Interdisciplinarity@WMU- Phase One planning Template

1. **Brief Overview**: Provide a brief overview of the proposed interdisciplinary initiative. What types of questions would the initiative ask? What types of complex problems would it seek to solve?

   Geoinformatics in Earth Sciences

   Many disciplines, especially in the public health and STEM fields (e.g., biology, geology, environmental sciences), are witnessing an explosion in the amounts of data that are being generated and an increasing need for expertise to analyze these data sets. Informatics is a growing field and many universities nation-wide are developing graduate programs (e.g., bioinformatics, geoinformatics, ecoinformatics) to prepare a workforce that masters such applications. We propose a joint, 30 credit hour, hybrid, non-thesis Master of Science (MS) program, hosted in Geological and Environmental Sciences and organized by the Departments of Geological and Environmental Sciences (GEOS) and Statistics (STAT). The two departments will provide the majority of the required courses, but there could be a few taught in the Geography and Computer Science units as well. The degree will focus on applications of geoinformatics in geological and environmental sciences. Examples of complex geologic and environmental problems that are/were recently addressed by the GEOS faculty and graduate students and rely on the application of state-of-the-art geoinformatics and statistical techniques are listed in our response to question (3).

2. **Impacted units**: What existing units, programs, and colleges would be involved in the proposed initiative? What other possibilities for collaboration across campus or in the broader community might exist now or in the future?

   Main units
   CAS – Geological & Environmental Sciences (program home)
   CAS – Statistics (joint)

   The program makes use of existing courses in the MS Statistics and MS Data Science program (a joint program with Statistics and Computer Science) and in both of the main units.

   Other units that could, but not necessarily, get involved
   CEAS – Computer Science (courses offered as part of the Data Science program)
   CAS – Geography (courses).

3. **Impact on teaching, learning, and curricula**: Describe the anticipated impact of the proposed initiative on teaching, learning, and curricula. How might this initiative help to grow enrollment, including by reaching new audiences of learners through continuing education, dual enrollment, or professional certification? How will the proposed initiative positively impact the training of

undergraduate and graduate students? How does it enhance our institutional commitment to diversity, equity, and inclusion?
The program will target at large the geology and statistics majors from Western and from other universities as well. We foresee interest from related fields such as mathematics, physics, environmental sciences, or engineering. The program will provide the tools and training needed to address a wide range of geological and environmental problems through the analysis of spatial and temporal data sets. The program will be flexible; geology majors will sign up for more of the STAT courses and vice versa for the non-geology majors who will take more of the GEOS courses. Graduates of this program will be well prepared to compete for job opportunities in the environmental sector (environmental companies and agencies), industry (mining, mapping, oil and gas sectors), governmental agencies (e.g., National Labs, Regulatory agencies), or pursue higher academic degrees. The competing geoinformatics programs are more generalized in their scope and are geared towards the analysis of spatial data sets in general, ours is geared towards the temporal and spatial analysis of geological and environmental data sets and hence our program is more focused/targeted. The students will work with, and get trained on real-world geological and environmental datasets. There will be a capstone course taught in the final term, where the students apply the gained knowledge in addressing a geological or environmental problem of interest. To the best of our knowledge none of the competing programs has this emphasis.

4. **Impact on research and creative activity:** Describe the anticipated impact of the proposed initiative on research and creative activity. How will this initiative promote discovery and creative scholarship? How might it result in increased external funding?

   Geoscientists collect and analyze spatial and/or temporal datasets (e.g., maps, topography, remote sensing, geochemical, hydrological, and geophysical, etc.) for a better understanding of a wide range of geological and environmental problems. Statisticians have cutting-edge tools and methods enabling sophisticated analysis of these kinds of datasets. The interdisciplinary collaboration between our units for this program will provide a platform for faculty from both departments to apply for, and secure, external funding, and collaborate on projects of mutual interest. Currently, graduate students of Drs. Reeves, Dogan, Petcovic, and Sultan are engaged in research projects that use various statistical approaches in their ongoing research. Examples of such projects that resulted in publications in peer reviewed journals in the past 5 years include applications of statistical approaches to identify areas susceptible to slope failure, predicting (in space and time) algal bloom occurrences in southwest Florida, identifying the distribution of shallow groundwater in Saudi Arabia, and mapping the distribution of particular landforms (theater head valleys) indicative of paleo groundwater discharge locations in Saharan Africa. These research activities and many others will benefit from, and blossom, if the colleagues in statistics are involved.

5. **Efficiencies and/or cost savings**: How might the proposed initiative contribute to increased efficiencies and/or cost savings, for example by reducing administrative positions (e.g. chairs/directors), sharing staff support services and/or by sharing facilities?
   This initiative will take advantage of existing resources and courses to develop a program that is much in demand. No new hires or additional teaching-related resources (facilities) will be required except for a new capstone course; all of the remaining required courses are already in place. The program will be appealing to geologists, statisticians, and earth scientists. We expect that many of our undergraduates from both departments will pursue this degree, so will

graduates from other universities as well. Earning this degree will make them competitive in the job market.

6. **Impact on course offerings and workload**: At present, proposed initiatives will only be feasible and sustainable if they can be supported by existing resources, including instructional capacity, faculty and staff time, and facilities. Will the proposed initiative streamline existing course or program offerings? Could the initiative help create more equitable and sustainable workload for faculty, for example, by reducing the need to offer under enrolled courses, reducing the frequency of course offerings or eliminating the need to teach some courses?

   The proposed program does not require additional hiring (faculty/TAs) in GEOS or Statistics. As the departmental program home, GEOS would assume administrative oversight of the program, and responsibility for student advising would be part of the Graduate Director's workload. All of the proposed MS program courses are currently being offered in both departments; a capstone course where students apply their gained knowledge in addressing geologic and environmental problems will be required and conducted as a graduate research project in GEOS. A number of the graduate and senior courses that will be utilized in this MS program are currently under-enrolled. With the implementation of the proposed MS degree, these classes will gain additional students and will then conform with WMU enrollment requirements and will help create more equitable and sustainable workload for faculty.

7. **Additional Information**: What additional information would you like to provide in support of this proposal?

   This program will be comprised of a core set of GEOS and STAT courses (to be determined). Students would choose additional coursework in GEOS, STAT, or other subjects based on their interests, intended capstone project, and in consultation with their advisor. For example, a student interested in geophysical applications of geoinformatics would take additional elective geophysics courses; whereas a student interested in data science would take more statistics courses. We will also develop a mechanism through which students can rapidly complete prerequisite courses that they may lack in their undergraduate program.

   A tentative course list to choose from includes:

   STAT 5680 – Regression Analysis
   STAT 5820 – Time Series Analysis
   STAT 5850 – Applied Data Mining
   STAT 5860 – Computer Based Data Analysis
   STAT 5870 – Big Data Analysis Using Python
   STAT 6350 – Spatial Statistics
   STAT 6690 – Studies in Probability and Statistics (flexible special topics course)
   CS 5280 – Artificial Intelligence
   CS 5821 – Machine Learning
   CS 6530 – Data Mining

   GEOS 5350 - GIS applications in geological and environmental sciences
   GEOS 5120 - Principles of Hydrogeology
   GEOS 5600 – Introduction to Geophysics
   GEOS 5210 – Geological and Environmental Remote Sensing
   GEOS 6050 – Groundwater Modeling

GEOS 6120 – Advanced Hydrogeology
GEOS 6340 - Research in Geology/Earth Sciences
GEOS 6500 - Special Topics: Geologic and Environmental GIS
GEOS 6550 - Quantitative Basin Analysis
GEOS XXXX (New Course) - Geoinformatics Capstone Project

8. **Contact**

Mohamed Sultan, Geological & Env Sciences
Duy Ngo, Statistics