Weber State University Geoscience Program Review

1.0) Executive summary

On 26 April 2013, at the invitation of Dr. David Matty, Dean of the College of Science, a team of four outside geoscientists conducted a detailed 5-year review of the Weber State University Department of Geosciences. The team found the WSU Geoscience Program to be robust, energetic, and focused on producing well-educated and well-trained students who are poised to succeed in the job market or in advanced degree programs. While this report identifies some weaknesses and offers some recommendations for change, the review team would like to emphasize that there is much to praise about the program, and the strengths far exceed the weaknesses. Chief among the praiseworthy aspects is the WSU Geoscience faculty. Every one of these six individuals is absolutely committed to the success of the students. They are intelligent, cooperative, enthusiastic, and exceedingly generous with their time. The review team hopes the WSU administration recognizes and rewards the talent and dedication of the Geoscience faculty. The Geoscience Department faculty members realize that WSU's program fills a specific niche in geoscience education in Utah, and they have done a very good job tailoring a program to fill that niche.

The primary challenges facing the department are:

- A very tight budget that is being stretched beyond its limit by a growing enrollment, an incessant need to update technology, and a need to provide significant field-based educational opportunities. Field-based education is one of the strengths of the program, and perhaps the most attractive incentive drawing students, and should not be sacrificed by budget or time constraints;
- Increasing enrollment that is straining the faculty ability and desire to provide individualized instruction and guidance to each student. This individualized attention is also a significant factor in drawing students to the program and needs to be maintained to the extent possible;
- Anticipated turnover (due to retirement) of ⅓ of their faculty, which will put additional burden on remaining faculty if those retiring members are not immediately replaced;
- Lack of a laboratory manager. A lab manager could teach lower-level lab classes and prepare materials for upper-level lab classes, thereby reducing the workload of the over-strained faculty.

While not all recommendations made by the review team are expected to be adopted by the Geosciences Department, it is hoped that the entire document will be read closely and each of the suggestions/recommendations will be carefully considered. The review team also realizes that the recommendations which are adopted by the department may take some time, in some cases several years, to fully implement.

2.0) Review Process

2.1) Review team

The review team consists of four outside geoscientists who are not current or former staff or alumni of Weber State University. Team members were selected for their years of experience with Geoscience Programs at other universities with similar goals and challenges; experience

with Utah's geology, geologic community, job market, hazards and related issues; as well as their demonstrated mutual interest in contributing to the education and development of future geologists.

Team members are:

Danny Horns -- Danny is an Associate Dean of the College of Science & Health at Utah Valley University (UVU). Prior to that position, he was the Chair of the Department of Earth Science at UVU, from the founding of the department in 2001 through the end of 2010. During his 9-year stint as Department Chair, he designed the first two bachelor degrees in earth science at UVU (B.S. in Geology and B.S. in Earth Science Education), and he oversaw growth of the department from three faculty members to nine members, and saw the number of majors in the department grow from less than ten to over 100.

Scott Linneman -- Scott is a professor of Geology and Science Education at Western Washington University in Bellingham WA. He has taught geology at the college level since 1989. He is a former president of the National Association of Geoscience Teachers, Washington Higher Education Science Teacher of the Year, and nominee for US Professor of the Year. Scott is a licensed geologist and specializes in geomorphology.

Keith Weber -- Keith is the GIS Director at Idaho State University (ISU) and has held this position since the inception of the GIS Training and Research Center (GIS TReC) in 1998. He has been involved in the geotechnology industry since 1989 and is a Certified GIS Professional (GISP). Keith has authored/co-authored nearly 40 peer-reviewed journal papers and is the principal investigator on over 20 external grants totaling nearly $8M in awards to the GIS TReC at ISU. Mr. Weber serves on the Geographic Information Science Institute (GISCI) certification committee and chaired its re-certification sub-committee. He is also a standing member of the Idaho Geospatial Council- Executing Committee (IGC-EC) and the chair of the state's geodetic control technical working group.

Grant Willis -- Grant has been manager of the Geologic Mapping Program of the Utah Geological Survey for 18 years, and was a mapping geologist and senior mapping geologist for the previous 11 years. He manages the Utah STATEMAP component of the National Cooperative Geologic Mapping Program and has overseen publication of over 300 geologic maps covering parts of Utah. He has worked on a large number of geology-related projects and committees with many different members of Utah's geologic community, including many faculty and students from Utah and neighboring universities. He served six years on Utah State University Geologic Advisory Board, and is currently president-elect of the Utah Geological Association.

2.2) Review activities

The review team was provided with:

1) A 10-page Executive Summary of the department authored by Rick Ford, Department Chair

2) A 55-page detailed description of the department mission and goals, department accomplishments of the past five years, a summary of previous reviews and progress on previous review recommendations, a summary of course offerings and schedules, accomplishments of past students and faculty, current placement of former graduates, and other pertinent information
3) A one-day on-campus session with opportunities to interview: (a) Dr. David Matty, Dean of the College of Science; (b) Dr. Rick Ford, Chair of the Department of Geosciences; (c) All six members of the department faculty; (d) Marianne Bischoff, department administrative assistant; (e) Adam Johnston (Department of Physics), science education; and (f) two groups of current WSU students.
4) A brief tour of WSU Geoscience facilities
5) Access to the department website
6) A review guide and worksheet consisting primarily of several topics and questions, a rating scale, and a comment and discussion field. While the review panel chose to not strictly adhere to the worksheet format, all the categories and questions are addressed in the SWOT and discussions below.

3.0) Synopsis of meetings

3.1) Dean Matty

Review team meetings with Dean Matty illustrated his support for the Geosciences Department at WSU. Dean Matty recognized the strengths of the department and was complimentary of its faculty and staff. He emphasized the financial challenges faced by the department, as well as the college and university as a whole. He also briefly described the approved new College of Science building and explained how it will help solve several issues raised by previous reviews.

3.2) Faculty and staff

The review team met with each of the Geoscience Department's faculty and staff individually. One overarching thread was apparent in these conversations -- the desire and commitment to helping each and every student. Surely no one can be condemned for such dedication, yet the realities of academic life in the 21st century must be considered, especially with regard to the Department's growing enrollment and yet static number of faculty/staff. Other themes common among most faculty members were the recognition that increasing enrollment is straining resources, that they must have a very diverse program that meets the needs of an unusually large percentage of non-traditional students, that loaming faculty changes present both a concern and an opportunity, and that budgets will always be tight.

3.3) Students

The review team met with two groups of students, the first group representing a cross-section of geology students at a morning break period and the second group effectively representing honors students within the Geosciences Department. We as a review board were struck by the unusually diverse backgrounds, goals, and needs of the students we interviewed.
Having been closely involved with geology departments of several other universities around the western U.S., we point out that WSU seems to have a higher percentage of non-traditional students than nearly any other program with which we have been associated. This is probably

due to WSU Geoscience Department's proximity to Hill Air Force base, dual role as a community college and undergraduate program that feeds into graduate programs, and proximity to two large research universities with well-established programs. We also noticed that WSU Geoscience students are involved in an unusually large number of fairly intensive undergraduate research projects and that the students seem to have benefited from a large amount of field-based education.

We quickly noted six general categories of students: (1) students desiring to quickly earn a BS degree and move directly into the job market in technical-type careers that only do not require high-level math or research skills; (2) students who desire a college degree, and have an interest in geology, but who are unlikely to actually have geology careers (many of these have military backgrounds); (3) students who are strongly motivated to continue on to earn advanced degrees (these need to take more math, chemistry, and physics courses, which they are advised early in the education); (4) students planning on K-12 earth science teaching careers; (5) students on Water Resources/Applied Environmental Geology track; and (6) students who have not yet decided what they want from their education. The broad backgrounds of the students, combined with their widely diverse goals, present one of the largest challenges to the Department.

In both meetings students expressed an appreciation for the faculty and staff and recognized their devotion. The primary student criticism of the program was a lack of early advising (perhaps due to non-declared majors) and conflicting advice from university advisors versus department advisors, with the latter advice being considered better. The second main concern was student frustrations in being able to take courses they needed to graduate -- we encountered several who claimed they have had to stay enrolled extra semesters just to get one or two required courses.

Another thread that emerged during these conversations was the need for an improved form of communication between the department and students. While they appreciated the newsletter very much it seems some of the students might be more engaged/communicative using social media such as Facebook. The new generation of students are also well suited to advanced methods of electronic instruction, a direction we encourage the Department to pursue (a few noted that some professors are "bad" with computers).

4.0) SWOT

Strengths

- Largely succeeding in fulfilling its stated mission: providing quality undergraduate education in geosciences
- Created a program targeted to the needs of unusually large percentage of nontraditional students, while maintaining quality education for traditional students (classroom, lab, and field camp schedules designed for student needs; Applied major requirements works for students who want to move directly into tech-level jobs that don't require advanced math)

- TT and NTT Faculty are dedicated teachers; most TT faculty are active, respected researchers
- Attention to student needs and situations is outstanding
- Rapid growth in the number of majors
- Excellent administrative staff of one
- Robust job market for graduates of all three majors
- Spectacular local geologic setting used well in curriculum
- Strong geospatial instruction and adequate facility
- New instrumentation (SEM)
- Interact well with neighboring universities, with those neighboring universities filling some needs that the small WSU program can't provide
- Good ties with industry, and including bringing industry reps onto campus
- Providing good advice to students on strategies for acceptance to graduate programs
- Counting summer classes as part of teaching load provides flexibility for faculty

Weaknesses

- Lack of instructional lab manager (contributes to unsustainable faculty workloads)
- Lack of curricular prerequisites allow students to put off support science and math coursework until after much of their major coursework is complete
- GIS not integrated across or within the geoscience curriculum
- Insufficient rock storage
- Poorly mediated teaching classrooms
- Inconsistent use of campus course management system (Canvas)
- Lack of CSME director results in missed opportunities to expand both preservice and inservice science teacher preparation
- Multiple small sections of GE course (e.g., Earthquakes and Volcanoes) take up valuable faculty teaching load
- Students inability to access required courses (because of infrequent offering) extends time-to-degree. Important classes in this regard are Structural Geology and Petrology
- Few or no campus resources for developing faculty pedagogy
- There have been some problems with students getting advice from the College of Science advisor (or from central advising) that was not consistent with advice from department advisors
- The lack of requirement for students to meet with department advisors every year has led to some delays in graduation
- There is only one person (Adam Johnston) to review performance of student teachers. In years with many student teachers, this creates a too large a load for Adam.

Opportunities

- Planned building could solve several weaknesses (classroom mediation, storage, safety, central location for faculty interaction) and potentially improve the geospatial lab capabilities
- Develop an advisory committee consisting of alumni, industry and governmental representatives

- Develop introductory GIS course that can serve as prerequisite core majors courses; develop GIS based exercises for core courses
- Course offerings should be examined for opportunities to streamline or consolidate courses; consider combining two GIS courses and two remote sensing courses into three courses; course offerings seem unreasonably large considering number of available faculty
- Expand use of course management system (Canvas); IT training of overloaded faculty could be done by the tech-savvy department secretary
- Expand use of computer-aided instruction such as providing students with online course notes, study guides, and homework exercises
- Expand geospatial lab to accommodate more students (25 student workstations with widescreen or dual monitors)
- Faculty replacements could bring state-of-the-art skills to both teaching and research (Earth systems perspective, teaching with technology, …)
- Develop a program of advanced geoscience students serving as teaching assistant ("teaching fellows"?) to assist overloaded faculty in lower level courses (e.g. Physical Historical Geology labs; large enrollment GE courses); students could be paid from funds derived from enhanced course fees (at least enough to compensate for cost of credits awarded for TA'ing); students could also be "paid" by receiving Independent Study course credit
- Develop student chapters of professional organizations such as AEG, SEG, AAPG and encourage networking with local professionals
- Share information about state geologist licensing with students' use success rate on ASBOG test as one element of program assessment
- In tenure and promotion policy, formalize expectations for mentoring student research
- A common thread throughout all upper level education is to encourage and aid students to make themselves more hirable, help them groom themselves to look good in interviews, develop their own marketable skills and resume. Help each student understand concept of, "what's my paragraph?"

Threats

- Any loss of faculty lines, especially in time of rapid growth, would threaten the integrity of the program and lead to substantial increase in time to degree
- Replacements for anticipated retirements of two faculty members should be planned carefully; avoid the temptation to hire someone who is not ideal match to the department's needs (better to go through an extra round of job announcement and interviews than to hire wrong person)
- Many worthy candidates may be unwilling or incapable of carrying the huge workload of the faculty they are replacing
- Aging building is full of seismic hazards putting all occupants at risk, given proximity to active range-front fault
- Continued enrollment growth without additional staff (lab manager) and faculty would increase faculty workload beyond sustainable, limit the department's ability to attract quality faculty, and substantially increase time to degree

- Lack of centralized funding of academic IT threatens continued functionality of the little classroom IT that does exist.

5.0) Discussion and Recommendations

The SWOT section above lists key findings and recommendations of the review panel in bullet form. This section provides additional discussion of select points listed above.

5.1). Geospatial science and technology is a growing field that integrates well into many natural resource sciences such as geology. Due to the technology-centered drive of the geospatial industry, students are typically expected to be knowledgeable of cutting edge tools and techniques to be competitive in the job market. As such, universities are caught in a conundrum where teaching geospatial fundamentals is still mandatory (e.g., topology, and understanding projections) while also teaching current state-of-the-art techniques (e.g., geodatabases and web services).

To accomplish this, the review team recommends GIS be introduced to WSU's Geoscience students during their Freshman or Sophomore year of study. Bearing in mind the limitations of faculty course loads we recommend cancelling the Remote Sensing II course and creating a new course focusing on "An Introduction to Digital Mapping". The new course would teach the fundamentals of GIS to Freshman or Sophomore students and familiarize them with the current ArcGIS interface.

GIS should be better integrated into other courses so the students can learn the use of these technologies in their chosen field of study. This may pose some problems or concerns as faculty teaching other geology courses may themselves not be comfortable with GIS. This is certainly understandable and it is not suggested that all faculty be required to learn and master GIS. Nor is it suggested that Dr. Hernandez somehow teach sections in each course currently being offered within the Department. Instead, it is suggested that WSU better leverage their existing Esri site license and offer students web-based virtual campus courses that are available through Esri's website at no additional cost.

The existing geospatial lab appeared to be the most technologically sophisticated and well mediated classroom in the department. Suggestions for future improvements include 1) dual monitors at all workstations, 2) gigabit ethernet connectivity to each workstation, and 3) acquisition and development of a dedicated geospatial server for data storage/sharing as well as development of web services to support the classroom and faculty/student research.

5.2) External funding and faculty support

After discussions with Geoscience faculty and Dean Matty, it was apparent that a healthy externally funded research program exists. It also became clear that faculty may not be requesting funding for portions of their own salaries as part of their grant proposals. While in some cases, specific request for proposals (RFPs) prohibit inclusion of any faculty salary, most RFPs anticipate partial funding will be devoted to the Principal Investigator. In these cases,

failure to include faculty salaries will often make the proposal less competitive as reviewers will not be given a sense of commitment on the part of the faculty. In contrast, including and receiving faculty salary will allow WSU to more accurately track faculty time and effort and use unspent faculty salary to fund adjunct faculty, visiting faculty, or postdoctoral faculty. Lastly, this change will increase indirect cost recovery which will further benefit WSU.

5.3) Personnel upgrades

It was apparent to the review team the Geosciences Department would greatly benefit from the creation of a new "Laboratory assistant" or "Laboratory technician" position. This position would ideally be a full-time staff position. A laboratory assistant would reduce the teaching burden on the department faculty by teaching many of the lower-level lab classes, and by helping to prepare upper-level labs.

In the next two to three years, the Geosciences Department at WSU will lose one third of their faculty due to retirement. This change may be a difficult one, but since it is already being discussed it will likely be seen as a period of transition rather than a period of difficulty. It is clear that this same period of time can be seen as a period of opportunity for the department. While it is anticipated that the new faculty members will be hired primarily to provide expertise in geology, the review team recommends including skills in GIS as a criterion in the hiring process. In addition, the review team recommends seriously considering the benefits of a more diverse faculty that better matches current student demographics. Finally, the review team encourages caution to make sure the new faculty members are well adapted to aid a broad range of students with variable goals and interests.

5.4) Facility upgrades

In the next few years, a new building will be constructed which will become the home of the Geosciences department (and other departments as well). This represents an opportunity for growth and improvement and should be viewed strategically as such. Under a worst-case scenario, the potential of no new building, this review team still strongly recommends significant facilities upgrades.

With or without the new building, the program would benefit from two key facility improvements. Most important would be inclusion of computer and projection systems in all the teaching rooms. Such systems are becoming increasingly important as computer applications and remotely-sensed images are incorporated into nearly every aspect of geosciences. The second needed facility improvement would be better storage facilities for rock and mineral samples.

A vibrant, university learning environment requires significant cyberinfrastructure. This includes a robust network (minimum 100Mbps with geospatial/research networks using 1Gbps) with dedicated server resources (e.g., geospatial data server). The Department should explore leveraging cloud resources as a solution and fully evaluate the cost-benefit of both local server(s) versus cloud hosted server solutions.

5.5) Program modifications

A careful review of the Department of Geosciences baccalaureate programs of study indicate five courses are considered core courses (required by all graduates in each program) with one additional course required by five of the six programs. These core courses are:

- GEO 1110 Dynamic Earth: Physical Geology
- GEO 1115 Physical Geology Lab
- GEO 1220 Historical Geology
- GEO 2050 Earth Materials
- GEO 3150 Geomorphology
- GEO 3550 Sedimentology & Stratigraphy (required by five of the six programs)

While the electives and other options for each of the six programs seems to clearly make each program unique, the review team encourages the department to carefully review each course description to ensure there is not too much overlap between required courses.

The Department of Geosciences may wish to investigate offering an Associate's Degree or additional Certificate to improve the proportion of student matriculating through the programs.

5.6) Streamlining and consolidating selected course offerings

The review team recommends eliminating Remote Sensing II and offering a Freshman or perhaps Sophomore geospatial course to introduce GIS fundamentals and spatial thinking (a suggested title might be "An Introduction to Digital Mapping").

The review team further recommends combining "Intro to Meteorology" and "Oceanography and Earth Systems" into one class. In addition, a review of course offerings should be made occasionally to improve the effectiveness of the program. In some cases, similar courses may be combined, obsolete courses may be eliminated, and new courses created.

5.7) Establishing some course prerequisites.

Earlier in this review the recommendation was made to include GIS earlier in the program and to integrate GIS directly into various courses in the Geosciences programs. In addition, it is recommended that chemistry and math classes be required earlier in the program of study. The Geosciences Department may also wish to consider adding a statistics course as an elective which will be especially beneficial to students interested in GIS and specifically geostatistics.

The Geosciences Department chair, Dr. Rick Ford and his faculty should also review/establish meaningful prerequisites for all their courses and use the prerequisite to ensure students are appropriately prepared for each course. Using and enforcing the prerequisite mechanism will allow the department to ensure students complete the chemistry, math and suggested "Introduction to Digital Mapping" classes before enrolling in classes where this knowledge is expected by the instructor.

5.8) Increasing student TA opportunities
At the time of the team's review, there appears to be no use of student teaching assistants by the Geosciences Department. This is a missed opportunity, since many upper-level students would benefit from the opportunity to assist with lower level classes or labs. These students could be rewarded for their efforts using either a TA stipend, credits, or both. The Geoscience program would also benefit by the faculty's workload being reduced, and the faculty having more time available for students.

5.9) Increasing frequency of key courses
Currently, two key courses, (GEO 3060 - Structural Geology and GEO 4300 - Igneous and Metamorphic Petrology) are taught only every other year. Since these courses are required for the B.S. in Geology, they should be taught each year. The current system has resulted in delayed graduation for some students.

5.10) Suggestions regarding Earth Science Education program.
We strongly support the addition of a director for the WSU Center for Science and Mathematics Education. In addition to teaching the secondary methods classes, a new director could coordinate externally funded professional development efforts for both the K-12 teaching corps and the WSU science and math faculty.