geographic Information Systems (71%) are the most desired subjects for the proposed program curriculum.** Hydrogeology (69%) and Applied Geophysics (68%) were also mentioned frequently.
  - Plate Tectonics and Earth History (30%) and Stratigraphy and Sedimentation (39%) were indicated by the fewest respondents as courses to include.

Cost Feasibility

- **The UW would draw students to this program for reasons beyond price and course offerings.** Respondents were given a range of pricing options and asked to choose the highest amount they would be willing to pay. Nearly three-quarters (73%) of respondents accepted the UW pricing structure: 49% stated that they would be willing to pay $22,000 to complete the degree at the UW and an additional 24% would pay more for other schools, indicating that the UW price is not out of range.
  - The $22,000 price tag is higher than that of UMASS ($12,000), yet many respondents nonetheless prefer UW.
- The majority of respondents would use their **personal savings** (65%) and/or **scholarships** (58%) to pay for this program.

Value of Program

- **Data suggest several compelling marketing messages that should be considered when creating promotional materials for the program**. When asked which qualifications would be most powerful, respondents indicated that the **ability to solve groundwater resource management issues through analysis of groundwater flow systems and hydraulic properties** (85%) and **expertise in USCS soil classification, ISRM rock classification and subsurface exploration methodology** (83%) would be most appealing to employers.
  - Additionally, 93% stated that graduates would be more attractive to employers and 77% indicated that graduates would have a higher paying job after completing this degree. **These are additional value statements that can be used when marketing the program.**

- **64 respondents (71% of those interested in the proposed program) want additional information about the degree.** Marketing directly to these respondents may garner additional applications.

Profile of INTERESTED survey respondents

Results for this section represent those who are 'very' or 'somewhat' interested in the proposed Professional Master's in Applied Earth Sciences (n=61). This represents 35% of the entire sample, and 60% of those who plan to pursue additional education. For a profile of the entire sample, please consult the 'Detailed Findings' Section.

Professional Profile

- Current occupation: Respondents interested in this program are employed in a variety of areas. Geologist (25%) and Engineer (8%) were mentioned most frequently.

Demographic Profile

- Age: Nearly three-quarters (71%) of interested respondents are under 35.

Educational Profile

- Highest level of education: **Incidence of holding an advanced degree is low** among interested respondents, as only 20% have completed a Master's or Doctoral Degree. 75% have completed their Bachelor's Degree.
  - Degrees are primarily held in Geological Sciences and Civil and Environmental Engineering.
  - Nearly two-thirds of those interested (64%) received their highest degree within the past 5 years.

DETAILED FINDINGS

Master's Degree in Applied Earth Sciences
Degree Feasibility Study

Detailed Findings

The following tables present findings from the total sample (n=174) of respondents obtained in this survey. Findings are not shown stratified by subsample, as sample sizes were too small (those results are available upon request). Sample sizes vary for each question as respondents could refuse to answer.

Of the entire sample, 59% (n=103) indicated they either plan to enroll (n=60) or they may/are not sure whether they will enroll (n=43) in some sort of professional development or continuing education activity in a field related to Applied Earth Sciences within the next three years. **These respondents answered detailed questions about the proposed Master's Degree in Applied Earth Sciences – their responses are shown in the appropriate sections**.

In addition, 35% (n=61) of the entire sample indicated that they were 'very interested' or 'interested' in the proposed degree, after hearing the description. **Where appropriate, findings for this group are also shown seperately.**

Likelihood of Pursuing Additional Education

Table 1: Plan to enroll in continuing education in next 3 years?

	Total Count	Percent of Total Sample (n=174)
Yes	60	34.5%
No	71	40.8%
Maybe/Not sure	43	24.7%
Plan to enroll/Maybe/Not sure	***103***	***59.2%***
Total	174	100.0%

Table 2: Type of continuing education likely to pursue

	Total Count	Percent of Respondents (n=102)
Job training course	5	4.9%
Certificate program	10	9.8%
Continuing education class	22	21.6%
Master's degree program	43	42.2%
PhD program	19	18.6%
Other**	3	2.9%

**Totals of multiple response questions may exceed 100%*
***Other responses included: (**bolded** responses mentioned by those 'interested' in the proposed degree)* Continuing education in modeling and computer statistics, **Environmental Law**, **Post doc program**

Table 3: Master's Programs already investigated

	Total Count	Percent of Respondents (n=40)	Percent of those interested (n=27)
University of Arizona	7	17.5%	25.9%
Central Washington University	6	15.0%	22.2%
MIT	4	10.0%	14.8%
California Institute of Technology	4	10.0%	11.1%
Boston University	3	7.5%	11.1%
Montana State University	3	7.5%	11.1%
Stanford University	3	7.5%	11.1%
University of Texas (Austin)	4	10.0%	7.4%
San Diego State University	2	5.0%	7.4%
UC Santa Cruz	1	2.5%	3.7%
University of Oklahoma	1	2.5%	3.7%
University of Utah	1	2.5%	3.7%
Michigan State University	0	.0%	.0%
North Carolina Central University	0	.0%	.0%
St Louis University	0	.0%	.0%
University of Pennsylvania	0	.0%	.0%
NONE	18	45.0%	44.4%
Other**	10	25.0%	18.5%

**Totals of multiple response questions may exceed 100%*
***Other responses included: (**bolded** responses mentioned by those 'interested' in the proposed degree)* **Colorado School of Mines (2), University of Oregon, Unviersity of Washington (2), Western WA University**, University of Alaska, University of Colorado (Boulder), UC Berkely, University of British Columbia, Seattle U, University of Idaho

Table 4: Motivation for pursuing a Master's in Applied Earth Science

	Total Count	Percent of Respondents (n=44)	Percent of those interested (n=29)
Increase salary potential	34	77.3%	72.4%
Enhance competitiveness in job market	28	63.6%	65.5%
Improve depth of knowledge	25	56.8%	65.5%
Stay current in field	28	63.6%	62.1%
Broaden skill base	28	63.6%	62.1%
Specialize in particular field	14	31.8%	34.5%
Develop better understanding of current job	12	27.3%	24.1%
Seeking career change	8	18.2%	10.3%
Change in responsibility	3	6.8%	6.9%
Other**	2	4.5%	6.9%

**Totals of multiple response questions may exceed 100%*

***Other responses included: (**bolded** responses mentioned by those 'interested' in the proposed degree)* **Provide a foundation for a PhD, Gain professional experience in the field**

Interest in Proposed Degree

Table 5a: Interest in the proposed degree (among entire sample): Comparing total sample of target population with those who plan to pursue continuing education

	Total sample of target population*		Respondents who plan to pursue continuing education	
	Count	Percent of Respondents (n=174)	Count	Percent of Respondents (n=102)
Not interested (1, 2 and no intention to pursue) **	93	53.4%	21	20.6%
Uncertain (3)	20	11.5%	20	19.6%
Interested (4)	44	25.3%	44	43.1%
Very interested (5)	17	9.8%	17	16.7%
Top 2 box (% 4,5)	***61***	***35.1%***	***61***	***59.8%***
Total	174	100.0%	102	100.0%

**This total uses the entire target sample as base, including those who do not plan to pursue any type of continuing education in earth science related field.*
*** This total includes the bottom two interest boxes, as well as those not interested in pursuing education, as they were assumed to have no interest in the proposed degree.*
.

Table 5b: Interest in proposed degree (among those who plan to pursue continuing education): Comparing UW Alumni and Members of Professional Associations

	Those who plan to pursue continuing education*					
	UW Alumni		Professional Association Members Combined		Total	
	Count	Percent of Respondents (n=35)	Count	Percent of Respondents (n=26)	Count	Percent of Respondents (n=102)
Not at all interested (1)	9	15.5%	5	11.4%	14	13.7%
Disinterested (2)	3	5.2%	4	9.1%	7	6.9%
Uncertain (3)	11	19.0%	9	20.5%	20	19.6%
Interested (4)	28	48.3%	16	36.4%	44	43.1%
Very interested (5)	7	12.1%	10	22.7%	17	16.7%
Top 2 box (% 4,5)	***35***	***60.4%***	***26***	***59.1%***	***61***	***59.8%***
Total	58	100.0%	44	100.0%	102	100.0%

**This table excludes those who do not plan to pursue additional education in a field related to earth science.*

Table 5c: Interest in proposed degree – stratified by current profession

Note: Sample sizes for each profession are very small and care should be taken upon interpretation.

	Those who plan to pursue continuing education*				
	Total percent of respondents (n=102)	**Engineer (n=9)**	**Geologist/Geo-physicist (n=31)**	**Hydrologist/ Hydrogeologist (n=8)**	**Other (n=48)**
Not at all interested (1)	13.7%	11.1%	12.9%	37.5%	10.4%
Disinterested (2)	6.9%	0.0%	12.9%	12.5%	2.1%
Uncertain (3)	19.6%	22.2%	19.4%	25.0%	18.8%
Interested (4)	43.1%	55.6%	29.0%	12.5%	54.2%
Very interested (5)	16.7%	11.1%	25.8%	12.5%	14.6%
Top 2 box (% 4,5)	***59.8%***	***66.7%***	***54.8%***	***25.0%***	***68.8%***
Total respondents	100.0%	100.0%	100.0%	100.0%	100.0%

**This table excludes those who do not plan to pursue additional education.*

Table 5d: Interest in proposed degree – stratified by baccalaureate major backgroud

	Those who plan to pursue continuing education*					
	Geological Sciences		**Civil and Environmental Engineering**		**All Other Majors****	
	Count	**Percent of Respondents (n=67)**	**Count**	**Percent of Respondents (n=9)**	**Count**	**Percent of Respondents (n=61)**
Not at all interested (1)	6	9.0%	1	11.1%	7	26.9%
Disinterested (2)	7	10.4%	0	0.0%	0	0.0%
Uncertain (3)	14	20.9%	2	22.2%	4	15.4%
Interested (4)	29	43.3%	5	55.6%	10	38.5%
Very interested (5)	11	16.4%	1	11.1%	5	19.2%
Top 2 box (% 4,5)	***40***	***59.7%***	***6***	***67.7%***	***15***	***57.7%***
Total	67	100.0%	9	100.0%	26	100.0%

**This table excludes those who do not plan to pursue additional education.*

***All other majors that show interest in the proposed degree include: Geophysics (3), Physics (2), Engineering Geology (2), Environmental Studies (2), Arts and Sciences (2),Aero Engineering (1), Industrial engineering (1), and Education (1), not specified (1).*

Respondents who indicated they were uncertain(n= 20), interested (n=44) or very interested (n=17) in the proposed degree (n=81) were asked detailed questions about the proposed degree. Questions relating to Program Specifics, Cost Feasibility, and Awareness of Current Offerings are shown for both the total sample who responded (n=81), as well as for those who are 'very interested' or 'interested' in the proposed degree (n=61).

Preferences for Program Specifics

Table 6: Preferred Delivery Format

	Total Count	Percent of Respondents (n=80)	Percent of those interested (n=61)
Traditional classroom with Instructor	22	27.5%	26.2%
Online delivery with instructor and classmates working at the same pace	6	7.5%	8.2%
Online delivery with instructor but working at own pace each quarter	11	13.8%	13.1%
Hybrid delivery with some online and some classroom with instructor	41	51.3%	52.5%
Total	80	100.0%	100.0%

Table 7: Preferred Time Completion

	Total Count	Percent of Respondents (n=80)	Percent of those interested (n=61)
2 years (3 courses a quarter/full-time)	27	33.8%	33.3%
3 years (2 courses a quarter/part-time)	37	46.3%	50.0%
4 years (1 course a quarter/part-time)	16	20.0%	16.7%
Total	80	100.0%	100.0%

Table 8: Subjects to include in the proposed curriculum

	Total Count	Percent of Respondents (n=80)	Percent of those interested (n=61)
Engineering Geology & Geotechnics	61	76.3%	77.0%
Geographic Information Systems	57	71.3%	73.8%
Applied Geophysics	54	67.5%	67.2%
Hydrogeology	55	68.8%	65.6%
Structural Geology	49	61.3%	63.9%
Remote Sensing & Computer Mapping of Physical Environment	46	57.5%	62.3%
Mitigating Natural Hazards	49	61.3%	60.7%
Hillslope Processes and Geomorphology	47	58.8%	59.0%
Environmental Geochemistry	43	53.8%	50.8%
Fluvial Geomorphology	39	48.8%	50.8%
Seismology	36	45.0%	49.2%
Economic Geology	35	43.8%	44.3%
Geoscience Computation	34	42.5%	44.3%
Stratigraphy and Sedimentation	31	38.8%	42.6%
Stream Restoration	32	40.0%	39.3%
Plate Tectonics and Earth History	24	30.0%	31.1%
Other**	6	7.5%	6.6%

***Other responses included: (**bolded** responses mentioned by those 'interested' in the proposed degree)* **Soils engineering (2), Environmental policy**, Groundwater and ambient geochemistry, Engineering/Mechanics, Subsurface Investigative Techniques, Technical report writing

Cost Feasibility

Table 9: Cost comparison of proposed degree

	Total Count	Percent of Respondents (n=80)	Percent of those interested (n=60)
$75,020 to complete at MIT	0	.0%	.0%
$39,450 to complete at Cornell University	4	5.0%	6.7%
$34,190 to complete at Stanford University	5	6.3%	6.7%
$34,437 to complete at Caltech	10	12.5%	13.3%
$22,000 to complete at University of Washington	**39**	**48.8%**	**46.7%**
$12,000 to complete at UMASS	19	23.8%	25.0%
Lower than the above	3	3.8%	1.7%
Total	80	100.0%	100.0%

Table 10: Anticipated funding source

	Total Count	Percent of Respondents (n=80)	Percent of those interested (n=60)
Personal savings	52	65.0%	66.7%
Scholarships	46	57.5%	60.0%
Federal student loans	42	52.5%	53.3%
Employer support	26	32.5%	31.7%
Private loans	20	25.0%	25.0%
Family contributions	14	17.5%	20.0%
Veterans assistance	2	2.5%	3.3%
Don't know	15	18.8%	15.0%
Other**	4	5.0%	5.0%

**Totals of multiple response questions may exceed 100%.*
***Other responses included: (**bolded** responses mentioned by those 'interested' in the proposed degree)* **Anything I could get my hands on, GI Bill, Teaching assistant**, Fellowship

(Anyone who is employed answered the next question)

Table 11: Employersupport/incentives offered to pursue continuing education

	Total Count	Percent of Respondents (n=141)	Percent of those interested (n=46)
Flexible scheduling	70	49.6%	50.0%
Tuition reimbursement	58	41.1%	41.3%
Recognition	23	16.3%	23.9%
Higher pay	33	23.4%	21.7%
Promotion	21	14.9%	13.0%
Paid release time	12	8.5%	8.7%
Scholarships	8	5.7%	4.3%
Job requirement	5	3.5%	2.2%
Loans	2	1.4%	.0%
None	26	18.4%	21.7%
Not employed	11	7.8%	6.5%
Other**	9	6.4%	6.5%

**Totals of multiple response questions may exceed 100%.*
***Other responses included: (**bolded** responses mentioned by those 'interested' in the proposed degree)* **4 month temporary position**, Movement on salary schedule, Paid professional development opportunities, Self employed (2), Retired, Not sure

Potential Marketing Messages

Table 12: Agreement with statements concerning the proposed degree

	Percent of respondents who indicated they…					Top 2 Box*	
	Strongly disagree	Somewhat disagree	Uncertain	Somewhat agree	Strongly agree	Of respondents (n=103)	Of those interested (n=61)
Graduates would be more attractive to employers after completing this degree	.0%	4.0%	3.0%	41.4%	51.5%	92.9%	93.2%
The qualifications of a graduate from this degree are well suited to the needs of employers in this field	.0%	5.1%	19.4%	44.9%	30.6%	75.5%	82.8%
Graduates would have a higher paying job after completing this degree	.0%	7.1%	16.2%	57.6%	19.2%	76.8%	81.4%
This degree would be a true contribution to the field of Earth Sciences	4.1%	5.1%	23.5%	41.8%	25.5%	67.3%	75.9%
There are many job opportunities for those who complete this degree	2.0%	8.1%	42.4%	32.3%	15.2%	47.5%	52.5%
This degree presents a unique higher education opportunity and is unlike other programs in the nation	2.0%	13.3%	41.8%	29.6%	13.3%	42.9%	50.0%

**Top 2 box = Somewhat Agree + Strongly Agree*

Table 13: Appeal of graduate qualifications to potential employers

	Percent of respondents who indicated …					Top 2 Box*	
	Not at all appealing	Somewhat un-appealing	Uncertain	Somewhat appealing	Very appealing	Of respondents (n=103)	Of those interested (n=61)
Solve groundwater resource management issues through analysis of groundwater flow systems and hydraulic properties	2.1%	1.1%	11.6%	30.5%	54.7%	85.3%	83.9%
Acquire expertise in USCS soil classification, ISRM Rock Classification and subsurface exploration methodology	1.0%	1.0%	15.3%	42.9%	39.8%	82.7%	79.3%
Analyze and classify georeferenced (GPS) data using GIS systems	3.1%	3.1%	16.3%	33.7%	43.9%	77.6%	74.1%
Understand landscape and hillslope evolution through quantitative analysis of fluvial and hillslope processes	2.1%	5.2%	21.9%	43.8%	27.1%	70.8%	69.6%
Apply refraction and reflection techniques to problems in engineering geology and mineral exploration	2.0%	3.1%	38.8%	35.7%	20.4%	56.1%	58.6%

**Top 2 box = Somewhat Agree + Strongly Agree*

The entire sample (n=174) was asked to complete the remaining profile questions. Answers to demographic, educational and occupational questions are shown for both the total sample who responded(n=174), as well as for those who are 'very interested' or 'interested' in the proposed degree (n=61).

Demographic Profile

Table 14: Age

	Total Count	Percent of Total Sample (n=173)	Percent of those interested (n=61)
18-24	21	12.1%	19.7%
25-34	80	46.2%	50.8%
35-44	25	14.5%	13.1%
45-54	17	9.8%	8.2%
55+	30	17.3%	8.2%
Under 35	*101*	*58.4%*	*70.5%*
35 or older	*72*	*41.6%*	*29.5%*
Total	173	100.0%	100.0%

Table 15: Geographic Region

	Total Count	Percent of Total Sample (n=174)	Percent of those interested (n=61)
Northeast: New England	4	2.3%	3.3%
Northeast: Mid-Atlantic	1	.6%	.0%
Midwest: East North Central	2	1.1%	1.6%
Midwest: West North Central	2	1.1%	.0%
South: South Atlantic	5	2.9%	3.3%
South : East South Central	0	.0%	.0%
South: West South Central	5	2.9%	.0%
West: Mountain	8	4.6%	8.2%
West: Pacific	141	81.0%	77.0%
Outside US	6	3.4%	6.6%
Total	174	100.0%	100.0%

Educational Profile

Table 16: Highest level of education

	Total Count	Percent of Total Sample (n=173)	Percent of those interested (n=61)
No degree, professional certification only	0	.0%	.0%
Associate's Degree	3	1.7%	4.9%
Bachelor's Degree	100	57.8%	75.4%
Master's Degree	50	28.9%	14.8%
Doctoral Degree	20	11.6%	4.9%
Total	173	100.0%	100.0%

Table 17: Subject area of highest degree

	Total Count	Percent of Total Sample (n=173)	Percent of those interested (n=60)
Geological Sciences	106	61.3%	66.7%
Civil and Environmental Engineering	31	17.9%	10.0%
Geophysics	7	4.0%	5.0%
Environmental Studies	2	1.2%	3.3%
Physics	3	1.7%	3.3%
Other engineering	4	2.4%	3.3%
Education	5	2.9%	1.7%
Biology	2	1.2%	.0%
Geography	1	.6%	.0%
Oceanography	1	.6%	.0%
Earth and Space Sciences	2	1.2%	.0%
Hydrology	2	1.2%	.0%
Other**	7	4.0%	6.6%
Total	173	100.0%	100.%

***Other responses included: (**bolded** responses mentioned by those 'interested' in the proposed degree)* **Arts and Sciences**, Medicine, MBA in sustainability, **Triple Degree (Physics, Chemistry, Geology)**, **Environmental Policy**, Biology and Geological Science, Petroleum Geology & Geophysics, **Geology/Microbiology**

Table 18: Attended UW for highest degree?

	Total Count	Percent of Total Sample (n=174)	Percent of those interested (n=61)
Yes	96	55.2%	62.3%
No	78	44.8%	37.7%
Total	174	100.0%	100.0%

Table 19: Year earned highest degree

	Total Count	Percent of Total Sample (n=173)	Percent of those interested (n=61)
2010	7	4.0%	6.6%
2009	18	10.3%	18.0%
2008	18	10.3%	16.4%
2007	10	5.7%	9.8%
2006	21	12.1%	13.1%
2005	20	11.5%	9.8%
2004	6	3.4%	3.3%
2003	6	3.4%	1.6%
2002	5	2.9%	3.3%
2001	3	1.7%	.0%
2000	5	2.9%	.0%
1999-1990	20	11.5%	6.6%
1989-1980	13	7.5%	3.3%
Earlier than 1980	21	12.1%	8.2%
Within past 5 years	*74*	*42.4%*	*63.9%*
More than 5 years ago	*99*	*57.6%*	*36.1%*
Total	173	100.0%	100.0%

Professional Profile

Table 20: Current Profession

	Total Count	Percent of Total Sample (n=174)	Percent of those interested (n=61)
Geologist	47	27.0%	24.6%
Engineer	23	13.2%	8.2%
Environmental Scientist	8	4.6%	4.9%
Research Technician	2	1.1%	3.3%
Teacher/Professor	14	8.0%	3.3%
Military Officer	2	1.1%	3.3%
Computer Programmer	3	1.7%	1.6%
Forest Ranger	1	.6%	1.6%
Geological Surveyor	1	.6%	1.6%
Hydrologists	4	2.3%	1.6%
Hydrogeologist	5	2.9%	1.6%
Geophysicist	3	1.7%	.0%
Student	22	12.6%	13.1%
Not employed	9	5.2%	9.8%
Other**	30	17.2%	22.9%
Total	174	100.0%	100.0%

***Other responses included: (**bolded** responses mentioned by those 'interested' in the proposed degree)*
Accounts Clerk, Carpenter, Construction Manager, Consumer Packaged Goods (Sales), Curriculum Developer and Program Coordinator **Drinking Water Quality,** Emergency Management Specialist, **Forensics, Funeral Home Staff,** Geologic Exploration Manager, **GIS Analyst,** Graphic Designer, **Management Commercial Sector,** Pilot, **Seismic Engineer,** Seismologist, Store general manager, **Tax Professional, Technical Writer (with B.S. Geology), unrelated field (4)**

Table 21: Professional Association Membership

	Total Count	Percent of Total Sample (n=174)	Percent of those interested (n=61)
Geological Society of America (GSA)	64	37.6%	37.3%
Assoc. of Environmental & Engineering Geologists (AEG)	34	20.0%	20.3%
NW Geological Society	35	20.6%	18.6%
American Society of Civil Engineers (ASCE)	18	10.6%	11.9%
American Geological Institute (AGI)	8	4.7%	3.4%
National Association of Geoscience Teachers	8	4.7%	3.4%
National Earth Science Teachers Association	2	1.2%	.0%
Rocky Mountain Association of Geologists	2	1.2%	.0%
None in this industry	48	28.2%	32.2%
Other**	50	29.4%	16.9%

***Other responses included: (**bolded** responses mentioned by those 'interested' in the proposed degree)* American Association of Petroleum Geologists (AAPG), **American Geophysical Union (AGU),** American Water Works Association, **ASM,** Association of Women Geoscientists, AWRA, Environmental and Engineering Geophysical Society, European Association of Geoscientists and Engineers, Geological Society (UK), **GSA,** Houston and Austin Geological Society (HGS), IAVCEI, **ICE AGE Flood Institute,** Institute of Transportation Engineers (ITE), **ISME,** Minnesota Ground Water Association, MSA, **National Ground Water Association (NGWA), NW Geological Society,** NW Hydrologic Society, NWMA, SEAW,

Interested in Additional Information

Table 22: Would like additional information on proposed degree?

	Total Count	Percent of Total Sample (n=173)	Percent of those interested (n=61)
Yes	64	37.0%	70.5%
No	109	63.0%	29.5%
Total	173	100.0%	100.0%

**These respondents were asked to provide contact information which will be shared with the sponsoring department.*

Questionnaire

Intro: Thank you for taking our survey. Your responses will help the University of Washington design programs in Applied Earth Sciences and related fields to better meet the needs of working professionals and students in the Earth Science industry.

Q 1 Do you plan to pursue any continuing education or professional development activities in a field related to Earth Sciences (such as Earth & Space Sciences, Applied Earth Sciences, Geosciences or Geology) in the next 3 years?

1) Yes **(Continue)**
2) No **(Skip to Q 13)**
3) Maybe/not sure **(Continue)**

Q 2 Which of the following continuing education or professional development activities are you **MOST LIKELY** to pursue in the next 3 years? ***Select only one***.

1) Job training courses **(Skip to Q 5)**
2) Certificate program **(Skip to Q 5)**
3) Continuing education courses **(Skip to Q 5)**
4) Master's degree program **(Continue)**
5) PhD degree program **(Skip to Q 5)**
6) Other (please specify): _____ **(Skip to Q 5)**

Q 3 Please identify Master's programs you may have already investigated in Applied Earth Sciences, if any. ***Select all that apply or write in an 'other' option.***

1) Boston University – Master of Arts in Earth Sciences
2) California Institute of Technology – Master of Geological and Planetary Sciences
3) Central Washington University – Master of Science in Geological Science
4) Cornell University – Master of Geological Sciences
5) Massachusetts Institute of Technology – Master of Geology
6) Michigan State University – Master of Science in Physical Science
7) Montana State University – Master of Sciences in Earth Sciences
8) North Carolina Central University – Master of Sciences in Earth Sciences
9) Saint Louis University – Graduate Study in Geosciences
10) San Diego State University –Master of Science in Geological Sciences
11) Stanford University – Master of Science in Geological and Environmental Sciences
12) University of Arizona – Master of Geosciences
13) University of California (Santa Cruz) – Master of Science in Earth & Planetary Sciences
14) University of Oklahoma – Master of Science in Geology
15) University of Pennsylvania – Master of Science in Applied Geosciences
16) University of Texas (Austin)— Master of Science in Geological Sciences
17) University of Utah – Master of Science in Geology and Geophysics
18) I have not investigated any programs in Earth Sciences
19) Other (Please specify):_____

Q 4 If you were to pursue a Master's degree in Applied Earth Sciences, what are the factors that would motivate you the most? ***Select up to three***.

1) Developing a better understanding in an area of importance to my current job
2) Wanting a change in responsibility
3) Seeking a major career change
4) Wanting to improve my depth of knowledge
5) Achieving greater specialization in a particular field
6) Enhancing competitiveness in the job market
7) Staying current in a field of interest
8) Broadening skill base
9) Increasing salary potential
10) Other (please specify): _____

Interest in Proposed Degree and Program Specifics

The College of the Environment at the University of Washington is exploring interest in a proposed Professional Master's Degree Program in Applied Earth Sciences. This program is designed for students interested in working in the geotechnical sector.

Students will study theoretical concepts while acquiring technical expertise in the application of tools and analyses commonly used in geochemistry, geophysics, engineering geology and other related Earth Science professions. Areas of interest include behavior of earth materials, subsurface conditions, interaction between subsurface conditions and humans, and risks to structures from natural hazards. In addition to coursework, students would be required to complete a field-based internship and document the results.

Graduates of this program will be prepared to:

- Apply refraction and reflection techniques to problems in engineering geology and mineral exploration
- Acquire expertise in USCS soil classification, ISRM Rock Classification and subsurface exploration methodology
- Understand landscape and hillslope evolution through quantitative analysis of fluvial and hillslope processes
- Solve groundwater resource management issues through analysis of groundwater flow systems and hydraulic properties
- Analyze and classify georeferenced (GPS) data using GIS systems

Q 5 Given the above description, how interested are you in a Professional Master's Degree in Applied Earth Sciences at the University of Washington?

1) Not at all interested **(Skip to Q 11)**
2) Disinterested **(Skip to Q 11)**
3) Uncertain **(Continue)**
4) Interested **(Continue)**
5) Very interested **(Continue)**

The University of Washington is planning to offer this Professional Master's Degree Program in Applied Earth Sciences in two formats: onsite and online. The onsite format will involve in classroom coursework completed at the UW Seattle campus. The online format will allow students to review instruction and lecture materials and complete coursework remotely and online through websites and streaming video. The University will also offer the option to choose a full-time or a part time option.

Q 6 If you were to enroll in this program, which delivery format would you prefer?

1) Traditional classroom with instructor
2) Online delivery with instructor and classmates working at the same pace
3) Online delivery with instructor but working at own pace each quarter
4) Hybrid delivery with some online and some classroom with instructor

Q 7 Which of the following credit scenarios would you choose should you decide to apply for this degree program?

1) Enroll in three courses per quarter and complete the degree in 2 years (full-time)
2) Enroll in two courses per quarter and complete the degree in 3 years (part-time)
3) Enroll in one course per quarter and complete the degree in 4 years (part-time)

Q 8 Which of the following subjects do you think should be included in the proposed Master's in Applied Earth Sciences curriculum? ***Select all that apply***.

1) Applied Geophysics
2) Economic Geology
3) Engineering Geology & Geotechnics
4) Environmental Geochemistry
5) Fluvial Geomorphology
6) Geographic Information Systems
7) Geoscience Computation
8) Hillslope Processes and Geomorphology
9) Hydrogeology
10) Mitigating Natural Hazards
11) Plate Tectonics and Earth History
12) Remote Sensing & Computer Mapping of Physical Environment
13) Seismology
14) Stratigraphy and Sedimentation
15) Stream Restoration
16) Structural Geology
17) Other (Please Specify):_____

Q 9 The following is a list of total fee-based tuition rates of other institutions that offer similar Master's degrees in Earth Sciences. Please indicate the highest total tuition you would consider paying for a Professional Master's Degree in Applied Earth Sciences, assuming you are willing to relocate and financial aid is available. ***Select only one.***

1) $75,020 to complete at Massachusetts Institute of Technology (MIT)
2) $39,450 to complete at Cornell University
3) $34,190 to complete at Stanford University
4) $34,437 to complete at California Institute of Technology (Caltech)
5) $22,000 to complete at University of Washington (*proposed*)
6) $12,000 to complete at University of Massachusetts (UMASS)
7) Lower than the above

***Total tuition figures are sourced from each institution for the 2009-2010 and 2010-2011 academic years. The above totals include tuition charges only, excluding additional fees charged to students.**

Q 10 If you wanted to attend this program, how would you pay for a Professional Master's Degree in Applied Earth Sciences? ***Select all that apply***.

1) Scholarships
2) Teaching Assistant or Research Assistant Tuition Waivers
3) Personal Funds/Savings
4) Federal Student Loans
5) Private Loans (student or other)
6) Employer Support
7) Veterans Assistance
8) Family Contributions
9) Don't Know
10) Other (Please specify):_____

(Those not interested will skip to here)

Q 11 As indicated above, students for this Professional Master's Degree Program in Applied Earth Sciences will graduate with specific skills. Please rate how appealing each of the following skills would be to prospective employers in the Earth Sciences industry.

	Not at all appealing to Employers	Somewhat Un-appealing	Uncertain
problems in engineering geology and mineral exploration	1	2	3
SRM Rock Classification and subsurface exploration methodology	1	2	3
through quantitative analysis of fluvial and hillslope processes	1	2	3
ues through analysis of groundwater flow systems and hydraulic properties	1	2	3
a using GIS systems	1	2	3

Q 12 Please indicate how much you agree or disagree with the following statements regarding a Professional Master's Degree Program in Applied Earth Sciences.

	Strongly Disagree	Somewhat Disagree	Uncertain	Somewhat Agree	Strongly Agree
1) Graduates would have a **higher paying** job after completing this degree	1	2	3	4	5
2) Graduates would be **more attractive** to employers after completing this degree	1	2	3	4	5
3) The qualifications of a graduate from this degree are well suited to the needs of employers in this field	1	2	3	4	5
4) There are **many** job opportunities for those who complete this degree	1	2	3	4	5
5) This degree would be a true contribution to the field of Earth Sciences	1	2	3	4	5
6) This degree presents a unique higher education opportunity and is unlike other programs in the nation	1	2	3	4	5

(Everyone completes remainder of survey)

Background Information

Q 13 Which of the following most closely describes your current professional occupation?

1) Atmospheric Scientist
2) Chemist
3) Computer Programmer
4) Engineer
5) Environmental Scientist
6) Forest Ranger
7) Geological Surveyor
8) Geologist
9) Hydrologists
10) Meteorologist
11) Natural Resources Planner
12) Oceanographer/ Marine Biologist
13) Research Technician
14) Teacher/Professor
15) Student (Skip to **Q 15**)
16) Not employed (Skip to **Q 15**)
17) Other (Please specify):_____

Q 14 Which, if any, of the following incentives does your organization/employer offer to staff to encourage them to pursue professional and continuing education? ***Select all that apply***.

1) Scholarships
2) Paid release time
3) Flexible scheduling
4) Job requirement
5) Promotion
6) Recognition
7) Higher pay
8) Tuition reimbursement
9) Loans
10) None
11) Other (please specify) _____
12) I'm not employed/do not have employer

Q 15 Please indicate the highest level of education you have completed.

1) No degree, professional certifications only
2) Associate's Degree
3) Bachelor's Degree
4) Master's Degree
5) Doctoral Degree

Q 16 What is the subject area of your highest degree?

1) Atmospheric Sciences
2) Biology
3) Chemistry
4) Civil and Environmental Engineering
5) Environmental Health
6) Environmental Studies
7) Forest Resources
8) Geography
9) Geological Sciences
10) Geophysics
11) Mathematics
12) Oceanography
13) Physics
14) Public Health
15) Other (Please Specify):_____

Q 17 In what year was your highest degree awarded?

1) 2010
2) 2009
3) 2008
4) 2007
5) 2006
6) 2005
7) 2004

8) 2003
9) 2002
10) 2001
11) 2000
12) Earlier (Please specify):_____

Q 18 Did you attend the University of Washington in Seattle for your highest completed degree?

1) Yes
2) No

Q 19 How old are you?

1) 18-24
2) 25-34
3) 35-44
4) 45-54
5) 55 or over

Q 20 In which geographic region do you live?

1) Northeast: New England (Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut)

2) Northeast: Mid-Atlantic (New York, Pennsylvania, New Jersey)
3) Midwest: East North Central (Wisconsin, Michigan, Illinois, Indiana, Ohio)
4) Midwest: West North Central (Missouri, North Dakota, South Dakota, Nebraska, Kansas, Minnesota, Iowa)

5) South: South Atlantic (Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida)
6) South: East South Central (Kentucky, Tennessee, Mississippi, Alabama)
7) South: West South Central (Oklahoma, Texas, Arkansas, Louisiana)
8) West: Mountain (Idaho, Montana, Wyoming, Nevada, Utah, Colorado, Arizona, New Mexico)
9) West: Pacific (Alaska, Washington, Oregon, California, Hawaii)
10) Outside the US

Q 21 Of which of the following professional associations are you a member, if any? ***Select all that apply.***

1) American Geological Institute (AGI)
2) American Society of Civil Engineers (ASCE)
3) Association of Environmental & Engineering Geologists (AEG)
4) Geological Society of America (GSA)
5) National Association of Geoscience Teachers
6) National Earth Science Teachers Association
7) NW Geological Society
8) Rocky Mountain Association of Geologists
9) I'm not a member of any Professional Association in this industry
10) Other (please specify) _____

Q 22 When available, would you like to receive additional information about the University of Washington's proposed Professional Master's Degree Program in Applied Earth Sciences?

1) Yes **(skip to Contact screen)**
2) No **(Skip to Ending screen)**

Ending screen: ***Thank you for your time; your responses are very important to the university. If you have any questions about this survey, please contact us via email at uweo_research@extn.washington.edu.***

Contact Screen: ***If you are interested in hearing more regarding this UW program, please click https://catalysttools.washington.edu/webq/survey/uweomr/100010 to provide us with your name, e-mail and mailing address.***

Thank you for your time; your responses are very important to the university. If you have any questions about this survey, please contact us via email at uweo_research@extn.washington.edu.